

Lake County Drug-related Overdose Deaths: 2013 to 2017

Informing a Five-year Perspective

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1. Executive Summary

Deaths attributed to drug-related overdose are a burden at the local, state, and national level. Since 1999, drug-related overdose deaths have continued to rise, and have been responsible for roughly half a million deaths to date. While these trends are illustrated nationally, Ohio has the fourth highest drug-related overdose death rate in the country, and drug-related overdose is the state's leading cause of death. Albeit retaining the smallest geographical footprint of any county in Ohio, Lake County has also been impacted by deaths attributed to drug-related overdose.

In order to identify a county-specific demographic profile of drug-related overdose death decedents, 2013 to 2017 vital statistics data for Lake County was analyzed in SPSS. As a result of this analysis, a stepwise relationship between overdose death and several demographic characteristics was identified, as sex, age, marital status, and occupation were associated with the type of substance used, the latter of which was ultimately associated with overdose death. Toxicologies associated with the aforementioned deaths were widely variable, and heavily impacted by the rapid emergence of fentanyl and fentanyl analogues.

The demographic profile outlined in this report should be utilized to inform targeted community-based overdose prevention initiatives. While these results are not generalizable beyond Lake County, a similar analysis and comparison of neighboring county vital statistics data may illustrate both overdose death commonalities and community-specific dynamics, both of which could further inform overdose prevention activities, initiatives, and policies.

2. Introduction

2.1 National and State Drug Mortality

The national impact of drug-related deaths is a considerable public health concern. In the past two decades, the frequency of drug-related deaths has steadily risen (Monnat 2018) across all age groups (Hedegaard et al. 2017), accounting for 493,400 drug-related overdoses and 82,834 drug-related suicides from 1999 to 2016 (CDC 2017). These deaths are further characterized by sizeable lifetime medical and work loss costs, the latter of which amounted nationally to \$55.6 billion in 2013 alone (Florence et al. 2016). While drug-related deaths were driven primarily by prescription opioids, such as OxyContin, in the early-to-mid 2000s, the emergence of high potency opioids in 2013, such as illicitly manufactured fentanyl and fentanyl analogues, has continued to drive drug-related deaths (Peterson 2016).

During the aforementioned period, Ohio experienced a total of 26,727 drug-related overdoses, and 2,923 drug-related suicides (CDC 2017). Unintentional drug overdose is the leading cause of injury-related death in Ohio (Penm et al. 2017), and the state currently has the fourth highest drug overdose death rate in the nation (Hedegaard et al. 2017), and this trend persists despite several strategic state initiatives, such as the establishment of the Governor's Cabinet Opiate Action Team (Penm et al. 2017), advocacy amongst prescribers for integration into the Ohio Automated Rx Reporting System (OARRS), passage of Ohio Revised Code 2925.11, otherwise referred to as the Good Samaritan Law, and the state health department's dissemination of overdose education and opioid-antagonist naloxone via Project DAWN (Deaths Avoided with Naloxone). The aforementioned efforts have been supplemented by the steady emergence of treatment-referring drug courts, the efficacy of which has been well documented (Marlowe 2010, Robertson and Swartz 2018). In order to attenuate these drug-related deaths, as well as inform targeted community drug

prevention, harm reduction, and treatment strategies, respectively, the construction of a drug overdose decedent profile is warranted.

2.2 Lake County, Ohio

Lake County, Ohio, is home to roughly 230,117 residents, and is situated along the Lake Erie shoreline, with neighboring Cuyahoga County to the West and Ashtabula County to the East (United States Census Bureau 2017). Despite being the smallest county in Ohio with respect to geographic bounds, Lake County has a considerable manufacturing and retail presence across the county's nearly 6,000 employers, and 86,697 employees (United States Census Bureau 2017). Lake County residents are primarily Caucasian (92%), female (51%), have a median household income of \$59,958, and are comprised of 2.37 persons per household (United States Census Bureau 2017).

Not unlike the state of Ohio, Lake County has experienced a number of resident drug-related overdose deaths, and the frequency of these deaths continue to increase amid prescription drug monitoring program (PDMP) integration, an increased focus on prescribing practices, adjacent drug supply reduction and enforcement, drug seizure toxicology surveillance, overdose education, and drug treatment efforts, respectively. In order to further inform these county-specific initiatives, a demographic profile of Lake County drug-related overdose deaths was constructed, based upon drug overdose deaths occurring in Lake County between 2013 and 2017.

3. Methods

3.1 Data Analysis

In order to obtain 2013 to 2017 Lake County resident drug overdose data, a vital statistics request was submitted to the Ohio Department of Health, Office of Vital Statistics. Upon completion of this request, the aforementioned data was deidentified through the use of

identification numbers, and any personally identifiable information was removed to ensure decedent confidentiality. The data was compiled, categorized, coded, and analyzed in SPSS Version 25, and statistical significance was established a priori, with an alpha level of $\alpha = 0.05$. Quantitative analysis techniques consisted primarily of chi-square and descriptive statistics.

4. Results

4.1 Lake County Drug Mortality: 2013 to 2017

A total of 329 drug-related overdose deaths occurred amongst Lake County residents between 2013 and 2017. Despite a 6% decrease in drug-related overdose deaths between 2014 and 2015, drug-related overdose deaths increased from 43 to 53 (23%) between 2013 and 2014, from 50 to 94 (88%) between 2015 and 2016, and remained relatively unchanged between 2016 and 2017, with 92 and 93 total overdose deaths, respectively (Table 1). It is important to note, however, that these totals do not speak to the frequency of nonfatal drug-related overdoses, the latter of which is likely greater in total, and considerably difficult to quantify. For example, while the increased availability of opioid-antagonist naloxone is efficacious and cost-effective for reducing opioid overdose deaths (Coffin and Sullivan 2013), its utilization also masks the frequency of nonfatal opioid overdoses that occur outside of medical intervention, and are thus undocumented.

Table 1. *Lake County Drug-related Deaths: 2013 to 2017*

	2013	2014	2015	2016	2017	Total
Unintentional Drug-related Overdoses	43	52	49	92	93	329

4.1.1 Demographic Information

Lake County residents who experienced a fatal drug-related overdose between 2013 and 2017 were primarily male (72%), non-Hispanic (99%), and Caucasian (98%). More than two-thirds (76%) of overdose decedents between 2013 and 2017 were between the ages of 25 and 54 years old, and overdose death frequency was highest amongst those 25 to 34 years of age (109), followed by 45 to 54 years of age (78), and 35 to 44 years of age (62); there were no overdose decedents under the age of 18 during the specified timeframe (Table 2).

Table 2. *Decedent Age Group: 2013 to 2017*

Age	N	%
18 to 24	45	13.7
25 to 34	109	33.1
35 to 44	62	18.8
45 to 54	78	23.7
55 to 64	29	8.8
65 and older	6	1.8

With regards to educational attainment, more than half of overdose decedents obtained a high school diploma or GED equivalent (65%), and 11% obtained an Associate's, Bachelor's, or Professional degree (Table 3).

Table 3. *Decedent Education Level: 2013 to 2017*

Education	N	%
8 th Grade or Less	2	0.6
9 th – 12 th grade, No Diploma	36	11.0
High School Graduate or GED Equivalent	212	64.8
Some College but no Degree	41	12.5
Associate’s Degree	14	4.3
Bachelor’s Degree	19	5.8
Professional or Doctoral Degree	3	0.9

Decedents were primarily characterized as single or never married (61%), and divorced (24%); less than 15% were married (Table 4).

Table 4. *Decedent Marital Status: 2013 to 2017*

Marital Status	N	%
Single or Never Married	202	61.4
Married	44	13.4
Divorced	79	24.0
Widowed	4	1.2

Roughly two-thirds (64%) of decedents overdosed at home, and overdose location was significantly associated with the respective overdose year ($p = 0.026$; Table 5).

Table 5. *Overdose Setting by Overdose Year: 2013 to 2017*

Setting	Year					Total	Chi-square	df	p
	2013	2014	2015	2016	2017				
Decedent's Home	31	32	32	55	59	209	59.105	40	0.026
Family Member's Home	0	0	3	6	0	9			
Friend's Home	4	6	5	5	8	28			
Hospital	2	0	0	0	0	2			
Hotel	3	3	2	5	4	17			
Jail	0	0	1	0	2	3			
Library Restroom	0	3	0	0	1	4			
Parked Automobile	1	1	0	4	1	7			
Recovery House	0	0	0	0	1	1			
Undisclosed Location	2	7	6	17	15	47			
Workplace	0	0	0	0	2	2			

Zip code-level residences were utilized to ensure decedent confidentiality. Half of overdose decedent residences were concentrated in 44077 (27%), which includes Painesville, Fairport Harbor, and Concord, and 44060 (23%), which includes Mentor, Mentor-on-the-Lake, and Kirtland Hills (Table 6). A number of other high burden zip codes, such as 44095 and 44094, were identified (Table 6).

Table 6. *Decedent Residence Zip Code by Overdose Year: 2013 to 2017*

Zip Code	Year					Total	Chi-square	<i>df</i>	<i>p</i>
	2013	2014	2015	2016	2017				
44092	7	7	4	3	10	31	32.750	32	0.430
44094	7	11	8	11	11	48			
44095	8	8	3	18	15	52			
44057	3	1	5	5	6	20			
44077	10	18	15	26	21	90			
44060	8	6	11	25	26	76			
44045	0	0	0	0	1	1			
44081	0	1	3	4	2	10			
44086	0	0	0	0	1	1			

Roughly three-quarters (71%) of identified decedent occupations were characterized as labor, maintenance, and trade (47%), food service (12%), and disabled, or not working (12%; Table 7).

Table 7. *Decedent Occupation: 2013 to 2017*

Occupation	N	%
Education	11	3.9
Healthcare	19	6.7
Retail and Entertainment Services	23	8.2
Government/ Administrative Professional	30	10.6
Disabled, or Not Working	33	11.7
Food Service	34	12.1
Labor, Maintenance, and Trade	132	46.8

4.1.2 Toxicology

The toxicology of drug-related overdose deaths occurring in Lake County between 2013 and 2017 varied considerably. While overdose deaths during this time period primarily involved illicit drugs (60%), cause of death was associated with 158 unique illicit and prescription drug combinations, varying between one and seven substances as a primary cause of death per decedent, with a mean of three substances, and 21% of the aforesaid combinations included alcohol as a primary contributor to the death. Overdose deaths attributed to prescription drugs declined from 2013 to 2017, while illicit, and illicit and prescription combinations, inversely increased ($p < 0.001$; Table 8). Illicit drug-attributed deaths were overwhelmingly driven by the emergence of fentanyl and fentanyl analogues in 2013, and their continued impact thereafter ($p < 0.001$; Table 10). Fentanyl and fentanyl analogues contributed to 49% of overdose deaths occurring between 2013 and 2017, and were present in 9% of 2013 overdose deaths, 8% of 2014 overdose deaths, 37% of 2015 overdose deaths, 77% of 2016 deaths, and 70% of 2017 overdose deaths (Table 10).

Table 8. *Prescription and Illicit Overdoses: 2013 to 2017*

Overdose Type	Year					Total	Chi-square	df	p
	2013	2014	2015	2016	2017				
Prescription	13	19	7	7	7	53	41.375	8	< 0.001
Illicit	24	24	30	68	53	198			
Both	6	9	12	17	33	77			

Decedents between the ages of 25 and 54 accounted for 67% of prescription, 76% of illicit, and 79% of illicit/prescription deaths, respectively ($p < 0.001$). With respect to occupation, overdoses attributed to illicit substances accounted for 60% of deaths (Table 9), and decedents were overwhelmingly affected by combined illicit and prescription substances, the latter of which accounted for 100% of education, 94% of food service, 88% of labor, maintenance, and trade, 83% of retail and entertainment services, 79% of healthcare, 70% of disabled, or not working, and 67% of government/administrative professional deaths, respectively ($p = 0.030$).

Table 9. *Occupation by Substance Type: 2013 to 2017*

Occupation	Substance Type			Total	Chi-square	df	p
	Prescription	Illicit	Both				
Education	0	9	2	11	22.698	12	0.030
Healthcare	4	9	6	19			
Retail and Entertainment Services	4	14	5	23			
Government/Administrative Professional	10	12	8	30			
Disabled, or Not Working	10	14	9	33			
Food Service	2	25	7	34			
Labor, Maintenance, and Trade	16	85	31	132			

Of those illicit substances identified, those containing fentanyl and fentanyl analogues accounted for 60% of total illicit substances ($p < 0.001$), followed by heroin, or substances containing heroin (24%), and cocaine, or substances containing cocaine (7%; Table 10). While prescriptions were commonly identified in combination with fentanyl, fentanyl analogues, cocaine, and heroin, respectively, deaths attributed solely to prescription drugs accounted for less than one quarter (18%) of identified overdose death toxicologies (Table 10).

Table 10. *Toxicology by Overdose Year: 2013 to 2017*

Toxicology	Year					Total	Chi-square	df	p
	2013	2014	2015	2016	2017				
Involving Fentanyl or Fentanyl Analogues	4	4	18	71	65	162	146.724	20	< 0.001
Heroin, or Heroin Combination	22	27	17	7	5	78			
Prescription	13	19	9	9	9	59			
Cocaine, or Cocaine Combination	2	1	5	3	11	22			
Cocaine and Heroin	2	1	0	1	2	6			
Methamphetamine	0	0	0	1	1	2			

Decedents between the ages of 25 and 54 accounted for 79% of illicit/prescription deaths, 76% of illicit, and 68% of prescription deaths, respectively ($p < 0.001$). Additionally, the aforementioned age range experienced the greatest frequency of overdose deaths attributed to all six included toxicology classifications ($p < 0.001$; Table 11), which included the following categories:

1. Involving Fentanyl or Fentanyl Analogues (127 of 162 cases, or 78%)
2. Cocaine, or Cocaine Combination (18 of 22 cases, or 82%)
3. Heroin, or Heroin Combination (57 of 78 cases, or 73%)
4. Cocaine and Heroin (6 of 6 cases, or 100%)
5. Prescription (40 of 59 cases, or 68%)
6. Methamphetamine (1 of 2 cases, or 50%)

Table 11. *Toxicology by Age Group: 2013 to 2017*

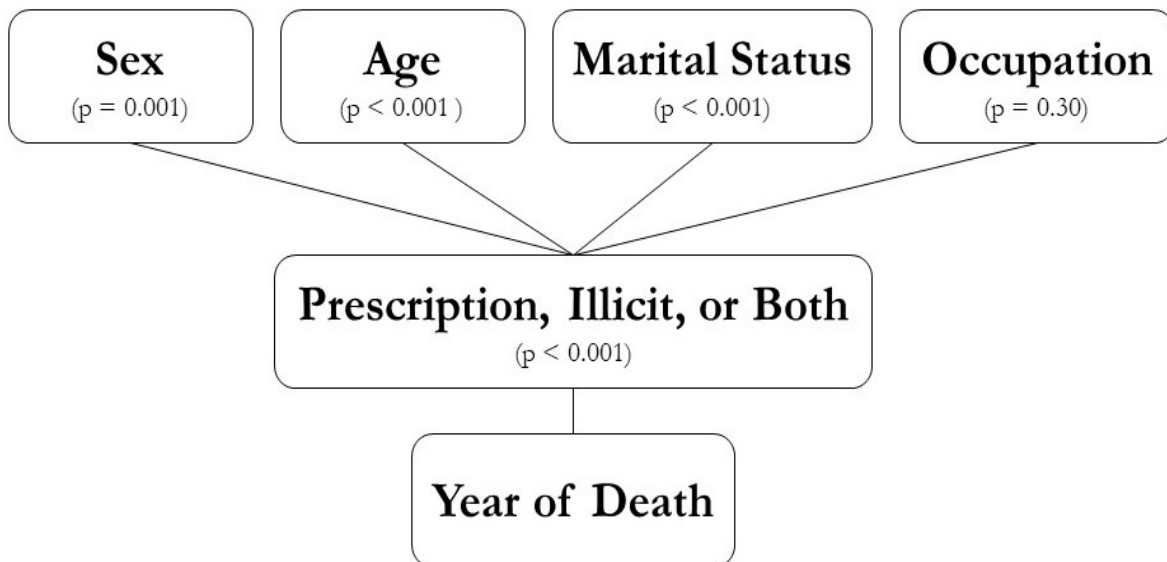
Toxicology	Age Group				Total	Chi-square	df	p
	18 to 24	25 to 54	55 to 64	65 and older				
Involving Fentanyl or Fentanyl Analogues	25	127	10	0	162	40.105	15	< 0.001
Heroin, or Heroin Combination	16	57	4	1	78			
Prescription	2	40	13	4	59			
Cocaine, or Cocaine Combination	1	18	2	1	22			
Cocaine and Heroin	0	6	0	0	6			
Methamphetamine	1	1	0	0	2			

5. Discussion

5.1 Demographic Patterns in Overdose Death

The association between age, sex, marital status, and occupation, as well as the collective stepwise association between these (1) demographic variables and (2) substance type (as indicated by the p values under each of the four demographic variables), and ultimately, the association between (2) substance type and (3) year of death ($p < 0.001$), is an important finding (Figure 1).

Figure 1. *Demographic Variables Associated with Substance Type and Overdose Death*



These findings are supported with respect to sex, and the increased risk amongst males for overdose death (Hedegaard et al. 2017), and mirror previously documented conclusions regarding the disproportionate burden of overdose deaths amongst those 25 to 54 years of age (Rudd et al. 2016). With respect to marital status and overdose death, 85% of Lake County overdose deaths occurring between 2013 and 2017 involved decedents who were single, never married, or divorced. These results may suggest that marriage is a protective factor for overdose death, and this

relationship has been suggested elsewhere (Johnson et al. 2013). Occupational patterns in drug-related overdose deaths have also been previously identified (Morano et al. 2018), and align with the findings presented here, specifically regarding the disproportionate burden of overdose deaths amongst labor, maintenance, and trade occupations (Bunn et al. 2014, Dissell 2016, Harik et al. 2017, Morano et al. 2018). Additionally, Morano and colleagues identified the respective group as most at risk for a heroin-related overdose between 2007 and 2012. Given local drug seizure identification of fentanyl and fentanyl-analogues in Lake County in 2014 (Rohde 2018; Table 12), as well as the documented presence of heroin contaminated with fentanyl, or fentanyl otherwise presented as heroin (Ciccarone 2017, Pichini et al. 2018), this abuse pattern, in conjunction with the high potency of fentanyl and fentanyl analogues, may be responsible in part for the continued deaths amongst labor, maintenance, and trade occupations.

Table 12. *Lake County Crime Lab Opioid Caseload: 2013 to 2017*

Drug	Year				
	2013	2014	2015	2016	2017*
Heroin	296	290	355	441	273
Fentanyl	0	12	88	403	258
Acetyl Fentanyl	0	0	19	22	18
U-47700	0	0	0	18	17
Furantyl Fentanyl	0	0	0	7	10
3-Methyl Fentanyl	0	0	0	5	12
Carfentanil	0	0	0	40	153
Acryl Fentanyl	0	0	0	0	34
Despropionyl Fentanyl	0	0	0	0	40
4-Fluoroisobutyryl Fentanyl	0	0	0	0	12
Butyryl Fentanyl	0	0	0	0	3
Methoxyacetyl Fentanyl	0	0	0	0	8
Benzyl Fentanyl	0	0	0	0	8
Phenyl Fentanyl	0	0	0	0	12
Cyclopropyl Fentanyl	0	0	0	0	7
U-48800	0	0	0	0	3
Total	296	302	462	936	868

Eighty-four percent of substances contributing to Lake County overdose deaths between 2013 and 2017 were either illicit, or a combination of illicit and prescription substances ($p < 0.001$), and deaths attributed to prescription-only substances have since declined. The shift towards increased illicit and illicit/prescription combinations warrants increased concern amongst the aforementioned demographic, as potency, drug combination, and substance awareness are variable.

5.2 Public Health Implications

5.2.1 Occupational-focused Programming

The aforementioned relationships inform a demographic profile of Lake County residents disproportionately at risk for overdose death between 2013 and 2017, and provide a basis for which to construct targeted community programming and initiatives. With an occupational focus in mind, and given the disproportionate burden amongst labor, maintenance, and trade occupations, these initiatives could foreseeably be directed and delivered through relevant Lake County employers, such as those involved with manufacturing, construction and building trades, landscaping, and general maintenance. Said initiatives might include drug-free workplace and employee education programs, as well as targeted naloxone education and distribution via Project DAWN (Deaths Avoided with Naloxone), or other local distribution points.

In light of the preexisting relationship between health departments and food service employees by way of regular food sanitation inspections, similar programming may prove beneficial, and could potentially supplement existing licensing processes and procedures. As both of the aforementioned occupations are associated with other negative health behaviors, such as tobacco use (CDC 2011), and may have limited or no health insurance coverage, educational efforts interfaced with Medicaid-eligible services, and social service resources and support, are also recommended.

5.2.2 Naloxone Dosage and Distribution Recommendations

The growing presence of high potency opioids fentanyl and fentanyl analogues in Lake County and their collective impact on the county's overdose deaths warrants attention. Upwards of 77% (2016) and 70% (2017) of Lake County overdose deaths were associated with fentanyl and/or fentanyl analogues, and when combined with heroin-related deaths in the same years, these totals rise to 86% and 77%, respectively. Concurrently, 64% of the overdose deaths during this time occurred in the decedent's home. As such, naloxone recommendations are twofold, and include (1) a reformulation to address the rising potency of illicit opioids, and (2) an increased focus on third-party naloxone distribution for family and friends of opioid abusers.

While the efficacy of naloxone in reversing an overdose is well documented (Dahan et al. 2010, Boyer 2012), and is currently recommended by both the Centers for Disease Control and Prevention (CDC 2015) and the United States Surgeon General (HHS 2018) for attenuating an opioid overdose, the current dosage of 2 milligrams is often inadequate when administered on an individual overdosing from fentanyl or a fentanyl analogue, may require several doses to successfully prevent overdose death (Somerville et al. 2017), and can permit for re-narcotization when a single dose is used for high dose or long acting opioids (Lynn and Galinkin 2018). According to the High Intensity Drug Trafficking Agency's (HIDTA) Overdose Detection Mapping Acquisition Program, 63% of non-fatal overdoses occurring in Lake County during 2017 required multiple doses of naloxone (HIDTA 2018). In a national examination of 2015 emergency medical service responder events, 31,000 required two or more naloxone administrations; of these, "...1,600 required four doses, 615 required five doses, and 200 cases required six or more doses" (NCADD 2018).

In order to address this growing resource burden, the reformulation of naloxone to an increased dosage may (1) better address the growing potency of illicit opioids, (2) reduce the number

of naloxone administrations and (3) time necessary to attenuate an opioid overdose event, and (4) may potential reduce the overall cost of naloxone distribution, as fewer atomizers, intramuscular syringes, and nasal sprays would be utilized per effective dose.

In supplement to a naloxone reformulation, attention to overdose setting is key. While lay notions might associate drug use with undesirable or risky settings, 64% of Lake County decedents between 2013 and 2017 overdosed in their home residence. Due to the high potency of illicit fentanyl and fentanyl analogues, the mixture of fentanyl with a variety of prescription and illicit drugs, and the relatively short time frame available for the administration of naloxone in the event of an overdose, this finding reaffirms the importance of third-party naloxone distribution for family and friends of known drug abusers, and aligns with previously documented recommendations (Davis et al. 2015).

5.3 Limitations

These findings are subject to a number of limitations. Firstly, the included vital statistics data are based upon death certificate information; in order to file a death certificate, various fields are provided by a listed informant. Given the emotional distress surrounding a death, the accuracy of informant recall could foreseeably be subject to error. Additionally, the substance cited by the coroner as the cause of death could potentially be misclassified, based upon toxicology capabilities of the coroner's preferred toxicology laboratory. For example, a number of toxicology laboratories may not have the equipment to detect new or emerging fentanyl analogues, and failure to detect said substances would result in a cause of death misclassification. Lastly, existing multicollinearity between sex, age, marital status, and occupation precludes certain data analysis techniques, such as the utilization of various regression methods, without considerable consolidation of the included

variable categories or variable omission, and would thus diverge from both the categorical specificity and breadth desired for this report.

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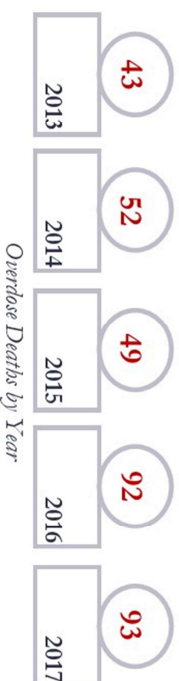
<https://www.hhs.gov/about/news/2018/04/05/surgeon-general-releases-advisory-on-naloxone-an-opioid-overdose-reversing-drug.html>.

Appendix

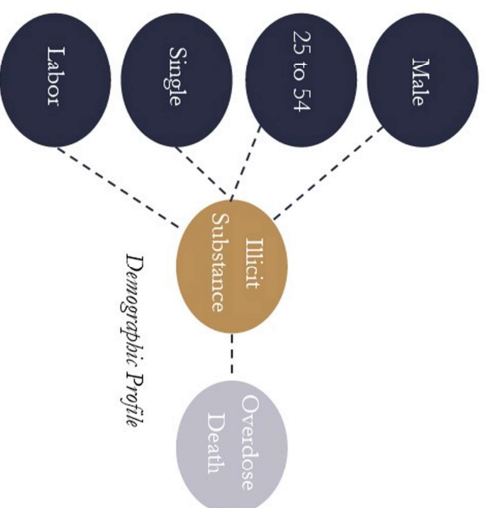
Lake County Drug-related Overdose Deaths: 2013 to 2017

Key Findings

- A total of 329 overdose deaths occurred amongst Lake County residents between 2013 and 2017.
- Overdose death frequency was highest amongst those 25 to 54 years of age.
- Decedents were primarily non-Hispanic Caucasian males.
- Labor, trade, and maintenance occupations were disproportionately affected by overdose deaths.
- More than half (64%) of decedents overdosed at home.
- While prescription-only overdoses have declined from 2013 to 2017, both illicit and illicit/prescription combinations have increased.
- A total of 158 unique illicit and prescription drug combinations were identified.



=329
Lake County Residents



Implications

- Informs a demographic profile of Lake County residents disproportionately at risk for overdose death.
- Warrants occupational-specific overdose prevention programming, initiatives, and naloxone distribution.
- Given fentanyl's high potency, a naloxone dosage increase is advisable.



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Unique illicit and Rx drug combinations identified