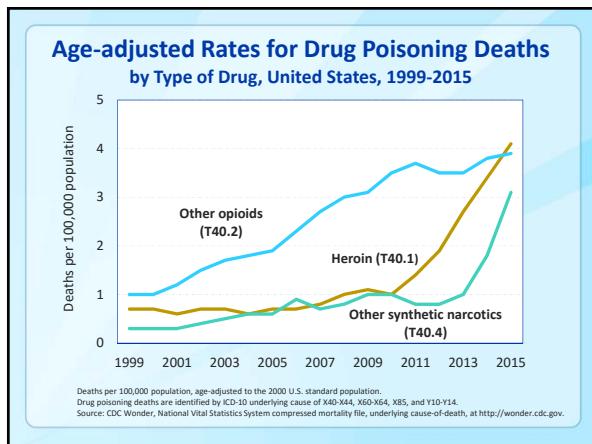


Using Literal Text from Death Certificates to Identify the Drugs Involved in Drug Overdose Deaths

Recent Reports from the National Center for Health Statistics



- Few codes for individual drugs (e.g., *T40.1 Heroin, T40.3 Methadone, T40.5 Cocaine*)
- Most codes are for broad categories of drugs (e.g., *T40.2 Other opioids, T40.4 Other synthetic narcotics*)
- Therefore, difficult to use ICD-10 coded data to monitor trends in deaths involving specific drugs not uniquely classified in ICD-10

Development of Methods for Literal Text Analysis for Drug-involved Deaths

U.S. Standard Death Certificate

Demographic
Completed by the funeral director using information from the *best qualified person* – in order of preference: spouse, parent, child, another relative, or other person who has knowledge of the facts

Medical
Completed by physician, nurse practitioner, physician's assistant for natural causes

Demographic
Completed by medical examiner, coroner, justice of the peace for sudden and unexplained deaths

Death Certificate Fields with Literal Text Information

CAUSE OF DEATH (See instructions and examples)

32. PART I Enter the **principal** (most serious) **injury** or **complication** that directly caused the death. DO NOT enter **underlying** causes. Enter only one cause on a line. Add additional lines if necessary.

Abbreviate. Enter only one cause on a line. Add additional lines if necessary.

IMMEDIATE CAUSE (principal cause of death in Part I) **Part 1, Lines 1-4: Cause of Death**

33. PART II Enter other significant conditions in death that resulted in the underlying cause. 33. WAS AN AUTOPSY PERFORMED given in Part I.

34. DID TOBACCO USE CONTRIBUTE TO DEATH? **Part 2: Other Significant Conditions**

35. DATE OF INJURY (date incident began) **How the Injury Occurred**

36. PLACE OF INJURY (eg. Doctor's home, institution, site, restaurant, Woods etc.) **37. INJURY AT WORK? Yes No**

38. LOCATION OF INJURY: **39. TIME OF INJURY:** **40. PLACE OF INJURY (eg. Doctor's home, institution, site, restaurant, Woods etc.)** **41. INJURY AT WORK? Yes No**

42. DESCRIBE HOW INJURY OCCURRED **43. INJURY SPECIFIC**

44. OTHER (check all that apply)

Considerations in Developing the Methods for Literal Text Analysis

- Availability of literal text information
- Structure of the literal text
 - Syntax
 - Relationship among the four text fields in Part 1
 - Case, symbols and numbers (special characters)
- Drug information
 - Specificity, synonyms, misspellings
- Contextual information

Availability of Literal Text Information

The literal text was considered uninformative if:

- there was no text in any of the three literal text fields
- the fields only contained descriptive words or phrases about the status of the investigation (e.g., mentions of "PENDING" or "UNDER INVESTIGATION")

Deaths with no informative literal text on cause of death, 2013

	Number of deaths	Percent of deaths
All deaths	2,596,993	100.00%
Deaths with no informative literal text	3,831	0.15%

Syntax, Order and Special Characters

- Syntax of literal text
 - Generally a few words or simple phrases rather than complete clauses or sentences
- Four text fields in Part 1 of the death certificate
 - The concept of "As a consequence of ..." was ignored
 - Concatenated into a single text field
- Case, symbols and numbers (special characters)
 - Convert to upper case; remove symbols and numbers

Development of the Drug Search Term List

- List of single word generic names
 - Substance Abuse and Mental Health Services Administration (SAMHSA) Drug Abuse Warning Network (DAWN) Drug Reference Vocabulary (DRV) 2012 (based on Multum Lexicon database)
 - DRUGS@FDA website for brand name drugs
 - FDA Adverse Event Reporting System data for misspellings
 - Non-systematic manual reviews and queries of the literal text
- Currently, the search term list includes >3,000 search terms representing >1,600 principal variants

Specificity of Drug Information

- Literal text on the death certificate may mention:
 - Specific drugs (e.g., "OXYCODONE" or "FENTANYL")
 - Drug classes (e.g., "OPIOID")
 - Exposures not otherwise specified (NOS) (e.g., "DRUG", "CHEMICAL", and "POLYPHARMACY")
- A combination of specific drugs, drug classes, and exposures NOS
 - e.g., "OPIOID (HEROIN) OVERDOSE"

Development of the Drug Search Term List: Categorization

- Search terms were categorized by various characteristics
 - Specific drug, a drug class, or an exposures NOS
 - Generic drug name, brand name, common use or street name, abbreviation, metabolite, or misspelling
- Search terms were mapped to a single “principal variant”
 - In general, the generic drug name
 - Some mapped to two or more principal variants (for combination drug products)

Development of the Drug Search Term List: Exclusions

- Foods and food additives (e.g., starch)
- Excipients
- Gases (e.g., helium, carbon monoxide)
- Airborne contaminants (e.g., soot)
- Industrial chemicals (e.g., ethylene glycol)
- Periodic table elements (e.g., lithium, iodine)
- Substances with unknown industrial or pharmaceutical application

Contextual Information

- Mention of a drug does not necessarily mean the drug was involved in the death
- Need contextual information to determine drug involvement
- Three lists developed using iterative manual reviews and queries of literal text of data from 2003-2014
 - Descriptors
 - Joining phrases
 - Contextual phrases

Contextual Information

- Contextual phrases that suggested no drug involvement generally referred to health conditions or disease states
 - “INSULIN DEPENDENT DIABETES”
 - “METHICILLIN RESISTANT STAPHYLOCOCCUS AUREUS INFECTION”
 - “NO DRUG INVOLVED”
- Drugs mentioned in the literal text were assumed to be involved in the death unless contextual information suggested otherwise
- Currently, the search term list includes >500 descriptors, 22 joining phrases, and >1,600 contextual phrases

Identifying Mentions of Drugs and Ascribing Context

SAS Version 9.3 programs to:

- Remove symbols, numbers, and double-spaces, and convert all characters to uppercase
- Identify drug mentions
- Map descriptors to the drug mentions
- Replace (consecutive) drug mentions and associated descriptors with a single asterisk (for efficiency in data processing)
- Map contextual phrases to the appropriate drug mention(s)

Example of Data Processing

```

"ingested illicit and rx drugs (heroin and methadone); hx of opioid abuse"
  Standardize characters
  ↓
  INGESTED ILLICIT AND RX DRUGS HEROIN AND METHADONE HX OF OPIOID
  ABUSE
  Identify drug mentions
  ↓
  INGESTED ILLICIT AND RX DRUGS HEROIN AND METHADONE HX OF OPIOID
  ABUSE
  Identify descriptors
  ↓
  INGESTED ILLICIT AND RX DRUGS HEROIN AND METHADONE HX OF OPIOID
  ABUSE
  Replace drug mentions/descriptors with "*"
  ↓
  INGESTED * HX OF * ABUSE
  Identify contextual phrases
  ↓
  INGESTED * HX OF * ABUSE
  
```

Results from Applying the Method to Death Certificate Literal Text from 2013

	Number of Deaths	Number of Mentions
Deaths among U.S. residents	2,596,993	Not applicable
Deaths with at least one drug, alcohol, tobacco, or nicotine mention	114,621	216,361
Deaths with at least one drug mention ¹	72,519	158,104
Deaths with at least one drug mention ¹ and context indicating drug involvement in the death	65,062	150,343

¹ Mentions of alcohol, tobacco, and nicotine were excluded; drug mentions only
SOURCE: NCHS, National Vital Statistics System, Mortality files linked with literal text data

Results from Applying the Method to Death Certificate Literal Text from 2013

	Number and Percent of Deaths
All drug involved deaths	65,062 100%
Deaths with mention of at least one specific drug	45,035 69.2%
Deaths with mention of a drug class only	4,560 7.0%
Deaths without mention of a drug class or a specific drug ¹	15,467 23.8%

¹ Category includes non-specific references to drugs (e.g., mention of "POLYPHARMACY" or "DRUG")
SOURCE: NCHS, National Vital Statistics System, Mortality files linked with literal text data

Top 10 Drugs Involved in Drug Overdose Deaths, 2010-2014

- **Opioids**
 - Heroin
 - Oxycodone
 - Methadone
 - Morphine
 - Hydrocodone
 - Fentanyl
- **Benzodiazepines**
 - Alprazolam
 - Diazepam
- **Stimulants**
 - Cocaine
 - Methamphetamine

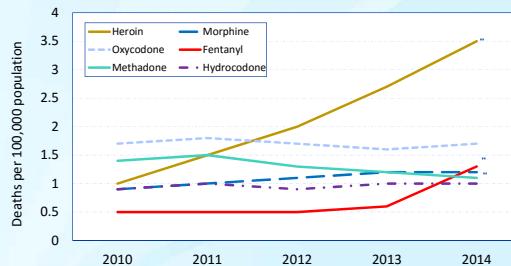
SOURCE: NCHS, National Vital Statistics System, Mortality files linked with literal text data

Top 10 Drugs Involved in Drug Overdose Deaths*, United States, 2010-2014

Rank	2010	2011	2012	2013	2014
1	Oxycodone	Oxycodone	Heroin	Heroin	Heroin
2	Methadone	Cocaine	Oxycodone	Cocaine	Cocaine
3	Cocaine	Heroin	Cocaine	Oxycodone	Oxycodone
4	Alprazolam	Methadone	Methadone	Morphine	Alprazolam
5	Heroin	Alprazolam	Alprazolam	Alprazolam	Fentanyl
6	Morphine	Morphine	Morphine	Methadone	Morphine
7	Hydrocodone	Hydrocodone	Hydrocodone	Methamphet.	Methamphet.
8	Fentanyl	Methamphet.	Methamphet.	Hydrocodone	Methadone
9	Diazepam	Diazepam	Fentanyl	Fentanyl	Hydrocodone
10	Methamphet.	Fentanyl	Diazepam	Diazepam	Diazepam

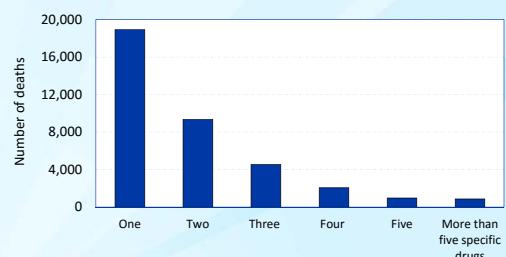
*Drug overdose deaths were identified using ICD-10 underlying cause of death codes of X40-X44, X60-X64, X85 or Y10-Y14.
SOURCE: CDC/NCHS, National Vital Statistics System, Mortality files linked with death certificate literal text

Age-adjusted rates for drug overdose deaths* involving selected opioids, US, 2010-2014

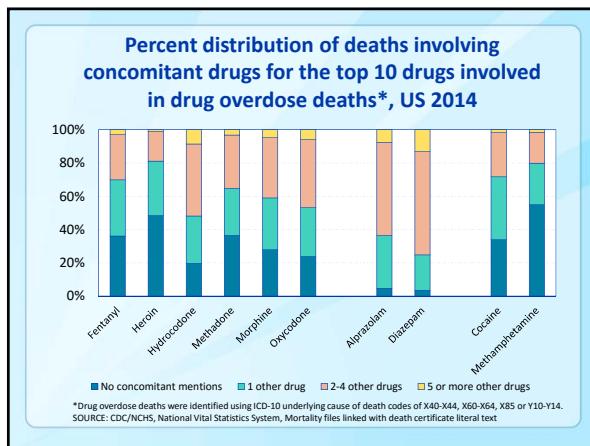


*Drug overdose deaths were identified using ICD-10 underlying cause of death codes of X40-X44, X60-X64, X85 or Y10-Y14.
† Increasing or decreasing trend is statistically significant
SOURCE: CDC/NCHS, National Vital Statistics System, Mortality files linked with death certificate literal text

Number of drug overdose deaths*, by number of specific drugs involved, US, 2014



*Drug overdose deaths were identified using ICD-10 underlying cause of death codes of X40-X44, X60-X64, X85 or Y10-Y14.
SOURCE: CDC/NCHS, National Vital Statistics System, Mortality files linked with death certificate literal text



Most frequent concomitant drugs for drug overdose deaths* involving selected drugs, US, 2014

Referent Drug	Most frequent concomitant drug	2 nd most frequent concomitant drug	3 rd most frequent concomitant drug	4 th most frequent concomitant drug	5 th most frequent concomitant drug
Fentanyl n=4,200	Heroin 23%	Cocaine 15%	Oxycodone 10%	Alprazolam 10%	Morphine 9%
Heroin n=10,863	Cocaine 20%	Fentanyl 9%	Alprazolam 8%	Methamphet. 7%	Morphine 5%
Oxycodone n=5,417	Alprazolam 23%	Morphine 11%	Diazepam 10%	Hydrocodone 10%	Heroin 8%
Cocaine n=5,856	Heroin 37%	Fentanyl 10%	Morphine 8%	Alprazolam 8%	Oxycodone 7%
Methamphet- amine n=3,728	Heroin 20%	Morphine 8%	Cocaine 6%	Amphetamine 5%	Alprazolam 4%

*Drug overdose deaths were identified using ICD-10 underlying cause of death codes of X40-X44, X50-X64, X85 or Y10-Y14.
SOURCE: CDC/NCHS, National Vital Statistics System, Mortality files linked with death certificate literal text

Continuing Work

- Public use files in the NCHS Research Data Center
- Collaboration with medical examiners/coroners/certifiers to improve the quality of information on cause of death
 - Encourage the reporting of the specific drugs involved on the death certificate
- Update the drug search term lists and contextual phrases
 - SAS Contextual Analysis software
- Modification of the SAS programs for use by state vital registrars and injury epidemiologists

Questions?

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