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Health Care Utilization of Opioid Overdose Decedents with No Opioid Analgesic Prescription History

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Abstract Opioid overprescribing is a major driver of the current opioid overdose epidemic. However, annual opioid prescribing in the USA dropped from 782 to 640 morphine milligram equivalents per capita between 2010 and 2015, while opioid overdose deaths increased by 63%. To better understand the role of prescription opioids and health care utilization prior to opioid-related overdose, we analyzed the death records of decedents who died of an opioid overdose in Illinois in 2016 and linked to any existing controlled substance monitoring program (CSMP) and emergency department (ED) or hospital discharge records. We found that of the 1893 opioid-related overdoses, 573 (30.2%) decedents had not filled an opioid analgesic prescription within the 6 years prior to death. Decedents without an opioid prescription were more likely to be black (33.3% vs 20.2%, $p < .001$), Hispanic (16.3% vs 8.8%, $p < .001$), and Chicago residents (46.8% vs 25.6%, $p < .001$) than decedents with at least one filled opioid prescription. Decedents who did not fill an opioid prescription were less likely to die of an overdose involving prescribed opioids (7.3% vs 19.5%, $p < .001$) and more likely to fatally overdose on heroin (63% vs 50.4%, $p < .001$) or fentanyl/fentanyl analogues (50.3% vs 41.8%, $p = .001$). Between 2012 and the time of death, decedents without an opioid prescription had fewer emergency department admissions (2.5 ± 4.2 vs 10.6 ± 15.8, $p < .001$), were less likely to receive an opioid use disorder diagnosis (41.3% vs 47.5%, $p = .052$), and were less likely to be prescribed buprenorphine for opioid use disorder treatment (3.3% vs 8.6%, $p < .001$). Public health interventions have often focused on opioid prescribing and the use of CSMPs as the core preventive measures to address the opioid crisis. We identified a subset of individuals in Illinois who may not be impacted by such interventions. Additional research is needed to understand what strategies may be successful among high-risk populations that have

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limited opioid analgesic prescription history and low health care utilization.

Keywords Opioid overdose · Drug overdose prescription opioids · Heroin · Fentanyl · Controlled substance monitoring programs

Introduction

Drug overdose, two thirds of which is opioid-related, is now the leading cause of accidental death in the USA [1]. The increasing prevalence of opioid misuse and opioid use disorder has been linked to a dramatic increase in opioid prescribing beginning in the late 1990s [2, 3]. A 2013 survey found that 79.5% of heroin users reported nonmedical use of prescription opioids prior to initiating heroin use [4]. This is a shift from the previous generations of patients with opioid use disorder (OUD), who predominantly initiated their opioid use with heroin. In a 2014 study, more than 80% of respondents who initiated opioid use in the 1960s used heroin as their first opioid, compared with fewer than 30% of respondents who initiated opioid use in the 2000s [3]. Driven by these findings, public health interventions have sought to curtail opioid prescribing through a variety of interventions including controlled substance monitoring programs (CSMPs), commonly referred to as prescription drug monitoring programs (PDMPs) [5].[1] These statewide databases collect information about controlled substance prescriptions dispensed from retail pharmacies and are typically used to inform provider decisions and as a tool for law enforcement [6].

Evidence suggests CSMPs are an effective surveillance tool and may reduce opioid prescribing and diversion of medication [6–9]. Although some studies associate implementation of CSMPs with a reduction in mortality due to overdose involving prescription opioids [10, 11], decreased opioid prescribing has had a minimal effect on the number of overall opioid overdose–related deaths, which are increasingly driven by illicit opioids [12–15]. While opioid prescribing has begun to decrease nationally, the number of annual opioid overdose deaths has continued to climb. According to the Centers for Disease Control and Prevention, the total amount of opioids prescribed in the USA has dropped from its peak of 782 to 640 morphine milligram equivalents (MME) per capita between 2010 and 2015 [16]. Over the same time period, the number of deaths related to natural and semisynthetic opioids, a category that includes many prescription opioids, increased by 15%, and the total number of opioid overdose deaths increased by 57% [17]. Illinois follows the national trend, where the total number of opioid prescriptions dispensed decreased by 9.8% between 2013 and 2017 [18], and the concurrent opioid-related fatal overdoses have increased by 82% [18].

The divergence between prescribed opioid volume and opioid overdose deaths has led some authors to argue that too much emphasis has been placed on reducing prescribing, and not enough attention has been paid to structural factors that contribute to the development of substance use disorder, such as poverty and lack of opportunity [19, 20]. Additionally, little effort has been devoted to improving outcomes for patients with an existing OUD diagnosis who may have known risk factors for a fatal overdose, such as a previous nonfatal overdose, or who return to opioid use after a period of abstinence [21, 22]. Further data are needed to understand how the interaction of prescription opioid use, health care utilization, and social environment relates to the incidence of fatal overdose. In this study, we compare the demographics and health care utilization of opioid overdose decedents with and without opioid analgesic prescription histories in the 6 years preceding death by linking individual death records, Illinois Controlled Substance Monitoring program (IL CSMP) records, and emergency department (ED) and hospital discharge claims data.

Methods

Study Sample

Death records were obtained from the Illinois Department of Public Health Division of Vital Records. We extracted the records of all decedents who died between January 1, 2016 and December 31, 2016 where a contributing or underlying cause of death was drug overdose, designated by any one of the ICD-10 codes X40-X44, X60-X64, X85, and Y10-Y14.

[1] We are using the terminology CSMP to more accurately describe these databases, which house information about receipt of controlled substance prescriptions (as opposed to all prescriptions) that are obtained in retail pharmacies.

Next, we retained records of overdoses only involving opioids by analyzing the ICD-10 codes and the death certificate text. We analyzed the text fields on the death certificate by splitting the text into single words and comparing each word with a list of drugs using a Jaro-Winkler string comparison algorithm [23]. If the Jaro-Winkler string distance exceeded 0.9, then the matches were manually inspected to ensure that each match represented an opioid drug or a misspelling of an opioid drug. An overdose was determined to be opioid involved if a specific opioid (listed in Table 1), the words “opioid,” “opiate,” or a misspelling thereof were found in the text analysis or if a contributing cause of death included any of the ICD-10 codes for opioid overdoses (T40.0, T40.1, T40.2, T40.3, T40.4). Details of this algorithm are reported separately [24].

Overdoses were further categorized by specific substances listed on the death certificate (Table 1). Each overdose was allowed to contribute to the counts for each drug class that contributed to the death. Fentanyl was categorized separately from other opioid analgesics because it is commonly obtained in an illicitly manufactured form [25]. An analysis of IL CSMP records supported this classification as only 5.5% of decedents who overdosed on fentanyl filled a fentanyl prescription in the last 30 days before death.

Because morphine is a metabolite of heroin and codeine, the mention of morphine on the death certificate does not imply that the decedent ingested exogenous morphine. Therefore, if morphine intoxication alone was listed as the cause of death, then overdoses were not categorized into the scheme above unless they occurred in Cook County where a team worked with the medical examiner to manually reclassify each overdose based on external circumstances, such as the presence of drugs or drug paraphernalia at the scene and/or known history of heroin use per history provided in the report [26]. For overdoses outside of Cook County, such an analysis was not available, and overdoses involving morphine only ($N = 28$) were not categorized into the prescription, fentanyl, or heroin categories. We performed a sensitivity analysis classifying all morphine-only overdoses outside of Cook County first as prescription opioid overdoses and then as heroin overdoses. The direction or significance of the differences in Table 1 was not significantly changed by either of these categorizations.

Demographic information for each decedent was obtained from the death certificate. Decedents were classified as urban or rural, based on the classification of their residence ZIP code by the US Health Resources and Services Administration [27]. The median income in decedents’ residence ZIP code was obtained from the 2016 American Community Survey, downloaded from the census bureau website [28].

Table 1 Classification of drugs found on postmortem toxicology.

Class	Compounds
Heroin	Heroin
Fentanyl and fentanyl analogues	Fentanyl Fentanyl analogues: Acetyl fentanyl Acryl fentanyl 3-Methyl fentanyl 4-ANPP Norfentanyl Carfentanyl U-47700 Furanyl fentanyl
Prescription opioids	Hydrocodone Oxycodone Hydromorphone Oxymorphone Tramadol Buprenorphine

IL CSMP Records

Prescription records for the decedents from 2010 to 2016 were obtained from the IL CSMP, which is formally known as the Illinois Prescription Monitoring Program. The IL CSMP records schedule II–V prescriptions dispensed by all retail pharmacies in Illinois as well as states that share CSMP records with the Illinois Program.[2] The IL CSMP does not record methadone dispensed for by opioid treatment programs for the treatment of opioid use disorder.

Decedents’ IL CSMP profiles were retrieved by linking on first name, last name, date of birth, and sex. We matched 1473/1893 (77.8%) of decedents in this study to a record in the IL CSMP. Decedents were stratified by whether they filled an opioid analgesic prescription between 2010 and the time of death. Decedents were classified as having received an opioid

[2] AL, AR, AZ, CA, CO, FL, GA, IA, ID, IL, IN, KS, KY, LA, MA, MD, MI, MN, MO, MS, NC, ND, NE, NH, NV, NY, OH, OK, OR, PA, TN, TX, UT, VA, WI.

analgesic if they filled one or more prescriptions for buprenorphine (transdermal patch only), butorphanol, codeine, fentanyl, hydrocodone, hydromorphone, meperidine, methadone (only captured in IL CSMP when prescribed for outpatient pain treatment), morphine, oxycodone, oxymorphone, propoxyphene, tapentadol, and tramadol. Decedents were classified as having received a benzodiazepine prescription if they filled one or more prescriptions for alprazolam, clonazepam, lorazepam, temazepam, diazepam, chlordiazepoxide, oxazepam, triazolam, estazolam, flurazepam, or clorazepate.

MME was calculated from the IL CSMP with the formula MME/day = strength per unit × (number of units/days supply) × MME conversion factor. We used MME conversion factors compiled by the CDC for research purposes [29].

ED and Hospitalization Records

ED and hospital discharge records were obtained for decedents from 2012 to the time of death from the Illinois Department of Public Health Division of Patient Safety and Quality with a fuzzy match on first name, last name, date of birth, and sex. We matched 1616/1893 (85.4%) decedents in this study to a hospitalization/ED discharge record. Diagnosis codes were in the International Statistical Classification of Diseases and Related Health Problems 9th edition (ICD-9) or 10th edition (ICD-10) format. ICD-9 diagnosis codes were converted to ICD-10 using the general equivalence mapping provided by the Centers for Medicare and Medicaid Services [30]. We identified decedents with a diagnosis of opioid use disorder by searching for ICD-10 code F11 and all sub-codes. We identified decedents with previous overdose by searching for ICD-10 codes T40.0, T40.1, T40.2, T40.3, T40.4, and T40.6. To count only diagnoses that were made prior to the fatal overdose, we excluded visits where the date of discharge was on the date of death.

For a given diagnosis code, we calculated the per-visit probability that this code was used by dividing the number of hospitalizations with the given code by the total number of hospitalizations in each study group. For each ICD-10 code, we compared the per-visit probability that this code was used between the two study groups. The difference in per-visit probability was considered significant if the Bonferroni-corrected p value of Fisher's exact test was less than .05. We excluded all codes that were used fewer than ten times due to data protection requirements.

Each decedent's insurance status was derived from the discharge data by assigning each decedent the primary payer type that was associated with their hospitalization records. When different payer types were used for successive visits, we assigned the most commonly listed payer type.

Statistical Analysis

Unless otherwise specified, statistical comparisons between groups were conducted using chi-squared tests for categorical variables and t tests for continuous variables. All analyses were done in R Version 3.

Results

There were 1893 Illinois residents who died of an opioid-related overdose in 2016 (Table 2). Of these decedents, 72% were male, 24% were black, and 11% were Hispanic; the mean age decedents was 42. Overdoses most commonly involved heroin (57%) and fentanyl or fentanyl analogues (44%). Among the 840 decedents who died of an overdose involving fentanyl or fentanyl analogues, 44 decedents (5.2%) filled a fentanyl prescription within the last 30 days of life. In contrast, among the 309 (16.3%) decedents who died of an overdose involving prescription opioids, 157 (52%) filled a prescription for one of the opioids involved within 30 days of the fatal overdose. There were 280 (15.6%) decedents who died of an overdose involving benzodiazepines, and of those, 120 (42.4%) filled a prescription for a benzodiazepine within the last 30 days of life. Among the 1893 decedents, 1616 (85%) were seen in a hospital or ED between 2012 and 2016. At these visits, 729 decedents (38.5%) were diagnosed with OUD, and 410 (21.7%) were diagnosed with a nonfatal overdose.

Of the 1893 opioid-related overdose decedents in this study, 573 (30.2%) did not fill an opioid analgesic prescription recorded in the IL CSMP in the 6 years preceding death (Table 3). Decedents without an opioid prescription filled were more likely to be black (33.3% vs 20.2%, $p < .001$), Hispanic (16.3% vs 8.8%, $p < .001$), Chicago residents (46.8% vs 25.6%, $p < .001$), and residents in a ZIP code with a lower median income ($53,230 vs $57,307, $p < .001$) than

Table 2 Study group characteristics

	Overall
n	1893
Demographics	
Male (%)	1367 (72.2)
Black (%)	457 (24.1)
Hispanic (%)	203 (11.0)
Age (mean (SD))	41.66 (12.82)
Rural (%)	179 (9.5)
Chicago resident (%)	606 (32.0)
Mean ZIP code income 2016 in USD (mean (SD))	56,079 (22712)
Drugs involved in overdose	
Prescription (%)	309 (16.3)
Prescription alone (%)	188 (9.9)
Filled prescription for ≥ 1 opioid involved in overdose in last 30 days of life (%)	157 (8.3)
Heroin (%)	1085 (57.3)
Fentanyl or fentanyl analogues (%)	840 (44.4)
Filled prescription for fentanyl within 30 days of fatal overdose involving fentanyl (%)	44 (2.3)
Cocaine (%)	416 (22.0)
Alcohol (%)	352 (18.6)
Benzodiazepine (%)	284 (15.0)
Filled prescription for benzodiazepine within 30 days of fatal overdose involving benzodiazepine (%)	120 (6.3)
Health care utilization (2012–2016)	
Any opioid analgesic prescription (%)	1320 (69.7)
Any > 100 MME/day (%)	371 (19.6)
Any opioid analgesic in last 12 months (%)	828 (43.7)
Any > 100 MME/day (%)	139 (7.3)
Buprenorphine in the last 12 months (%)	133 (7.0)
Any Benzodiazepine prescription (%)	988 (52.2)
Benzodiazepine prescription in last 12 months (%)	698 (36.9)
Any ED or hospital admission (%)	1616 (85.4)
Hospital admissions (mean (SD))	2.37 (5.66)
ED admissions (mean (SD))	8.14 (13.90)
Total hospital stay (mean (SD))	11.41 (34.55)
OUD diagnosis = 1 (%)	729 (38.5)
Previous OD = 1 (%)	410 (21.7)
Primary insurance (%)	
Commercial	393 (24.3)
Medicaid	713 (44.1)
Medicare	207 (12.8)
Other	77 (4.8)
Self-pay	226 (14.0)

ED emergency department, *MME* morphine milligram equivalents, *SD* standard deviation, *OD* overdose, *OUD* opioid use disorder

decedents with at least one filled opioid prescription between 2010 and 2016. Decedents without an opioid prescription history were less likely to overdose on prescription opioids (7.3% vs 20.2%, $p < .001$) or benzodiazepines (11.2% vs. 16.7%, $p = 0.003$) but more likely to overdose on heroin (66.1% vs 53.5%, $p < .001$) or fentanyl/fentanyl analogues (50.3% vs 41.8%, $p = .001$).

Between 2012 and the time of death, decedents without an opioid prescription had fewer ED admissions (2.5 ± 4.2 vs 10.6 ± 15.8, $p < .001$) and lower number of days spent as an inpatient (3.7 ± 13.4 vs 14.8 ± 40.0, $p < .001$). They were less likely to receive an OUD diagnosis (24.1% vs 44.8%, $p < .001$) or present with a previous, nonfatal overdose (13.4% vs 25.2%, $p < .001$). However, among decedents with at least one hospital admission, the rates of OUD diagnosis were similar (41.3% vs 47.5%, $p = .05$), as were rates of nonfatal overdose (23.1% vs 26.7%, $p = .20$). Decedents without an opioid prescription were less likely to fill prescriptions for formulations of buprenorphine approved for OUD treatment (sublingual, buccal) in the last year of life (3.3% vs 8.6%, $p < .001$).

Insurance status differed significantly between the two study groups ($p < .001$). Decedents with no opioid prescription history were more than twice as likely to be self-pay (24.8% vs 10.9%) and less likely to be on Medicare (3.1% vs 15.5%) than decedents with an opioid prescription history, whereas the rates of Medicaid were similar (42.5% vs 44.6%).

Table 4 lists ICD-10 diagnosis codes that were significantly more likely to be applied to hospital/ED visits of decedents with an opioid prescription history. These diagnosis codes include codes for low back pain (M545 5.5% vs 1.2% of visits, $p < .001$) or other chronic pain (G8929 7.2% vs 0.9% of visits, $p < .001$). Additionally, hospital/ED visits by decedents with an opioid prescription were more likely to be associated with chronic health conditions such as primary hypertension (I10 19.1% vs 12% of visits, $p < .001$), hyperlipidemia (E785 4.2% vs 1.3% of visits, $p < .001$), and uncomplicated type 2 diabetes mellitus (E119 4.7% vs 1.9% of visits, $p < .001$), as well as for sequelae of these conditions such as atherosclerotic heart disease (I2510 2.9% vs 0.5% of visits) and heart failure (I509 2.2% vs 0.6% of visits, $p < .001$).

Table 5 lists ICD-10 diagnosis codes that were significantly more likely to be applied to hospital/ED visits of decedents without an opioid prescription history. This

Table 3 Demographics, postmortem toxicology, and health care utilization among decedents in 2016 stratified by any opioid analgesic prescription from 2010 to 2016 in the IL CSMP

	Any opioid analgesic prescription		
	Yes	No	Test statistic (*p*)
n	1320	573	
Demographics			
Male (%)	921 (69.8)	446 (77.8)	12.5***
Black (%)	266 (20.2)	191 (33.3)	37.2***
Hispanic (%)	113 (8.8)	90 (16.3)	21.9***
Age (mean (SD))	42.16 (12.85)	40.51 (12.69)	6.8**
Rural (%)	144 (10.9)	35 (6.1)	10.2**
Chicago resident (%)	338 (25.6)	268 (46.8)	81.3***
ZIP median income, 2016 USD (mean (SD))	57,307 (21907)	53,230 (24258)	11.9***
Drugs involved in overdose			
Prescription (%)	267 (20.2)	42 (7.3)	47.7***
Prescription alone (%)	166 (12.6)	22 (3.8)	33.1***
Heroin (%)	706 (53.5)	379 (66.1)	25.7***
Fentanyl and fentanyl analogue (%)	552 (41.8)	288 (50.3)	11.2**
Cocaine (%)	269 (20.4)	147 (25.7)	6.2*
Alcohol (%)	228 (17.3)	124 (21.6)	4.8*
Benzodiazepine (%)	220 (16.7)	64 (11.2)	9.0**
Health care utilization (2012–2016)			
Buprenorphine in last 12 months (%)	114 (8.6)	19 (3.3)	16.5***
Any Benzodiazepine prescription (%)	886 (67.1)	102 (17.8)	387.5***
Benzodiazepine prescription in the last 12 months (%)	637 (48.3)	61 (10.6)	241.2***
Any ED or hospital admission (%)	1261 (95.5)	355 (62.0)	357.9***
Hospital admissions (mean (SD))	3.06 (6.47)	0.77 (2.39)	126.7***
ED admissions (mean (SD))	10.58 (15.80)	2.52 (4.21)	295.5***
Total hospital stay (mean (SD))	14.78 (39.97)	3.65 (13.35)	81.4***
OUD diagnosis (%)	591 (44.8)	138 (24.1)	71.4***
Previous nonfatal overdose (%)	333 (25.2)	77 (13.4)	32***
Primary insurance (%)			73.8***
Commercial	310 (24.6)	83 (23.4)	
Medicaid	562 (44.6)	151 (42.5)	
Medicare	196 (15.5)	11 (3.1)	
Other	55 (4.4)	22 (6.2)	
Self-pay	138 (10.9)	88 (24.8)	

Note. The test statistic is *t* statistic or χ-squared statistic for continuous and categorical variables, respectively

$^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

ED emergency department, *SD* standard deviation, *OUD* opioid use disorder

group of decedents was more likely to receive visit diagnoses related to psychiatric illness such as suicidal ideation (R45851 8.1% vs 4.4% of visits, $p < .001$), schizophrenia (F209 2.3% vs 0.8% of visits, $p < .001$), and schizoaffective disorder (F259 3% vs 0.9% of visits, $p < .001$). In addition, these decedents were more likely to receive visit diagnoses related to substance use disorder such as opioid use disorder (F1110 11.9% vs 6.4%

Table 4 Diagnosis codes that are more likely during ED/hospital visits of decedents with opioid prescription history than of decedents with no opioid prescription history

ICD-10 code	Description	Percentage of visits with diagnosis		Difference (%)
		Any opioid analgesic prescription		
		Yes	No	
I10	Essential (primary) hypertension	19.1	12	− 7***
G8929	Other chronic pain	7.2	0.9	− 6.3***
M545	Low back pain	5.5	1.2	− 4.2***
M549	Dorsalgia, unspecified	4.8	0.8	− 4***
F419	Anxiety disorder, unspecified	11.3	7.6	− 3.7**
M5489	Other dorsalgia	3.8	0.6	− 3.2***
K219	Gastro-esophageal reflux disease without esophagitis	4.7	1.7	− 3***
Z79891	Long-term (current) use of opiate analgesic	6.8	3.8	− 3***
E785	Hyperlipidemia, unspecified	4.2	1.3	− 2.9***
E119	Type 2 diabetes mellitus without complications	4.7	1.9	− 2.8***
F319	Bipolar disorder, unspecified	5.5	2.7	− 2.8***
J449	Chronic obstructive pulmonary disease, unspecified	4.6	1.8	− 2.8***
I2510	Atherosclerotic heart disease of the native coronary artery without angina pectoris	2.9	0.5	− 2.4***
E784	Other hyperlipidemia	2.8	0.7	− 2.1***
I509	Heart failure, unspecified	2.2	0.6	− 1.6***
Z8673	Personal history of transient ischemic attack (TIA) and cerebral infarction without residual deficits	2.1	0.6	− 1.5**
Z7982	Long-term (current) use of aspirin	1.9	0.5	− 1.4*

Note. Columns "Yes" and "No" contain the percentage of all visits in each group that carried each ICD-10 code. The p values are Bonferroni-corrected p values calculated using Fisher's exact test

$^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

of visits, $p < .001$) and cannabis use disorder (F1210 4.7% vs 2.6% of visits, $p = .005$) and with diagnoses related to opioid overdose such as accidental heroin poisoning (T40.1X1A 6.4% vs 2.2% of visits, $p < .001$).

Discussion

We found that more than 30% of those who died of an opioid-related overdose in the state of Illinois in 2016 had no opioid analgesic prescription history during the prior 6 years. This finding is consistent with recent surveys of OUD patients, which show that between 20% and 35% of individuals who report nonmedical opioid use initiated their opioid use with heroin [3, 4]. The early public understanding of the opioid epidemic was shaped by accounts that highlight the role of prescribed opioids [31] and subsequent interventions focused on the role of opioid prescribing as a driver of the opioid crisis [19, 32]. Those interventions are unlikely to benefit a population of overdose decedents who have filled any opioid prescriptions in the 6 years before fatal overdose. Our study adds to the growing body of evidence that demonstrates the importance of a multimodal approach in the public health response to the opioid overdose epidemic [19].

Fewer than 20% of all decedents in our study cohort had benzodiazepines listed as a contributing factor to the cause of death. However, medical examiners in Illinois were not routinely testing for benzodiazepines in 2016. While Cook County, the most populous jurisdiction in the state, began routinely testing all overdose decedents for benzodiazepines in 2017, these practices still vary across the state and the country. This presents an important gap in the national overdose surveillance, because the combined use of opioids and benzodiazepines greatly increases the risk of fatal overdose, and the two drug classes are frequently prescribed in combination [33,

Table 5 Diagnosis codes that are more likely during ED/hospital visits of decedents with no opioid prescription history than of decedents with opioid prescription history

ICD-10 code	Description	Percentage of visits with diagnosis		Difference
		Any opioid analgesic prescription		
		Yes	No	
F1110	Opioid use disorder, uncomplicated	6.4	11.9	5.5***
J45901	Unspecified asthma with (acute) exacerbation	2.2	6.4	4.2***
T401X1A	Poisoning by heroin, accidental (unintentional), initial encounter	2.3	6.1	3.8***
R45851	Suicidal ideations	4.4	8.1	3.7***
I469	Cardiac arrest, cause unspecified	1.6	4.4	2.7***
F1210	Cannabis use disorder, uncomplicated	2.6	4.7	2.1**
F259	Schizoaffective disorder, unspecified	0.9	3	2.1***
F209	Schizophrenia, unspecified	0.8	2.3	1.5***
F29	Unspecified psychosis not due to a substance or known physiological condition	0.4	1.9	1.5***
T401X4A	Poisoning by heroin, undetermined, initial encounter	1.3	2.8	1.5*
T401X2A	Poisoning by heroin, intentional self-harm, initial encounter	1.1	2.5	1.4*
G931	Anoxic brain damage, not elsewhere classified	0.6	1.9	1.3***
I468	Cardiac arrest due to other underlying condition	0.2	1	0.8**

Note. Columns "Yes" and "No" contain the percentage of all visits in each group that carried each ICD-10 code. The *p* values are Bonferroni-corrected *p* values calculated using Fisher's exact test

*$p < .05$; **$p < .01$; ***$p < .001$

34]. Among decedents in our study who filled at least one opioid prescription in the last 6 years of life, two thirds also filled a benzodiazepine prescription during this period.

We observed significant differences in health care utilization between our study groups. Decedents without an opioid prescription history spent an average of 3.7 nights in the hospital between 2012 and 2016 compared to 14.8 nights for decedents with an opioid prescription history. High hospital utilization may cause the stratification into the two groups because hospitalized patients are frequently discharged with opioid prescriptions and may subsequently develop chronic opioid use [35, 36]. However, the difference in health care utilization may also be related to disparities in health care access; decedents without an opioid prescription history were more likely to reside in ZIP codes with lower median incomes and were more likely to be self-pay than decedents with an opioid prescription history.

Decedents without an opioid prescription history were more likely to be black or Hispanic than decedents with an opioid prescription history (49.6% vs 29.0%). Blacks and Hispanics may be less likely to receive opioid prescriptions as they continue to have lower rates of health care access than whites [37]. Racial differences between our study groups may also be driven by provider bias, as previous studies have shown that black patients are less likely than white patients to receive prescription opioids when presenting to the ED with certain pain conditions [38, 39].

The observed disparities in health care utilization may adversely affect care and outcomes for patients with OUD. In our setting, decedents who lacked an opioid prescription history were more likely to be urban, black, and Hispanic than those who had filled at least one opioid prescription. Previous studies have shown that blacks and Hispanics are more likely to receive no care or delayed care for substance use disorders [40]. Similarly, this analysis showed that individuals with no opioid prescription history were less likely to receive any hospital or emergency room care (62% vs 95.5%, $p < .001$), less likely to receive a diagnosis of OUD (24.1% vs 44.8%, $p < .001$) and less likely to be prescribed buprenorphine formulations that are indicated for OUD treatment (3.3% vs 8.6%, $p < .001$). These results are consistent with the previous studies which document that blacks are less likely to initiate opioid dependence treatment with an opioid agonist [41].

An analysis of diagnosis codes showed substantial disparities between decedents with and without an opioid analgesic prescription history. Decedents with an opioid prescription history were more likely to receive hospital/ED care for back pain or chronic pain, which is not surprising given that pain is a common indication for prescription opioid analgesics. However, visits by this group of decedents were also more likely to be related to common chronic health conditions such as diabetes, hypertension, and hyperlipidemia. This finding is surprising because decedents with an opioid prescription history were more likely to be white, a demographic that has lower rates of hypertension [42] and diabetes [43] than Hispanics and blacks. One reason for the differences in inpatient diagnoses may be the age difference between the two groups. Decedents with an opioid prescription history are on average 2 years older than decedents without an opioid analgesic prescription history. Alternatively, the differences in inpatient diagnoses between the groups may be accounted for by disparities in health care access. Decedents with an opioid prescription history, who have higher overall health care utilization, may be more likely to receive outpatient care for chronic health conditions, despite lower prevalence of these conditions.

Decedents without an opioid prescription history were much less likely to be seen in the hospital or ED between 2012 and 2016. However, when they were seen, visits by these decedents were often related to drug use, overdose, asthma exacerbations, and psychiatric conditions like schizophrenia, psychosis, and suicidal ideation. This group of decedents may have had limited access to longitudinal care for chronic health conditions. For example, we have shown that this group of decedents was less likely to receive buprenorphine for OUD treatment. Therefore, this group of decedents presented to the hospital and ED predominantly in times of crisis, during exacerbations of untreated chronic conditions.

This analysis has several limitations. The data described are limited to Illinois residents, where the opioid epidemic has disproportionately affected black communities [44]. This finding may not be generalizable to other states. IL CSMP data on opioid prescribing before 2010 was not captured, so only 6 years of controlled substance prescription history could be reviewed. Additionally, decedents may have had access to diverted opioid medications not prescribed to them; this information would not be available in the IL CSMP. Among decedents who died of an overdose involving prescription opioids, 51% filled an opioid prescription in the last 30 days of life. Similarly, among decedents who died of an overdose involving benzodiazepines, only 42% filled a benzodiazepine prescription in the last 30 days of life. This indicates that many decedents had access to diverted drugs or filled prescriptions outside of the 36 states that share data with the IL CSMP. Notably, Missouri, a border state, only recently initiated its CSMP in 2017. Additionally, IL CSMP does not record methadone dispensed in opioid treatment programs. Our ED and hospitalization data does not include outpatient interactions like outpatient addiction treatment, which may account for a larger proportion of care related to OUD than hospitalization and ED discharge records. Finally, in the analysis of diagnostic codes associated with decedent types, the use of single-level modeling does not account for the possible interdependence of diagnosis codes. Analysis of this data using multilevel models is currently underway.

Conclusion

We showed that a substantial proportion of opioid overdose decedents in Illinois did not fill an opioid prescription in the 6 years preceding fatal overdose. A narrowed focus on opioid prescribing may not adequately address the continued rise of overdose, particularly in urban settings and among black and Hispanic populations. Additional research is needed to understand which public health approaches may help reduce morbidity and mortality among urban, minority communities where opioids are prescribed at low rates, heath care utilization is low, and OUD treatment with buprenorphine is uncommon.

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