



Who is Overdosing? An Updated Picture of Overdose Deaths From 2008 to 2015

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Abstract

Purpose: To determine the role of opioids in drug overdose deaths in Allen County, Indiana between January 1, 2008, and December 31, 2015.

Methods: File review of 418 overdose deaths was performed using Indiana State Department of Health death certificates available through the Allen County Coroner's Office. Data from autopsy and toxicology reports and coroner-requested prescribing data from Indiana's Prescription Monitoring Program were reviewed. Cause of death and available data were analyzed to identify patterns and trends related to overdose deaths.

Results: Four hundred eighteen drug overdose deaths were identified (336 accidental, 66 intentional, and 16 undetermined). Mean age was 42.5 years, 88.5% were Caucasian, and 68.7% were employed. The majority of deaths occurred at a place of residence (71.4%) and with other people present (57.5% of the time). Depression was the most common comorbidity identified. The most common drug classes identified by toxicology were opioids, followed by benzodiazepines. Significant increases in both heroin (35% of deaths in 2015 versus 8.2% in 2013) and fentanyl (30% of deaths in 2015 versus 2.2% in 2011) were observed.

Conclusions: Drug overdose continues to be a significant cause of death in Allen County. The majority of deaths were accidental and in relatively young, employed individuals. Prevention and awareness strategies should be encouraged, given that the majority of overdose deaths occurred at a place of residence with other people frequently present. Additional concerns about patterns of drug use were confirmed with marked increases in both heroin and fentanyl contributing to overdose deaths in the latter part of the study.

Keywords

health outcomes, health promotion, medications, pain management, primary care

Background

Drug overdose is the leading cause of accidental death in the United States.¹⁻⁵ More than half of drug overdose deaths involve the opioid analgesics; 28 647 of the 47 055 drug overdose deaths in 2014 were due to opioids.⁶ Although national estimates of drug use prevalence have not changed in recent years, rates of overdose deaths have been steadily increasing in the United States.⁷ Since 2000, rates of overdose deaths have increased by over 137%, with a 200% increase from overdose deaths that included opioids.^{6,8}

The number of overdose deaths has risen nationally, and more individuals have died from drug overdoses in 2014 than in any other year.^{6,9} Southern and Midwestern states have witnessed substantial increases in drug overdose-related mortality rates.^{10,11} Indiana, one of the rural states hit hardest by this surge, has enacted a variety of public health measures to reduce

unintentional overdose deaths.¹² The Indiana State Department of Health's outreach to statewide media and prescribers to increase awareness has not translated to a decrease in mortality rates thus far.¹⁰ This lack of improvement in mortality rates indicates that further action is needed in order to produce a meaningful impact.

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Although prescription medications are the leading cause of overdose death in the United States, heroin, cocaine, alcohol, and other substance abuse are contributing to the overall escalation of the epidemic.¹³ From 2004 to 2007, a Centers for Disease Control and Prevention study concluded that medical examiners and coroners reported the presence of an illegal drug (eg, cocaine, methamphetamine, or heroin) in 20% of the deaths that they analyzed.¹⁴ Between 2013 and 2014, overdose rates involving methadone remained unchanged. However, deaths involving opioid pain relievers have increased by 9%, those involving heroin have increased by 26%, and deaths involving synthetic opioids other than methadone (eg, fentanyl) have increased by 80%.

The purpose of this study was to establish the commonalities shared by drug overdose decedents, which physicians might find useful in assessing patient risk factors. The decedent commonalities evaluated include demographics, toxicology screens, accidental versus intentional deaths, and comorbidities.

Methods

This study was approved by the institutional review board of Lutheran Health Network (LHN IRB 14-386) on April 20, 2016. This study was a retrospective, descriptive, correlational study of accidental and intentional deaths occurring in Allen County, Indiana resulting from drug and/or alcohol interaction as identified by the Allen County Coroner's Office (ACCO) for the years 2008 to 2015. We obtained 2008 to 2015 overdose death records through the ACCO and the Department of Health. Each decedent was assigned an individual study number that was stored in a separate, password-protected file. Any data collected used the individual study number. We conducted chart review of 418 coroner charts for the study years 2008 to 2015 as well as Department of Health death certificates to populate our data collection form. Investigators reviewed coroner's reports and files, including narratives, autopsy results (if applicable), toxicology reports, Indiana's Prescription Drug Monitoring Program reports when available, and death certificates. The data were then analyzed to determine any statistical significance.¹⁵

Statistical Analysis

Descriptive and correlational statistical measures were used to examine and describe the data. Statistical tests performed include χ^2 tests and Fisher exact test (FET). The level of significance was $\alpha = .05$, with all P values lower than that value considered statistically significant. Inclusion criteria sought to identify all deaths that resulted from a drug- and/or alcohol-related event occurring in Allen County, Indiana (2008-2015) as identified by the ACCO or Fort Wayne Allen County Department of Health (FWAC DOH) death certificates.

Deaths not caused by overdose and/or any criminal cases as identified by the District Attorney's Office with pending litigation or criminal investigation were excluded. Confidentiality protection was maintained by assignment of an identification

number to deidentify the data. All data collected utilize preexisting information that was available from medical records, police reports, death certificates, and toxicology reports.

Results

From 2008 to 2015, a total of 418 overdose deaths in Allen County, Indiana were reported. Overdose deaths included 336 accidental, 66 intentional, and 16 undetermined deaths. Undetermined cases could not be identified as either accidental or intentional. There was an increase in the number of overdose deaths from 2008 to 2015. Our study results showed decedents were 88.5% white and 10.3% African American, so the overdose death racial demographic was consistent with the population distribution in Fort Wayne (79.3% white and 11.7% African American).

Accurate toxicology reports were obtained for 412 cases of the 418 overdose deaths. The 6 cases without the toxicology reports were confirmed to be overdose deaths by the ACCO. From Table 1, it is evident that nearly 60% of overdose deaths were male and the mean age of all overdose deaths is 42.5 (standard deviation [SD] = 12.3) years with a median age of 43 years. The racial breakdown of the deaths showed that 88% were white, 68% of the study population were also employed at the time of their death, and 79.4% had at least a high school education. Multiple substance overdoses account for 74.4% of the deaths (Table 2). Overdoses occurred at a residence 71.4% of the time and other people were present 57.5% of the time. Other locations where overdoses occurred include: in a motor vehicle, in a hotel/motel, and in parks or other public areas. For data collection starting in 2014 to 2015, "other residence" was added to the place of injury and mainly included residences of significant others, friends, or family (Table 2).

Medical conditions present by "manner of death" are shown in Figure 1. Based on available data, history of depression was identified in 20% and prior substance abuse in 12.4% of decedents. The strong possibility of underreporting or limitations in capturing this historical information is recognized. There was a clear difference in the "accidental versus intentional" deaths by age groups for opioid-related overdose deaths (Figure 2). Accidental deaths account for over 90% of the deaths in both the 15 to 24 and 25 to 34 cohorts. There were significant differences between accidental and intentional deaths for the age groups 55 to 65, χ^2 (1, $N = 402$) = 4.110, $P = .043$, and 65 to 74 ($P = .013$, FET).

Multiple drug classes were found among the study population, with the mean number of 4.3 drug classes present per person as identified by toxicology. The most common drug class present was opioids, which included fentanyl, methadone, and tramadol (Figure 3). These 3 drugs were recorded as separate variables on the data collection tool. The opioids present for each case were adjusted to include the 3 additional drug classes without counting the number of opioids present more than once. Drugs present in at least 20% of the study population were included in the graphs. Undetermined

Table 1. Demographic information of All Overdose Deaths in Allen County, Indiana (2008-2015).

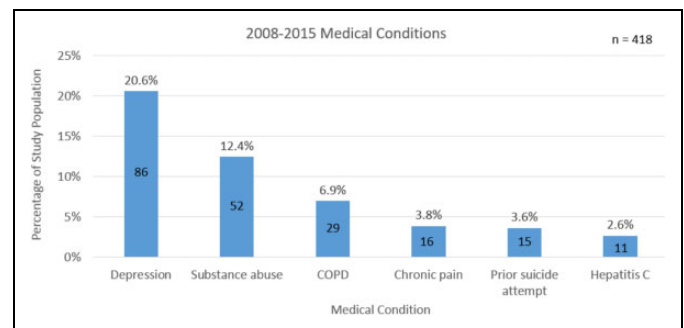
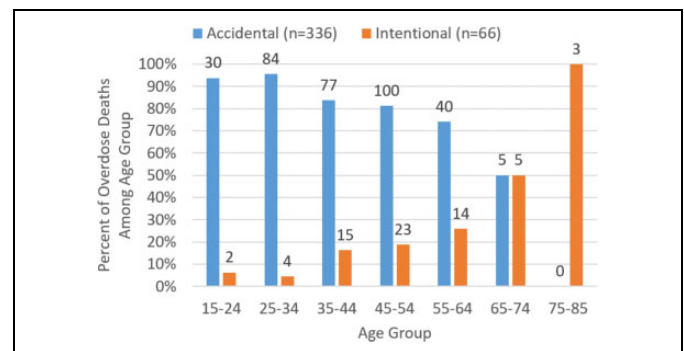
Demographic	Deaths, n (%)
Gender	
Female	169 (40.4%)
Male	249 (59.6%)
Race	
White	370 (88.5%)
Black/African American	43 (10.3%)
Hispanic/Latino	2 (0.5%)
Asian/Pacific Islander	0 (0.0%)
Other	3 (0.7%)
Marital status	
Never married	157 (37.6%)
Married	104 (24.9%)
Married but separated	5 (1.2%)
Widowed	21 (5.0%)
Divorced	110 (26.3%)
Unknown	21 (5.0%)
Employment	
Currently employed	287 (68.7%)
Currently unemployed	57 (13.6%)
Student	17 (4.1%)
Disabled	35 (8.4%)
Retired	1 (0.2%)
Unknown	21 (5.0%)
Armed forces	
Yes	34 (8.1%)
No	180 (90.9%)
Unknown	4 (1.0%)
Education level	
Under 8th grade	8 (1.9%)
High school—not finished	75 (17.9%)
Graduated high school	211 (50.5%)
Some college, no degree	79 (18.9%)
Technical/vocation degree	8 (1.9%)
College degree	28 (6.7%)
Postgraduation degree	6 (1.4%)
Unknown	3 (0.7%)
Age information	
Mean	42.5
Standard deviation	12.3
Minimum	15
Maximum	78

overdoses were included in demographic statistics only. Opioids and illicit drugs were more commonly present in accidental overdoses.

The presence of heroin and fentanyl was measured. Fentanyl was present in 20% of decedents in 2008 and declined through 2013 (Figure 4). The presence of fentanyl increased from 6% to 36% in the subsequent 2-year period. The presence of identified heroin in overdose deaths was under 5% from 2008 through 2011. A notable increase in the presence of heroin was seen beginning in 2011 at 2.2% of all the overdose deaths in that year to 11% in 2012, 18% in 2013, 24% in 2014, and an all-time high of 30% in 2015. The rise in heroin and fentanyl corresponds to the increase in drug overdose deaths.(Figure 5)

Table 2. Other Demographic Information from All Overdose Deaths in Allen County, Indiana (2008-2015).

Demographic	Deaths, n (%)
Cause of death	
Single substance	107 (25.6%)
Multiple substance	311 (74.4%)
Other people present	
Yes	240 (57.4%)
No	178 (42.6%)
Place of injury	
Residence	299 (71.5%)
Workplace	1 (0.2%)
Other	83 (19.9%)
Unknown	15 (3.6%)
Other residence	20 (4.8%)

**Figure 1.** Identified medical conditions for overdose deaths in Allen County, Indiana for 2008 to 2015.**Figure 2.** Accidental versus intentional overdose deaths in Allen County, Indiana for 2008 to 2015.

Discussion

Allen County overdose deaths increased each year from 2008 through 2013. Although rates did moderate somewhat in 2014, the overdose death rate resumed its upward path in 2015 and is comparable with national trends.^{16,17} This study looked at a variety of additional factors related to overdose deaths including demographics, comorbidities, intentionality by age, and other drug classes present on toxicology evaluation. We also considered the history for increase in use over time of heroin and fentanyl as these relate to overdose deaths. Medical

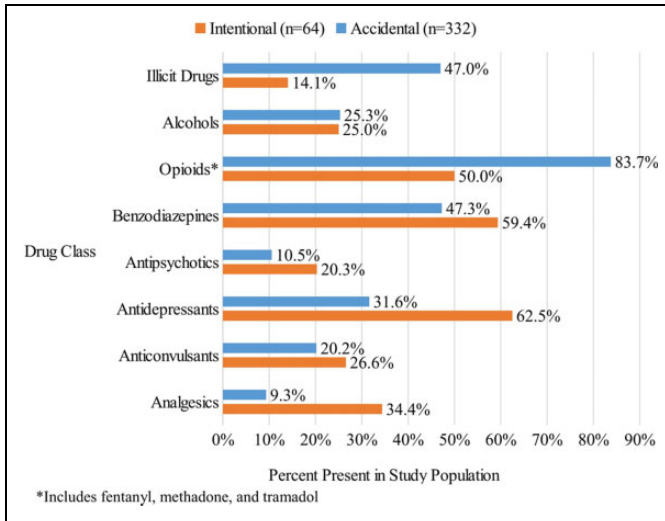


Figure 3. Drug classes present by manner of death in Allen County, Indiana. N = 396 for 2008 to 2015.

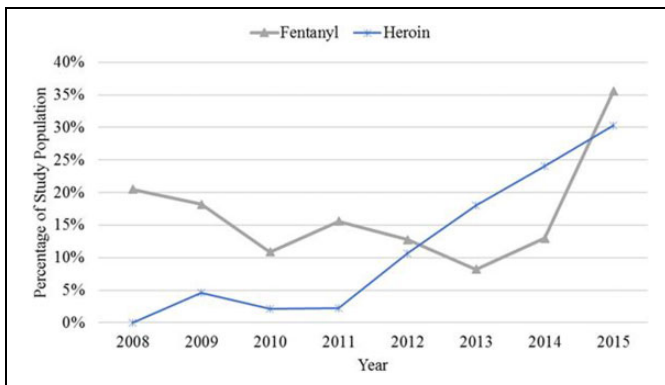


Figure 4. Incidence of fentanyl and heroin in overdose deaths from 2008 to 2015.

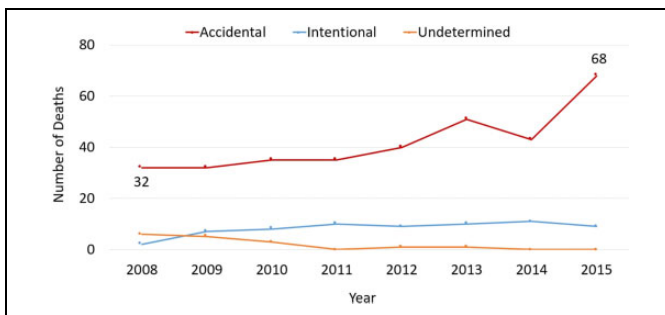


Figure 5. Overdose deaths in Allen County (2008-2015).

conditions were important pieces of information collected from the coroner's case reports (Tables 1 and 2). This information allowed us to determine whether there were any correlations with specific medical conditions and overdoses. In our study, 46% did not have a medical history in their case reports or a medical condition that was identified from records available to the coroner. The remaining 54% with medical conditions were

separated by manner of death (accidental or intentional). A portion of those who intentionally overdosed had conditions such as prior suicide attempts or depression, while those who accidentally overdosed more frequently had comorbid substance use disorder (SUD) or chronic pain conditions (Figure 1). An opportunity to alter these negative outcomes may lie in gathering more targeted medical history and then offering treatment to patients with these concerns when they present for medical care.¹⁸ Our data appear to support the importance of follow-up for patients who have a medical history that indicates depression with or without prior suicide attempt, substance abuse disorder, or a chronic pain condition to ensure that appropriate mental health referrals are made.^{19,20} The need for better appreciation of this information by prescribers was demonstrated in a study of patients diagnosed with SUD who were also prescribed opioids. Of note, there was little change how opioids were prescribed even after a diagnosis of SUD was rendered.²¹ Changing prescribing habits presents an opportunity to reduce mortality risk.

This study also evaluated whether others were present at the time of the individual's overdose death (Table 2). These data were manually extracted by reviewing the circumstances of the individual's death from police reports and other logs available in the coroner's case file. The presence of others at the time of overdose is encouraging, as it suggests that intervention for these individuals may be possible.^{22,23} Naloxone (Narcan) is an opioid antagonist that is able to reverse the effects of an opioid overdose.²⁴ Mirroring national trends, recent Indiana legislation has increased the availability of naloxone, allowing more individuals to obtain this medication without a prescription. The findings over the entire study period demonstrated that over 57% of the victims had other people present at the time of their overdose. This would suggest that over half of overdose deaths could have potentially been avoided had naloxone been available and administered when needed. When stratifying by age group for overdose death, it was determined that 100% of those who were under the age of 20 had other people present at the time of overdose. Looking at ages up to 50 years, the percentage of individuals who died of overdose with other people present was 70%. Older individuals were less likely to have others present than younger individuals, which might suggest that overdoses occur in a social setting for younger populations. It is important to note that "individuals present" refers to another individual's presence anywhere in the residence, not specifically in the same room observing the "at-risk" individual.

Study limitations include potential gaps in the completeness of data available through the 2008 to 2013 time period. Incomplete information related to drug classes present and comorbid conditions may have led to underestimation in certain circumstances. For instance, depression, substance abuse, and prior suicide attempts may be underreported, as these conditions were not always reflected in records available for our review.

The number of intentional and undetermined overdose deaths was relatively consistent from year to year over the course of the study, with benzodiazepines or antidepressants

frequently present per toxicology testing (Figure 3). Recent studies have drawn a correlation between opioid use and development of depression, which warrants further investigation.^{18,25} Several drug classes were identified in our study population, with the most significant of these included in Figure 3. The 3 most prevalent medication classes/drugs identified were opioids, benzodiazepines, and antidepressants.²⁶ Rates of benzodiazepine presence remained relatively level throughout the study period. Opioid presence, including heroin and fentanyl, increased significantly during the latter part of our study, mirroring national trends. Both reached an all-time high in 2015 when over 90% of individuals had opioids in their system and over 35% had fentanyl present. In recent years, fentanyl has been produced illicitly and is commonly combined with heroin, substantially increasing mortality risk of heroin users due to its potency which is 30 to 50 times greater than heroin.²⁷ It is worth noting that all opioids, including oxycodone, hydrocodone, morphine, and other formulations, even if prescribed for legitimate use, have the potential to be abused or diverted and present significant abuse potential for those at risk.²⁸

Allen County overdose deaths have dramatically increased since 2008 and have affected mainly employed, educated individuals. This is a significant public health concern involving opioids from both legal and illegal sources. Heroin and illicit fentanyl are increasingly present in these overdose deaths. Possible explanations include new prescribing regulations driving change in physician practice and the relatively lower cost of heroin. Review of prescription drug monitoring programs would provide potential opportunity for identification of prescribing patterns and drug sources. Leveraging this information could further enable the public health community to better identify and target high-risk areas, to develop prevention and intervention strategies, and thereby potentially reverse the trends in overdose death rates.

Drug overdose deaths doubled from 2008 to 2015, with a progressive increase of opioids present in the overdose deaths. Toxicology reports showed an average of more than 4 drugs in their system, raising polypharmacy concern as a risk factor. The percentage of intentional overdose deaths increased with age, whereas a percentage of accidental overdose deaths decreased with age. Accidental deaths were seen more frequently in people with substance abuse, whereas intentional overdose deaths were seen more often in people with a history of depression. Opioids taken in combination with benzodiazepines or by those with a history of depression may be at the greatest risk of overdose death.

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Declaration of Conflicting Interests

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