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Drugs Most Frequently Involved in Drug Overdose Deaths: United States, 2017–2023

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Abstract

Objective—This report identifies the specific drugs most frequently involved in drug overdose deaths in the United States from 2017 through 2023.

Methods—Data from the 2017–2023 National Vital Statistics System mortality files were linked to literal text data from death certificates. Drug overdose deaths were identified using the *International Classification of Diseases, 10th Revision* underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14. Specific drugs were identified by searching three literal text fields of the death certificate: the causes of death from Part I, significant conditions contributing to death from Part II, and the description of how the injury occurred. Contextual information was used to determine drug involvement in the death. Descriptive statistics were calculated for the most frequently mentioned drugs involved in drug overdose deaths. Deaths involving multiple drugs were counted in all relevant drug categories.

Results—Among drug overdose deaths with mention of at least one specific drug, the most frequently mentioned drugs during 2017–2023 included: fentanyl, heroin, oxycodone, morphine, methadone, hydrocodone, alprazolam, diphenhydramine, cocaine, methamphetamine, amphetamine, gabapentin, and xylazine. Fentanyl ranked first across all years and was the most common concomitant drug found with other top drugs, ranging from 99.0% of xylazine-involved drug overdose deaths to 48.3% of oxycodone-involved drug overdose deaths. Cocaine and methamphetamine were also frequent concomitant drugs. Trends in age-adjusted rates across the 2017 to 2023 period varied by drug, but notably the rate for heroin-involved deaths sharply declined, while the rate for fentanyl-involved deaths increased and then stabilized between 2022 and 2023. In 2023, the most frequently mentioned drugs in unintentional drug overdose deaths were fentanyl, methamphetamine, and cocaine, while the most frequently mentioned drugs for suicide-related drug overdoses were diphenhydramine, oxycodone, and bupropion.

Conclusions—This report identifies patterns in the specific drugs most frequently involved in drug overdose deaths from 2017 through 2023.

Keywords: opioid • fentanyl • methamphetamine • cocaine • National Vital Statistics System (NVSS)

Introduction

Between 2003 and 2023, the age-adjusted rate of drug overdose deaths more than tripled, from 8.9 deaths per 100,000 standard population to 31.3, although rates have started to level off and decline (1,2). Studies have generally examined drug overdose trends using mortality data from the National Vital Statistics System (NVSS), which is coded using the *International Classification of Diseases, 10th Revision* (ICD–10) (3–5). ICD–10 is the classification system used in the United States to categorize the underlying and multiple causes of death from death certificates (6). The National Center for Health Statistics (NCHS) codes mortality data from 57 jurisdictions (mostly states) using ICD–10. A limitation of ICD–10 in the analysis of drug overdose mortality is that codes may reflect broad categories of drugs rather than unique or specific drugs. For example, fentanyl, Demerol, tramadol, nitazenes, and Suboxone are each classified to the same ICD–10 code T40.4, "other synthetic narcotics," which is commonly referred to as "synthetic opioids other than methadone" in publications. Also, depending on the drug of interest, ICD–10 drug code categorizations can make it difficult to use ICD–10-coded data to monitor trends in deaths involving specific drugs. One example is deaths involving oxycodone, which are generally coded to T40.2, "other opioids." This category can also contain drugs such as codeine or morphine, making the surveillance or study of the specific drug oxycodone challenging.

To address the limitations of ICD–10 codes, NCHS developed a method that searches the literal text of death certificates to identify specific drugs and other substances involved in the deaths (7). The literal text refers to the written information provided by the medical certifier, usually a medical examiner or coroner in the case of drug overdose deaths, that describes the cause of death as well as other factors or circumstances that contributed to the death (8,9). The NCHS method searches across three literal text fields from the U.S. standard death certificate: the causes of death from Part I, significant conditions contributing to death from Part II, and a description of how the injury occurred (7,8).

A previous study presented findings using literal text analysis to identify the specific drugs most frequently involved in drug overdose deaths from 2011 through 2016 (10). This report provides an update to that report, with results for drug overdose deaths from 2017 through 2023.

Data and Methods

Data source and study population

The study population includes decedents who resided and died in the United States and had an underlying cause of death of drug overdose as identified by the following ICD–10 codes: X40–X44 (unintentional), X60–X64 (suicide), X85 (homicide), and Y10–Y14 (undetermined intent). The underlying cause-of-death codes reflect deaths resulting from acute intoxication from drugs (drug overdose). Deaths from chronic exposure to drugs (such as liver toxicity) or adverse effects experienced from therapeutic or prophylactic dosages of drugs are not included in this analysis. Across the study period, the manner of death was unintentional for 87%–93% of drug overdose deaths, suicide for 4%–7%, undetermined for 3%–5%, and homicide for 0.2%.

Death certificate records (mortality data) from NVSS are held in a live dynamic database and are considered provisional until the data have been processed, reviewed, verified, and released by NCHS as a final data set. The dynamic database continues to receive updates to death certificate data after the final closeout of data years (the final mortality file); therefore, death counts may differ from other published sources.

For this analysis, a file containing literal text and other mortality information for 2017–2023 was retrieved from the database on April 6, 2025.

Measuring the percentage of specific drugs on death certificates

The ICD–10 multiple cause-of-death codes T36.0–T50.8 provide information on the types of drugs or drug classes involved in the death. The percentage of deaths with an underlying cause-of-death code of X40–X44, X60–X64, X85, or Y10–Y14 that have one or more multiple cause-of-death codes in the range T36.0–T50.8 is a measure of the specificity of reporting of drugs or drug classes in drug overdose deaths. This measure can be used to assess changes in reporting across the study period.

Identifying drug mentions and involvement of the drug in the death

Specific drugs are identified when the drug or substance is mentioned in the literal text of the death certificate. The drugs or substances mentioned in literal text fields are assumed to be involved in the death unless contextual information indicates otherwise. The methodology for searching literal text information to characterize drugs involved in deaths is briefly described below, and in detail in previous reports (7,10,11).

The Drugs Mentioned with Involvement (DMI) method involves searching the literal text for mentions of drugs and other substances, as well as terms that provide context about the involvement of the drug in the death (whether the drug contributed to the death). For example, the phrase "METHICILLIN RESISTANT STAPHYLOCOCCUS AUREUS INFECTION" does not suggest drug involvement in mortality, but rather a type of bacterial infection. Similarly, the phrase "NOT DRUG RELATED" clearly indicates that the death did not involve a drug, even though "DRUG" is mentioned in the phrase. The drug or substance mentioned in a literal text field is assumed to be involved in the death unless the contextual information indicates otherwise.

The DMI method was designed to identify mentions of drugs and other substances using various search terms. Search terms can include generic drug names, brand names, common usage or street names, abbreviations, metabolites, misspellings, and other variations. The search term list has been updated to include new and emerging drugs and was applied to the entire period. Therefore, numbers reported here may differ from numbers reported in previous reports due to the inclusion of additional terms.

Each term is mapped to a "principal variant." A principal variant is a label assigned to a drug or drug class. Principal variants are then linked to a "unique ingredient identifier," which describes a substance's molecular structure or descriptive information as generated by the Global Substance Registration System maintained by the U.S. Food and Drug Administration (FDA). The use of principal variants makes it possible to generate aggregate counts for all search terms that refer to the same drug or substance. For example, terms such as "COCAIEN," "COCAINE CRACK," "COCAINE HYDROCHLORIDE," and "COCAINETOXICITY" were all mapped to the principal variant "COCAINE." In general, the principal variant was the generic drug name. For search terms that represent multiple drugs, such as combination drug products, drugs can be mapped to two or more principal variants.

"Referent drug groups" serve as the unit of analysis for reporting drug overdose deaths of specific drugs. A referent drug group is a category made up of one or more principal variants grouped together to reflect a broader drug category. In some cases, the referent drug group and the principal variant are the same, such as for xylazine. In other cases, the referent drug group may include multiple principal variants. For example, the referent drug group "FENTANYL" comprises many principal variants, including fentanyl analogs (for example, "CARFENTANIL"), precursors (for example, "DEPROPIONYLFENTANYL"), and metabolites (for example, "NORFENTANYL"). The grouping of

principal variants into referent groups was based on expertise from FDA and NCHS. The referent groups table, which contains a list of DMI search terms, is provided in a supplemental file (https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Publications/NVSR/75-1/Table.xlsx).

Analysis

Results are reported as numbers, percentages, and age-adjusted rates for the deaths involving the referent drug. Numbers reported for each referent group are not mutually exclusive. Deaths involving more than one referent drug are counted in all relevant drug categories. For example, for a death where both cocaine and heroin are listed on the death certificate, the same death is included in both heroin and cocaine death counts, percentages, and rates.

Age-adjusted death rates are calculated using the direct method and the 2000 standard U.S. population (12). Population estimates used for computing rates for 2017 through 2020 are yearly July 1 postcensal population estimates based on the 2010 decennial census and are available from the U.S. Census Bureau at: https://www.census.gov/programs-surveys/popest/technical-documentation/research/evaluation-estimates/2020-evaluation-estimates/2010s-national-detail.html. Rate calculations for 2021 through 2023 used July 1, 2024, population estimates and are available from the Census Bureau at: https://www.census.gov/data/tables/time-series/demo/popest/2020s-national-detail.html. These population estimates are based on the blended base produced by the Census Bureau instead of the April 1, 2020, decennial population count. The blended base consists of the blend of 2020 postcensal population estimates, based on the April 1, 2010, census; 2020 Demographic Analysis estimates; and 2020 census data from the internal Census Edited File (https://www2.census.gov/programs-surveys/popest/technical-documentation/methodology/2020-2023/methods-statement-v2023.pdf).

Trends in age-adjusted death rates were evaluated using the National Cancer Institute's Joinpoint Regression Program (version 5.0.2) (13). Joinpoint software fitted weighted least-squares regression models to the rates on the log transformation scale. Allowing one observed time point at each end and two for the middle line segments, the grid search algorithm searched for a maximum of two joinpoints at an overall alpha level of 0.05 (14). Any mention of an annual percent change in this report indicates a statistically significant trend. Comparisons of rates between years were tested for statistical significance using methods described elsewhere (12). Counts and percentages based on 1–9 deaths are not presented according to NCHS data confidentiality standards (12). Rates based on fewer than 20 deaths are not shown due to a lack of statistical reliability. Because some drugs are newer, such as bromazolam and xylazine, data for some years are not reported because fewer than 10 deaths occurred. For these cases, trends are tested on the years available when data are available for 3 or more consecutive years.

Other drugs mentioned in addition to the referent drug (concomitant drugs) were also assessed. Only deaths with mentions of at least two specific drugs (the referent drug and at least one concomitant drug) are included in this part of the analysis. Alcohol, nicotine, and other non-drug substances are not included.

The numbers and rates of drug-specific overdose deaths reported here may be undercounts. Data shown in the tables and figures should be considered the minimum number or rate for that referent drug category because additional deaths may have occurred in which the drug was involved, but the drug was not reported in the literal text on the death certificate.

Results

The number of drug overdose deaths increased by 53.8% from 70,715 deaths in 2017 to 108,790 deaths in 2022 and then decreased to 106,352 deaths in 2023 (Table A). The percentage of death records indicating an underlying cause of a drug overdose along with a multiple-cause ICD–10 code increased each year: 87.7% in 2017, 92.0% in 2018, 93.8% in 2019, 94.4% in 2020, 95.2% in 2021, 95.8% in 2022, and 96.0% in 2023. The improvement in reporting of specific drugs and drug classes across the study period could potentially influence the observed trends for specific drugs (Figures 1–4).

Most frequently mentioned drugs

Table A shows the ranking of the top 15 drugs involved in drug overdose deaths that mentioned at least one specific drug each year from 2017 through 2023. The top 15 drugs were identified based on the number of drug overdose deaths per referent drug category. While some drugs were consistently in the top 15, specific rankings changed from year to year, and several new drugs emerged on the list in recent years.

For the top 15 drugs:

- Fentanyl was the top drug involved in drug overdose deaths for each year between 2017 and 2023. The number of deaths increased from 2017 (27,542) through 2022 (73,944) and then declined in 2023 (73,297). Fentanyl was mentioned in an increasing percentage of drug overdose deaths (38.9% in 2017 to 68.9% in 2023).
- Drug overdose deaths involving methamphetamine increased year over year during the period (9,438 in 2017 to 34,167 in 2023). The percentage of drug overdose deaths that involved methamphetamine more than doubled from 13.3% in 2017 to 32.1% to 2023. In 2017, it was the fourth most common drug involved in overdose deaths and by 2023, it was the second most common drug.
- Throughout the study period, cocaine was the second or third ranked drug involved in overdose deaths. Cocaine involvement in drug overdose deaths increased from 21.3% in 2017 to 29.8% in 2023, with deaths doubling from 15,050 to 31,700.
- Drug overdose deaths involving heroin decreased across the period, declining from the second most common drug involved in 2017 (16,085 deaths) to seventh in 2023 (4,071).
- Xylazine first appeared in the top 15 drugs list in 2021 as the 11th most common drug involved in drug overdose

Table A. Top 15 drugs involved in drug overdose deaths: United States, 2017–2023

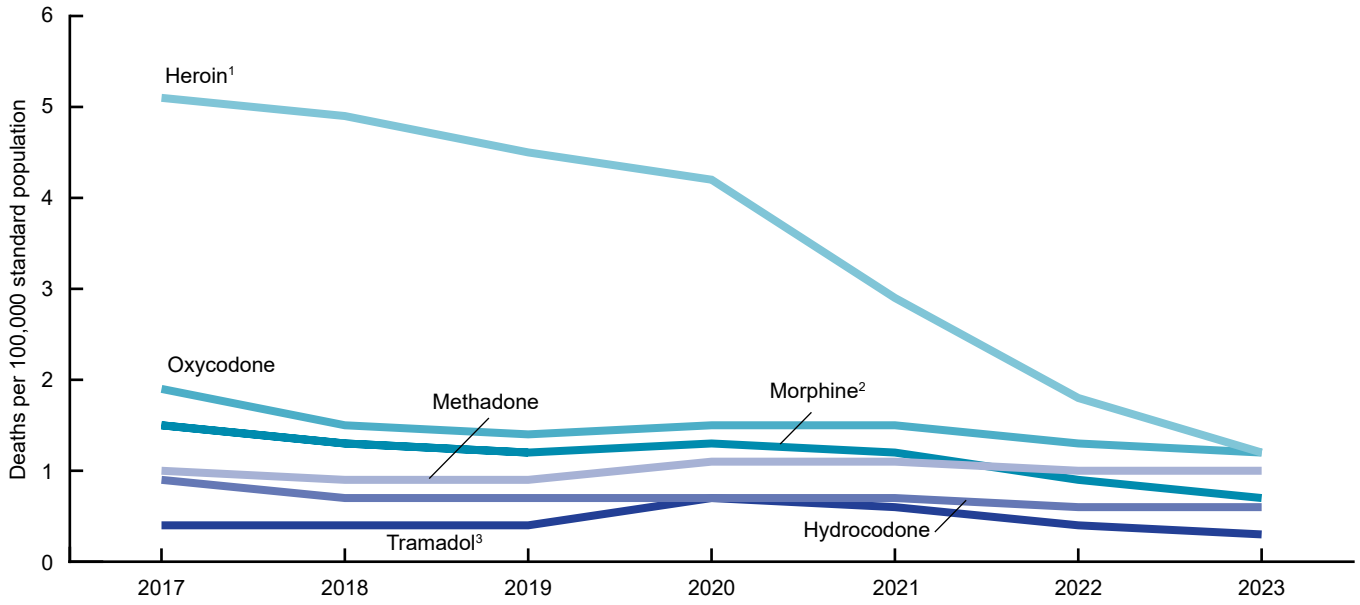
Rank[1]	Referent drug	Number[2]	Percent[3]
	2017 (*n* = 70,715)		
1	Fentanyl	27,542	38.9
2	Heroin	16,085	22.7
3	Cocaine	15,050	21.3
4	Methamphetamine	9,438	13.3
5	Alprazolam	6,699	9.5
6	Oxycodone	6,094	8.6
7	Morphine	4,913	6.9
8	Methadone	3,305	4.7
9	Hydrocodone	3,086	4.4
10	Diphenhydramine	2,304	3.3
11	Diazepam	2,279	3.2
12	Clonazepam	2,083	2.9
13	Gabapentin	1,865	2.6
14	Amphetamine	1,585	2.2
15	Tramadol	1,347	1.9
	2018 (*n* = 67,740)		
1	Fentanyl	30,293	44.7
2	Cocaine	15,694	23.2
3	Heroin	15,494	22.9
4	Methamphetamine	11,790	17.4
5	Alprazolam	6,069	9.0
6	Oxycodone	5,073	7.5
7	Morphine	4,310	6.4
8	Methadone	3,107	4.6
9	Hydrocodone	2,520	3.7
10	Diphenhydramine	2,473	3.7
11	Diazepam	1,988	2.9
12	Clonazepam	1,971	2.9
13	Gabapentin	1,925	2.8
14	Amphetamine	1,821	2.7
15	Tramadol	1,437	2.1
	2019 (*n* = 71,059)		
1	Fentanyl	35,473	49.9
2	Cocaine	16,997	23.9
3	Methamphetamine	15,096	21.2
4	Heroin	14,525	20.4
5	Alprazolam	5,146	7.2
6	Oxycodone	4,630	6.5
7	Morphine	4,042	5.7
8	Methadone	2,831	4.0
9	Gabapentin	2,579	3.6
10	Diphenhydramine	2,330	3.3
11	Hydrocodone	2,284	3.2
12	Amphetamine	2,253	3.2
13	Diazepam	1,813	2.6
14	Clonazepam	1,696	2.4
15	Tramadol	1,301	1.8
	2020 (*n* = 92,491)		
1	Fentanyl	55,821	60.4
2	Methamphetamine	22,559	24.4
3	Cocaine	21,079	22.8
4	Heroin	13,643	14.8
5	Alprazolam	6,687	7.2
6	Oxycodone	5,124	5.5
7	Morphine	4,351	4.7
8	Gabapentin	3,941	4.3
9	Methadone	3,667	4.0
10	Amphetamine	3,266	3.5
11	Diphenhydramine	2,804	3.0
12	Hydrocodone	2,559	2.8
13	Tramadol	2,184	2.4
14	Clonazepam	1,986	2.1
15	Diazepam	1,898	2.1
	2021 (*n* = 107,557)		
1	Fentanyl	70,523	65.6
2	Methamphetamine	31,461	29.3
3	Cocaine	26,418	24.6
4	Heroin	9,504	8.8
5	Alprazolam	6,491	6.0
6	Oxycodone	5,090	4.7
7	Gabapentin	4,318	4.0
8	Amphetamine	4,021	3.7
9	Morphine	4,020	3.7
10	Methadone	3,829	3.6
11	Xylazine	3,501	3.3
12	Diphenhydramine	3,101	2.9
13	Hydrocodone	2,545	2.4
14	Clonazepam	2,081	1.9
15	Diazepam	2,074	1.9
	2022 (*n* = 108,790)		
1	Fentanyl	73,944	68.0
2	Methamphetamine	33,283	30.6
3	Cocaine	29,401	27.0
4	Heroin	5,988	5.5
5	Alprazolam	5,332	4.9
6	Oxycodone	4,510	4.1
7	Xylazine	4,466	4.1
8	Gabapentin	4,348	4.0
9	Amphetamine	3,969	3.6
10	Methadone	3,405	3.1
11	Morphine	2,920	2.7
12	Diphenhydramine	2,844	2.6
13	Hydrocodone	2,217	2.0
14	Clonazepam	2,052	1.9
15	Diazepam	1,852	1.7
	2023 (*n* = 106,352)		
1	Fentanyl	73,297	68.9
2	Methamphetamine	34,167	32.1
3	Cocaine	31,700	29.8
4	Xylazine	6,096	5.7
5	Alprazolam	4,642	4.4
6	Oxycodone	4,142	3.9
7	Heroin	4,071	3.8
8	Gabapentin	4,027	3.8
9	Amphetamine	3,658	3.4
10	Methadone	3,451	3.2
11	Diphenhydramine	2,616	2.5
12	Morphine	2,345	2.2
13	Hydrocodone	2,043	1.9
14	Clonazepam	1,976	1.9
15	Bromazolam	1,734	1.6

[1]Ranks were not tested for statistical significance.
[2]Number of drug overdose deaths involving the referent drug.
[3]Percentage of drug overdose deaths involving the referent drug.

NOTES: Drug overdose deaths are identified using *International Classification of Diseases, 10th Revision* (ICD–10) underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14. Deaths may involve other drugs in addition to the referent drug. Deaths involving more than one drug (such as a death involving both heroin and cocaine) are counted in both totals. Caution should be used when comparing numbers across years. The reporting of at least one specific drug or drug class in the literal text, as identified using ICD–10 multiple cause-of-death codes T36–T50.8, improved from 88% of drug overdose deaths in 2017 to 96% of drug overdose deaths in 2023.

SOURCE: National Center for Health Statistics, National Vital Statistics System, mortality.

Figure 1. Age-adjusted rates for drug overdose deaths involving selected opioids: United States, 2017–2023



[1]Significant decreasing trend from 2017 to 2023, with different rates of change over time, $p < 0.05$.
[2]Significant decreasing trend from 2021 to 2023, $p < 0.05$.
[3]Significant increasing trend from 2017 to 2021, and significant decreasing trend from 2021 to 2023, $p < 0.05$.
NOTES: Drug overdose deaths are identified using *International Classification of Diseases, 10th Revision* underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14. Deaths may involve other drugs in addition to the listed drug. Deaths involving more than one drug (such as a death involving both heroin and cocaine) are counted in both totals. Caution should be used when comparing numbers across years. The reporting of at least one specific drug in the literal text improved from 88% of drug overdose deaths in 2017 to 96% of drug overdose deaths in 2023.
SOURCE: National Center for Health Statistics, National Vital Statistics System, mortality.

deaths and increased through 2023, when it was the fourth most common drug. In 2023, xylazine was involved in 6,096 deaths, or 5.7% of drug overdose deaths.
- Alprazolam was the fifth most common drug involved in drug overdose deaths across the period. In 2023, alprazolam was involved in 4,642 deaths, or 4.4% of drug overdose deaths.
- Drug overdose deaths involving morphine declined during the study period. In 2017, it was involved in 6.9% of drug overdose deaths and was the seventh most common drug. In 2023, it was involved in 2.2% of drug overdose deaths and was the 12th most common drug.
- Drug overdose deaths involving gabapentin more than doubled between 2017 (1,865) and 2023 (4,027). Gabapentin was the 13th most common drug involved in drug overdose deaths in 2017, increasing to the seventh most common in 2021. In 2023, gabapentin was ranked eighth.
- The number of drug overdose deaths involving amphetamine increased from 1,585 in 2017 to 3,658 in 2023.

Age-adjusted rates for drug overdose deaths involving the most frequently mentioned drugs, 2017–2023

Trends from 2017 through 2023 in age-adjusted rates of drug overdose deaths involving the top 15 most frequently mentioned drugs are shown in Figures 1–4. Improvements in reporting should be considered when interpreting these trends. All rates presented below are age adjusted.

Selected opioids

- From 2017 to 2023, the rate of drug overdoses involving heroin decreased from 5.1 deaths per 100,000 standard population to 1.2. From 2017 to 2020, the rate decreased on average by 6% per year, and then from 2020 to 2023 by about 35% per year (Figure 1, Table).
- From 2017 to 2023, the rate for drug overdose deaths involving oxycodone decreased 36.8% from 1.9 to 1.2, although the downward trend was not statistically significant.
- Rates for drug overdose deaths involving morphine did not significantly change between 2017 (1.5) and 2021 (1.2) but then decreased on average by about 26% per year through 2023 (0.7).
- Rates for drug overdose deaths involving methadone or hydrocodone did not significantly change between 2017 and 2023.
- From 2017 to 2021, the rate of drug overdose deaths involving tramadol increased from 0.4 to 0.6 and then decreased to 0.3 in 2023.

Fentanyl and xylazine

- The rate of drug overdose deaths involving fentanyl increased from 8.8 in 2017 to 21.8 in 2021, increasing on average by about 29% each year (Figure 2, Table). The rate increased to 22.7 in 2022 and then decreased to 22.3 in 2023.

- From 2018 to 2023, the rate of drug overdose deaths involving xylazine increased from 0.0 to 1.9, with an average annual percentage increase of about 61%. Xylazine first appeared on death certificates in 2017, although the rate for 2017 is not reported because it did not meet the NCHS reliability standard of being based on 20 or more deaths.

Selected benzodiazepines and anticonvulsants

- From 2017 to 2023, the rate of drug overdose deaths involving alprazolam decreased from 2.1 to 1.4, although the overall trend was not significant (Figure 3, Table).
- The rate of drug overdose deaths involving gabapentin increased between 2017 and 2021, from 0.6 to 1.3, with an average annual percentage increase of about 27%. From 2021 (1.3) to 2023 (1.2), the rate remained stable.
- Rates for drug overdose deaths involving clonazepam or diazepam did not significantly change between 2017 and 2023.
- From 2021 to 2023, the rate of drug overdose deaths involving bromazolam increased from 0.1 to 0.5. Bromazolam first appeared on death certificates in 2020, although the rate for 2020 is not reported because it did not meet the NCHS confidentiality and reliability standards (the death count was fewer than 10).

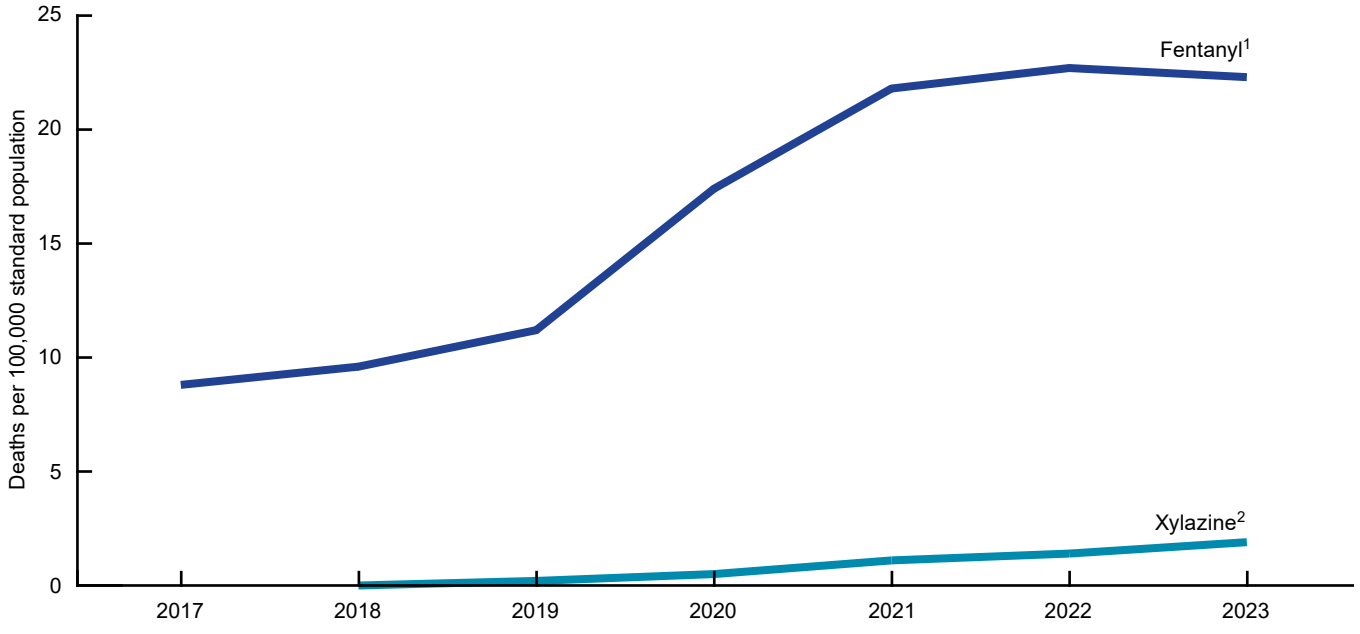
Selected stimulants

- The rate of drug overdose deaths involving methamphetamine increased between 2017 and 2021, from 3.0 to 9.7, with an average annual percentage increase of about 37% per year (Figure 4, Table). From 2021 (9.7) to 2023 (10.4), the rate was stable.
- From 2017 to 2023, the rate of drug overdose deaths involving cocaine increased from 4.7 to 9.3, with an average annual percentage increase of about 14%.
- The rate of drug overdose deaths involving amphetamine increased between 2017 and 2021, from 0.5 to 1.3, with an average annual percentage increase of about 28%. From 2021 to 2023, the rate did not change significantly.

Drug overdose deaths in 2023 involving multiple drugs

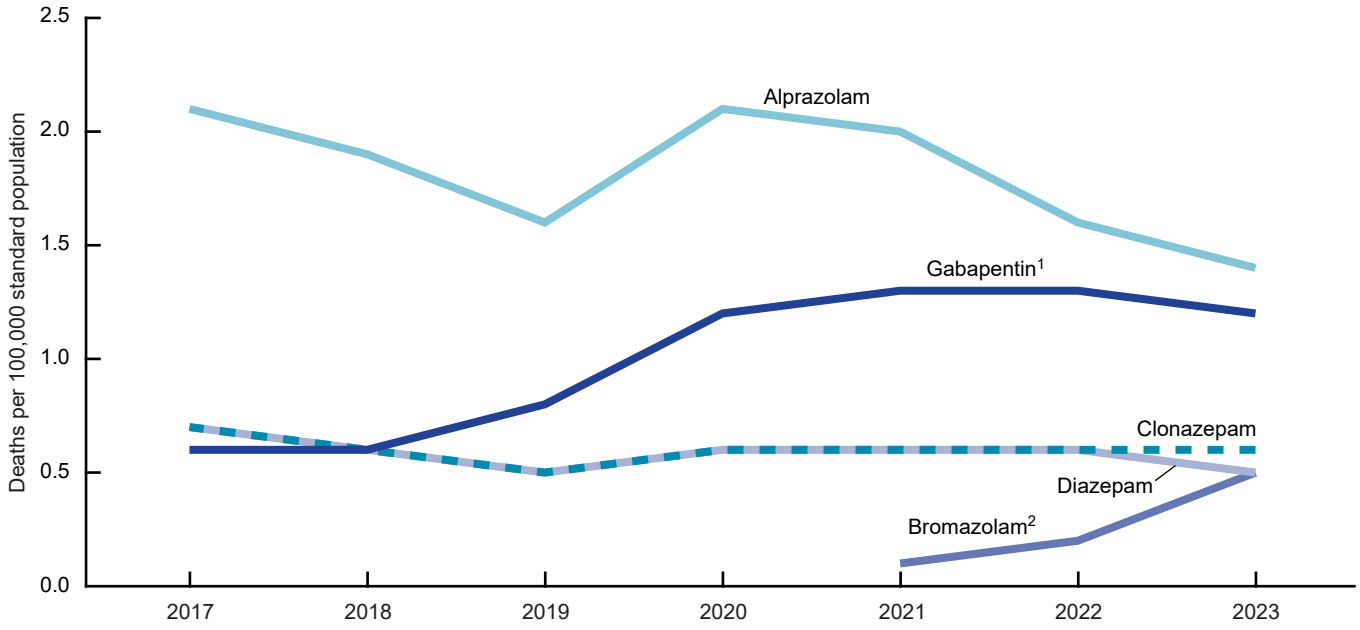
Table B shows the most frequent concomitant drugs mentioned for each of the top 10 drugs involved in drug overdose deaths in 2023. Across all drugs, fentanyl was the most common concomitant drug. Fentanyl co-involvement ranged from 99.0% of overdoses that involved xylazine and 81.9% of overdoses that involved heroin to 57.4% of drug overdoses involving methadone and 48.3% of overdoses involving oxycodone. For most of the top drugs, fentanyl was a concomitant drug in more than one-half of drug-specific drug overdoses. Among overdose deaths involving fentanyl, cocaine was the most frequent concomitant drug, which was seen in 32.9% of death records

Figure 2. Age-adjusted rates for drug overdose deaths involving fentanyl or xylazine: United States, 2017–2023



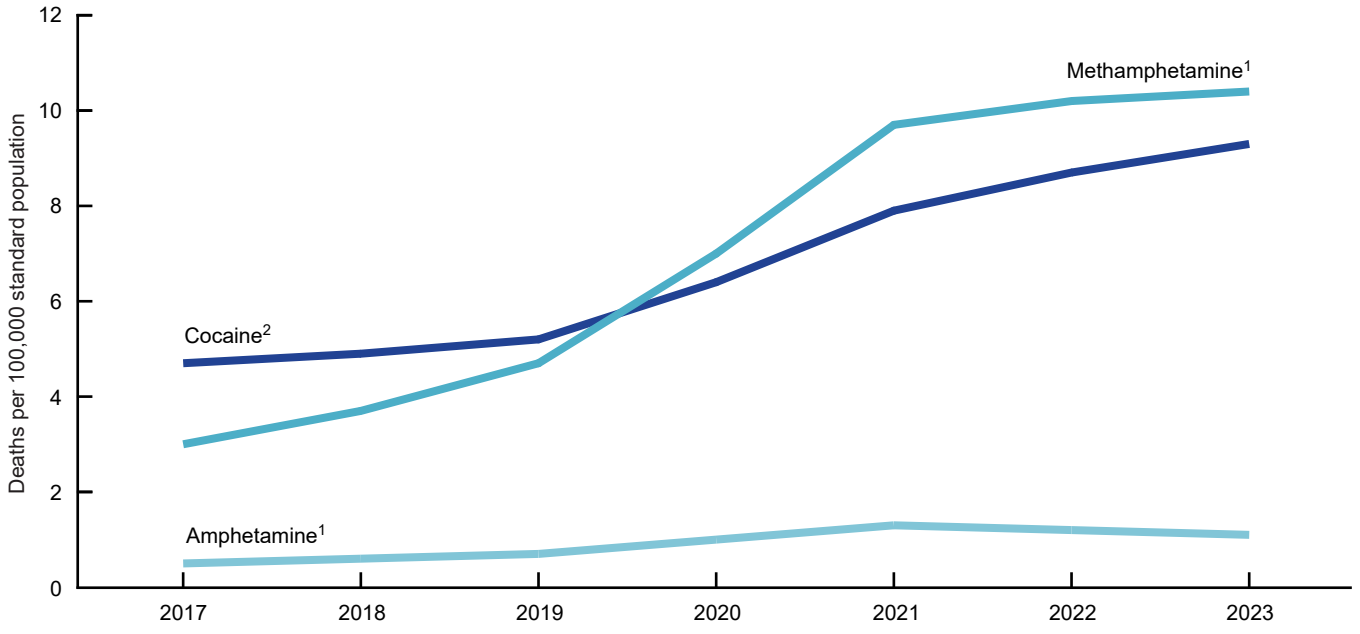
[1]Significant increasing trend from 2017 to 2021, $p < 0.05$. The rate in 2022 was higher than the rate in 2021, and the rate in 2023 was lower than the rate in 2022, $p < 0.05$.
[2]Significant increasing trend from 2018 to 2023. Rate for 2017 does not meet the National Center for Health Statistics reliability standard of being based on 20 or more deaths.
NOTES: Drug overdose deaths are identified using *International Classification of Diseases, 10th Revision* underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14. Deaths may involve other drugs in addition to the listed drug. Deaths involving more than one drug (such as a death involving both heroin and cocaine) are counted in both totals. Caution should be used when comparing numbers across years. The reporting of at least one specific drug in the literal text improved from 88% of drug overdose deaths in 2017 to 96% of drug overdose deaths in 2023.
SOURCE: National Center for Health Statistics, National Vital Statistics System, mortality.

Figure 3. Age-adjusted rates for drug overdose deaths involving selected benzodiazepines and anticonvulsants: United States, 2017–2023



[1]Significant increasing trend from 2017 to 2021, $p < 0.05$.
[2]Significant increasing trend from 2021 to 2023, $p < 0.05$. Rates for 2017–2020 do not meet the National Center for Health Statistics reliability standard of more than 20 deaths.
NOTES: Drug overdose deaths are identified using *International Classification of Diseases, 10th Revision* underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14. Deaths may involve other drugs in addition to the listed drug. Deaths involving more than one drug (such as a death involving both heroin and cocaine) are counted in both totals. Caution should be used when comparing numbers across years. The reporting of at least one specific drug in the literal text improved from 88% of drug overdose deaths in 2017 to 96% of drug overdose deaths in 2023.
SOURCE: National Center for Health Statistics, National Vital Statistics System, mortality.

Figure 4. Age-adjusted rates for drug overdose deaths involving selected stimulants: United States, 2017–2023



[1]Significant increasing trend from 2017 to 2021, $p < 0.05$.
[2]Significant increasing trend from 2021 to 2023, $p < 0.05$.
NOTES: Drug overdose deaths are identified using *International Classification of Diseases, 10th Revision* underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14. Deaths may involve other drugs in addition to the listed drug. Deaths involving more than one drug (such as a death involving both heroin and cocaine) are counted in both totals. Caution should be used when comparing numbers across years. The reporting of at least one specific drug in the literal text improved from 88% of drug overdose deaths in 2017 to 96% of drug overdose deaths in 2023.
SOURCE: National Center for Health Statistics, National Vital Statistics System, mortality.

Table B. Most frequent concomitant drugs for drug overdose deaths involving the top 10 drugs: United States, 2023

Referent drug	Number of drug overdose deaths involving the referent drug	Most frequent concomitant drug: Concomitant drug	Most frequent concomitant drug: Number and percentage[1] of deaths involving both drugs	Second most frequent concomitant drug: Concomitant drug	Second most frequent concomitant drug: Number and percentage[1] of deaths involving both drugs	Third most frequent concomitant drug: Concomitant drug	Third most frequent concomitant drug: Number and percentage[1] of deaths involving both drugs
Opioids							
Fentanyl	73,297	Cocaine	24,084 (32.9)	Methamphetamine	22,705 (31.0)	Xylazine	6,033 (8.2)
Heroin	4,071	Fentanyl	3,335 (81.9)	Cocaine	1,351 (33.2)	Methamphetamine	1,021 (25.1)
Methadone	3,451	Fentanyl	1,980 (57.4)	Cocaine	871 (25.2)	Methamphetamine	631 (18.3)
Oxycodone	4,142	Fentanyl	2,002 (48.3)	Alprazolam	791 (19.1)	Cocaine	712 (17.2)
Stimulants							
Amphetamine	3,658	Fentanyl	2,507 (68.5)	Methamphetamine	2,210 (60.4)	Cocaine	739 (20.2)
Cocaine	31,700	Fentanyl	24,084 (76.0)	Methamphetamine	4,478 (14.1)	Xylazine	2,528 (8.0)
Methamphetamine	34,167	Fentanyl	22,705 (66.5)	Cocaine	4,478 (13.1)	Amphetamine	2,210 (6.5)
Other drugs							
Alprazolam	4,642	Fentanyl	3,175 (68.4)	Cocaine	1,069 (23.0)	Methamphetamine	902 (19.4)
Gabapentin	4,027	Fentanyl	2,390 (59.3)	Methamphetamine	903 (22.4)	Cocaine	832 (20.7)
Xylazine	6,096	Fentanyl	6,033 (99.0)	Cocaine	2,528 (41.5)	Methamphetamine	1,318 (21.6)

[1]Percentage of drug overdose deaths involving the referent drug that also involved the concomitant drug. Deaths may involve more than one concomitant drug in addition to the referent drug.

NOTES: Drug overdose deaths are identified using *International Classification of Diseases, 10th Revision* underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14. Only deaths with at least one specific drug identified are included in the analysis.

SOURCE: National Center for Health Statistics, National Vital Statistics System, mortality.

that identified fentanyl. Methamphetamine was the second most frequent concomitant drug occurring with fentanyl-involved drug overdoses (31.0%), followed by xylazine (8.2%), which was the third most frequent concomitant drug occurring with fentanyl-involved drug overdoses.

Methamphetamine, which was involved in the second greatest number of overall drug deaths, was the second or third most frequent concomitant drug among the other top drugs. It was the second most frequent concomitant drug for drug overdoses involving amphetamine (60.4%), fentanyl (31.0%), gabapentin (22.4%), and cocaine (14.1%). It was the third most frequent concomitant drug for heroin (25.1%), xylazine (21.6%), alprazolam (19.4%), and methadone (18.3%).

Cocaine, which was involved in the third greatest number of overall drug deaths, was also the second or third most frequent concomitant drug among the other top drugs. It was the second most frequent concomitant drug for drug overdoses involving xylazine (41.5%), heroin (33.2%), methadone (25.2%), alprazolam (23.0%), and methamphetamine (13.1%). It was the third most frequent concomitant drug for drug overdoses involving gabapentin (20.7%), amphetamine (20.2%), and oxycodone (17.2%).

Most frequently mentioned drugs involved in drug overdose deaths in 2023, by intent of death

Table C shows the top 10 drugs involved in drug overdose deaths in 2023 by intent of death, for deaths where one or more specific drugs were identified. Results are shown for unintentional drug overdose deaths (ICD–10 underlying-cause codes X40–X44), suicides involving drug overdose (ICD–10 underlying-cause codes X60–X64), and drug overdose deaths for which the intent was undetermined (ICD–10 underlying-cause codes Y10–Y14). The results for the 218 deaths with an intent of homicide (ICD–10 underlying-cause code X85) are not shown due to small numbers.

In 2023, unintentional drug overdose deaths most frequently mentioned fentanyl (71.9% of unintentional drug overdose deaths), methamphetamine (33.9%), and cocaine (31.0%). Suicides by drug overdose most frequently mentioned diphenhydramine (14.7% of suicide-related drug overdose deaths), oxycodone (10.3%), bupropion (9.8%), fentanyl (9.7%), and acetaminophen (8.0%). Undetermined drug overdose deaths most frequently mentioned fentanyl (63.2% of undetermined intent drug overdose deaths), cocaine (32.5%), and methamphetamine (13.9%). Fentanyl, methamphetamine, alprazolam, gabapentin, and oxycodone ranked in the top 10 for drugs for all three drug overdose intent categories. Heroin was listed in the top 10 drugs for unintentional drug overdose deaths (ranked sixth), but not suicide or undetermined intent deaths. Bupropion, acetaminophen, quetiapine, and hydrocodone were only listed in the top 10 drugs for suicide-related drug overdose deaths.

Discussion

Findings for specific drugs

From 2017 to 2023, the number of drug overdose deaths increased by 50.4%. The most frequently mentioned drugs involved in these deaths were fentanyl, cocaine, and methamphetamine.

Table C. Top 10 drugs involved in drug overdose deaths, by intent of death: United States, 2023

	Unintentional (*n* = 98,497)			Suicide (*n* = 4,711)			Undetermined (*n* = 2,926)		
Rank[1]	Referent drug	Number of deaths[2]	Percent of deaths[3]	Referent drug	Number of deaths[2]	Percent of deaths[3]	Referent drug	Number of deaths[2]	Percent of deaths[3]
1	Fentanyl	70,848	71.9	Diphenhydramine	693	14.7	Fentanyl	1,849	63.2
2	Methamphetamine	33,411	33.9	Oxycodone	485	10.3	Cocaine	952	32.5
3	Cocaine	30,562	31.0	Bupropion	462	9.8	Methamphetamine	406	13.9
4	Xylazine	5,874	6.0	Fentanyl	458	9.7	Xylazine	167	5.7
5	Alprazolam	4,203	4.3	Acetaminophen	379	8.0	Methadone	164	5.6
6	Heroin	3,993	4.1	Alprazolam	352	7.5	Oxycodone	136	4.6
7	Gabapentin	3,553	3.6	Gabapentin	350	7.4	Gabapentin	124	4.2
8	Oxycodone	3,518	3.6	Quetiapine	328	7.0	Diphenhydramine	112	3.8
9	Amphetamine	3,474	3.5	Hydrocodone	315	6.7	Alprazolam	87	3.0
10	Methadone	3,223	3.3	Methamphetamine	288	6.1	Morphine	82	2.8

[1]Ranks were not tested for statistical significance.
[2]Number of drug overdose deaths involving the referent drug.
[3]Percentage of drug overdose deaths involving the referent drug.

NOTES: Drug overdose deaths are identified using *International Classification of Diseases, 10th Revision* underlying cause-of-death codes X40–X44 (unintentional), X60–X64 (suicide), and Y10–Y14 (undetermined). Only deaths with at least one specific drug identified are included in the analysis. The results for 218 deaths with an intent of homicide (X85) are not shown due to small numbers. Deaths may involve other drugs in addition to the referent drug (the one listed). Deaths involving more than one drug (for example, a death involving both heroin and cocaine) are counted in both totals.

SOURCE: National Center for Health Statistics, National Vital Statistics System, mortality.

Among drug overdose deaths that mentioned at least one specific drug, fentanyl was ranked first each year from 2017 to 2023. Heroin, which ranked second in 2017, fell to third in 2018, and then to fourth for 2019–2022 and seventh in 2023. Cocaine, ranked third in 2017, increased to second place in 2018 and 2019, and then returned to being ranked third from 2020 to 2023. Methamphetamine was ranked fourth for 2017 and 2018, shifting into third for 2019, and then was ranked second each year from 2020 to 2023.

Trends for age-adjusted death rates varied among the most frequently mentioned drugs. Some drugs had steep increases between 2017 and 2023, including xylazine, bromazolam, cocaine, and methamphetamine. For other drugs, the picture was more complex. The rate for fentanyl almost tripled between 2017 and 2021, but the rate of increase slowed from 2021 to 2022 and then decreased from 2022 to 2023 (although not statistically significant). The following drugs had little to no decreases: oxycodone, hydrocodone, methadone, clonazepam, and diazepam. Heroin experienced one of the largest rate decreases over the period, with declines seen in every year. The death rate for drug overdoses involving morphine also declined, but only significantly between 2021 and 2023.

The top 10 most frequently mentioned drugs involved in overdose deaths were often found in combination with one another. The most frequent concomitant drug across all referent groups was fentanyl. Fentanyl was co-involved in less than one-half of the oxycodone-involved overdose deaths (2,002 deaths) and nearly all xylazine-involved overdose deaths (6,033 deaths). Following fentanyl, methamphetamine and cocaine were the next most reported concomitant drugs.

The drugs most frequently mentioned in the literal text varied by the intent of the drug overdose death. In 2023, unintentional deaths most often involved fentanyl, methamphetamine, or cocaine, with each drug implicated in more than 30% of those deaths. The most common drugs involved in suicide-related deaths were diphenhydramine, oxycodone, and bupropion. The most frequently reported drugs for undetermined intent deaths more similarly matched the patterns for unintentional deaths, with fentanyl, cocaine, and methamphetamine being the top three drugs. Notably, overdoses involving suicide decreased slightly overall from 5,086 deaths in 2016 to 4,711 in 2023 (10), despite overall increases in the suicide rate during that time (10,15). Decreases in overdose-related suicides come from declines in deaths indicating opioid class drug involvement. This includes oxycodone, which decreased from 648 (12.7%) to 485 (10.3%); hydrocodone, which decreased from 472 (9.3%) to 315 (6.7%);and morphine, which dropped from the top 10 drug list by 2023.

Data considerations and study limitations

This report used the literal text on death certificates to identify drugs most involved in overdose deaths (7). Software programs search the literal text for mentions of drugs and for terms that provide context about the involvement of the drug in each death. As shown in Table B, drug overdose deaths frequently involve multiple drugs. For deaths in which multiple drugs are involved, it cannot be determined from the literal text analysis whether the death was caused by just one of the drugs or by a combination of some, or all, of the drugs present. This limitation in identifying the specific contribution of any given drug to the death should be considered when reviewing the findings in this report.

Reporting of deaths with at least one specific drug in the death certificate literal text has improved over time, from 87.7% of drug overdose deaths in 2017 to 96.0% in 2023. While improved reporting enhances the quality of the data, it can add complexity in interpreting the reported trends and rankings. The findings in this report should be considered in light of the improvements in reporting. For example, some of the observed increases for the top 15 drugs may be attributable, in part, to improvements in reporting. However, it is unlikely that the large increases observed for some drugs would be solely explained

by improvements in reporting. Decreases in deaths for specific drugs over time are likely true decreases, although improvements in reporting specific drugs could obscure these declines as specific drugs are increasingly specified on the death certificate.

Methods based on literal text analysis are dependent on the quality and completeness of the literal text, which may vary from jurisdiction to jurisdiction due to the variation in death investigation and reporting practices or other differences in medicolegal death investigation systems across the United States (16–19). These issues have been discussed elsewhere, and are summarized below (7,20,21).

- *Variation in death investigations and reporting*—This includes whether toxicological laboratory testing is performed to determine the type(s) of drugs present. The substances tested for and the circumstances under which the tests are performed may vary by jurisdiction, decedent, and over time.
- *Interpretation of toxicology results*—Interpretation of findings depends on which tests are ordered, the characteristics of the causative agent(s), the characteristics of the metabolites, and other evidence gathered during the investigation.
- *Attribution to a specific drug*—Some drugs have the same metabolites or are metabolites of other drugs, potentially resulting in misattribution of a drug involved in the death. For example, mentions of morphine could potentially refer to the involvement of heroin, as morphine is a metabolite of heroin. This could underestimate the number of deaths involving heroin and overestimate the number involving morphine.
- *Determination of which drugs to report on the death certificate*—Some medical certifiers focus on a single lethal drug rather than listing multiple drugs involved in the death, while others list multiple drugs because they believe the drugs to be of equal lethality or that the interaction of all drugs mentioned is important. Some certifiers have noted that space limitations in the software programs they use to complete electronic death registration limit their ability to include all drugs that contributed to the death.

These and other factors may contribute to variation in the completeness and accuracy of the information on the death certificate about the specific drugs involved in the death. The literal text analysis depends on the quality of the information available. Therefore, the results presented in this report should be considered the minimum number or rate for each specific drug, because additional deaths involving the drug may not be reflected in the literal text.

Finally, it is possible that drugs rarely mentioned in drug overdose deaths were not included in the search term list used in this study, despite multiple efforts to develop a comprehensive list of search terms (7). This may also lead to underestimation of deaths involving specific drugs.

Conclusions

Literal text analysis is essential for extracting key information from death certificates to monitor specific substances involved in drug overdose deaths. This report covers the period from 2017 to 2023 and updates a previous report by detailing the drugs most frequently mentioned in drug overdose deaths (10). Specific drugs most frequently mentioned included the opioids fentanyl, oxycodone, heroin, and methadone; the stimulants amphetamine, cocaine, and methamphetamine; and other drugs such as alprazolam, gabapentin, and xylazine. In recent years, new drugs such as bromazolam and xylazine have entered the top 15, while others like diazepam and tramadol have dropped out. During the 2017–2023 period, trends varied, but notably the rate for deaths involving heroin declined, while the rate for fentanyl began to stabilize in 2022 and 2023 following a period of increasing rates.

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Table. Age-adjusted rates for drug overdose deaths involving selected drugs: United States, 2017–2023

Drug	2017		2018		2019		2020		2021		2022		2023	
	Deaths	Rate	Deaths	Rate	Deaths	Rate	Deaths	Rate	Deaths	Rate	Deaths	Rate	Deaths	Rate
Selected opioids														
Heroin[1]	16,085	5.1	15,494	4.9	14,525	4.5	13,643	4.2	9,504	2.9	5,988	1.8	4,071	1.2
Oxycodone	6,094	1.9	5,073	1.5	4,630	1.4	5,124	1.5	5,090	1.5	4,510	1.3	4,142	1.2
Morphine[2]	4,913	1.5	4,310	1.3	4,042	1.2	4,351	1.3	4,020	1.2	2,920	0.9	2,345	0.7
Methadone	3,305	1.0	3,107	0.9	2,831	0.9	3,667	1.1	3,829	1.1	3,405	1.0	3,451	1.0
Hydrocodone	3,086	0.9	2,520	0.7	2,284	0.7	2,559	0.7	2,545	0.7	2,217	0.6	2,043	0.6
Tramadol[3]	1,347	0.4	1,437	0.4	1,301	0.4	2,184	0.7	2,070	0.6	1,470	0.4	1,140	0.3
Fentanyl or xylazine														
Fentanyl[4]	27,542	8.8	30,293	9.6	35,473	11.2	55,821	17.4	70,523	21.8	73,944	22.7	73,297	22.3
Xylazine[5]	12	*	102	0.0	627	0.2	1,499	0.5	3,501	1.1	4,466	1.4	6,096	1.9
Selected benzodiazepines and anticonvulsants														
Alprazolam	6,699	2.1	6,069	1.9	5,146	1.6	6,687	2.1	6,491	2.0	5,332	1.6	4,642	1.4
Gabapentin[6]	1,865	0.6	1,925	0.6	2,579	0.8	3,941	1.2	4,318	1.3	4,348	1.3	4,027	1.2
Clonazepam	2,083	0.7	1,971	0.6	1,696	0.5	1,986	0.6	2,081	0.6	2,052	0.6	1,976	0.6
Diazepam	2,279	0.7	1,988	0.6	1,813	0.5	1,898	0.6	2,074	0.6	1,852	0.6	1,688	0.5
Bromazolam[7]	---	---	---	---	---	---	†	*	151	0.1	575	0.2	1,734	0.5
Selected stimulants														
Amphetamine[6]	1,585	0.5	1,821	0.6	2,253	0.7	3,266	1.0	4,021	1.3	3,969	1.2	3,658	1.1
Cocaine[8]	15,050	4.7	15,694	4.9	16,997	5.2	21,079	6.4	26,418	7.9	29,401	8.7	31,700	9.3
Methamphetamine[6]	9,438	3.0	11,790	3.7	15,096	4.7	22,559	7.0	31,461	9.7	33,283	10.2	34,167	10.4

* Estimate does not meet National Center for Health Statistics standards of reliability; based on fewer than 20 deaths.
--- Data not available.
† Number based on fewer than 10 deaths and not shown to protect confidentiality.
[1]Significant decreasing trend from 2017 to 2023, with different rates of change over time, $p < 0.05$.
[2]Significant decreasing trend from 2021 to 2023, $p < 0.05$.
[3]Significant increasing trend from 2017 to 2021, and significant decreasing trend from 2021 to 2023, $p < 0.05$.
[4]Significant increasing trend from 2017 to 2021, $p < 0.05$. The rate in 2022 was higher than the rate in 2021, and the rate in 2023 was lower than the rate in 2022, $p < 0.05$.
[5]Significant increasing trend from 2018 to 2023.
[6]Significant increasing trend from 2017 to 2021, $p < 0.05$.
[7]Significant increasing trend from 2021 to 2023, $p < 0.05$.
[8]Significant increasing trend from 2017 to 2023, $p < 0.05$.

NOTES: Drug overdose deaths are identified using *International Classification of Diseases, 10th Revision* underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14. Deaths may involve other drugs in addition to the listed drug. Deaths involving more than one drug (such as a death involving both heroin and cocaine) are counted in both totals. Caution should be used when comparing numbers across years. The reporting of at least one specific drug in the literal text improved from 88% of drug overdose deaths in 2017 to 96% of drug overdose deaths in 2023.

SOURCE: National Center for Health Statistics, National Vital Statistics System, mortality.

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