



Text Analysis of Death Certificate Records to Ascertain Drugs Involved in Deaths in the National Vital Statistics System

Merianne Rose Spencer¹, Brigham A. Bastian², and Margaret Warner²

Division of Analysis and Epidemiology¹, Division of Vital Statistics²

National Center for Health Statistics

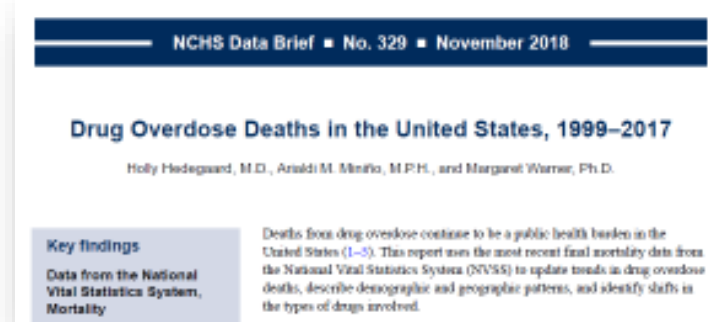
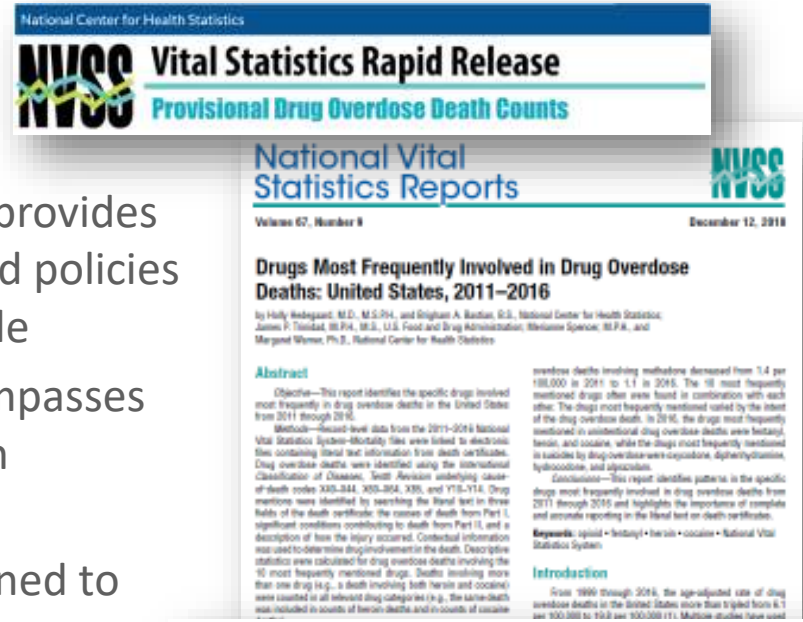
Government Advances in Statistical Programming (GASP) Workshop

Monday, September 23, 2019

Introduction: NCHS and NVSS

- National Center for Health Statistics (NCHS) provides statistical information that guides actions and policies to improve the health of the American people
- National Vital Statistics System (NVSS) encompasses the processing and coding of birth and death certificate records from 57 jurisdictions*
 - Cause-of-death (ICD-10) codes are assigned to death data received by jurisdictions at NCHS
 - Data are coded, processed and then disseminated for health statistics, surveillance and research

*50 states, New York City, District of Columbia and 5 US territories (American Samoa, Guam, Northern Marianas, Puerto Rico, and Virgin Islands)



Data Source: Death Certificate

The image shows a sample U.S. Standard Certificate of Death form. The form is divided into several sections, each highlighted with a different color: a blue section at the top, a yellow section in the middle, and a blue section at the bottom. The form contains various fields for recording information about the deceased, including name, date of birth, sex, race, and cause of death. The form is titled "U.S. STANDARD CERTIFICATE OF DEATH" at the top.

Demographic information

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

Medical information

For natural causes, completed by attending physician, nurse practitioner, physician's assistant

For sudden and unexplained deaths, completed by medical examiner, coroner, Justice of the Peace

Demographic information

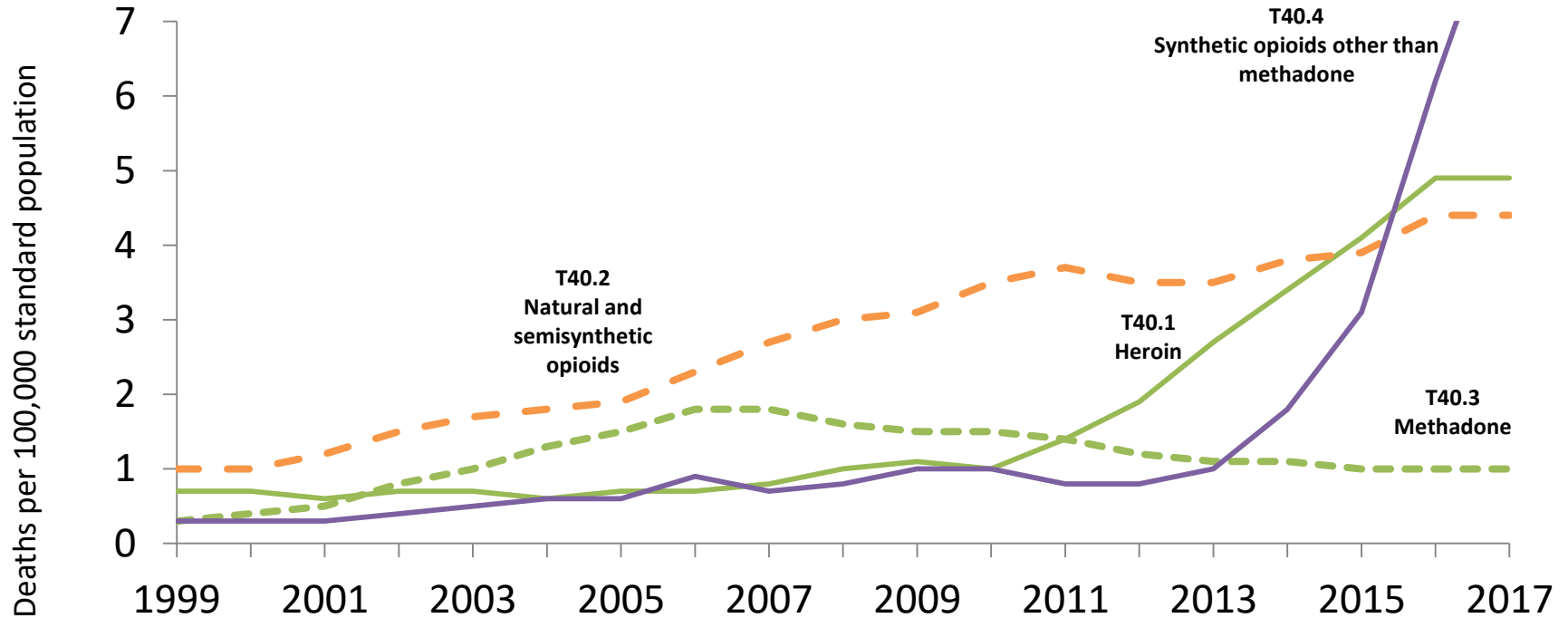
U.S. Standard Death Certificate: Cause-of-Death Section

Referred to as the **literal text**:

- the information written by the medical certifier on the cause, manner, circumstances, and other factors contributing to the death
 - Part I – Chain of events that directly caused the death
 - Part II – Significant conditions contributing to death
 - Box 43 – Describe how the injury occurred

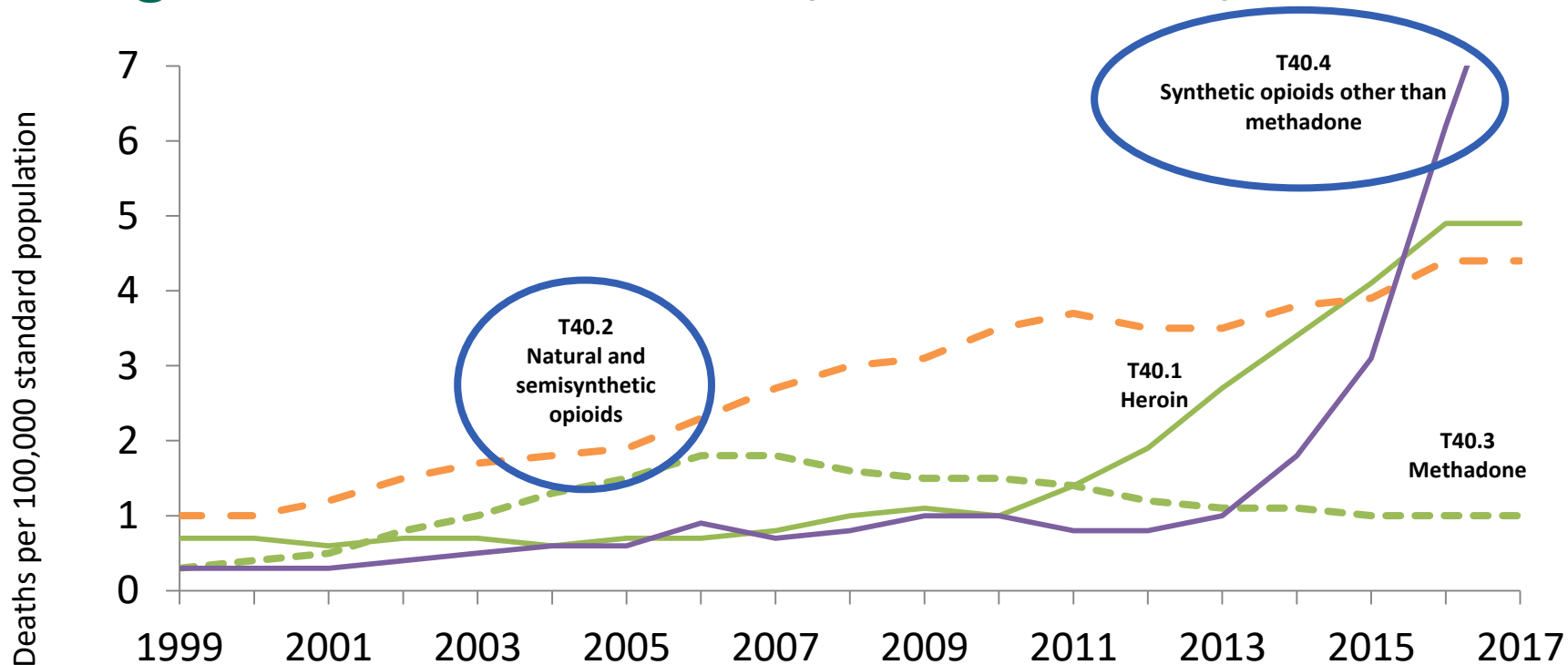
CAUSE OF DEATH (See instructions and examples)				Approximate Interval Onset to death
XX. PART I. Enter the chain of events—diseases, injuries, or complications—that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.				
IMMEDIATE CAUSE (Final disease or condition resulting in death)		a. _____ Due to (or as a consequence of)		_____
Sequentially list conditions, if any, leading to the cause listed on line a. Enter the UNDERLYING CAUSE (disease or injury that initiated the events resulting in death) LAST		b. _____ Due to (or as a consequence of)		_____
		c. _____ Due to (or as a consequence of)		_____
		d. _____		_____
PART II. Enter other significant conditions contributing to death but not resulting in the underlying cause given in PART I.				
33. WAS AN AUTOPSY PERFORMED? <input type="checkbox"/> Yes <input type="checkbox"/> No				
34. WERE AUTOPSY FINDINGS AVAILABLE TO COMPLETE THE CAUSE OF DEATH? <input type="checkbox"/> Yes <input type="checkbox"/> No				
To Be Completed By MEDICAL CERTIFIER	36. DID TOBACCO USE CONTRIBUTE TO DEATH? <input type="checkbox"/> Yes <input type="checkbox"/> Probably <input type="checkbox"/> No <input type="checkbox"/> Unknown	38. IF FEMALE: <input type="checkbox"/> Not pregnant within past year <input type="checkbox"/> Pregnant at time of death <input type="checkbox"/> Not pregnant, but pregnant within 42 days of death <input type="checkbox"/> Not pregnant, but pregnant 43 days to 1 year before death <input type="checkbox"/> Unknown if pregnant within the past year	37. MANNER OF DEATH <input type="checkbox"/> Natural <input type="checkbox"/> Homicide <input type="checkbox"/> Accident <input type="checkbox"/> Pending Investigation <input type="checkbox"/> Suicide <input type="checkbox"/> Could not be determined	
	36. DATE OF INJURY (Mo/Day/Yr) (Specify Month)	39. TIME OF INJURY	40. PLACE OF INJURY (e.g., Decedent's home; construction site; restaurant; wooded area)	41. INJURY AT WORK? <input type="checkbox"/> Yes <input type="checkbox"/> No
42. LOCATION OF INJURY: State _____ City or Town _____		43. DESCRIBE HOW INJURY OCCURRED		
Street & Number: _____ Apartment No.: _____		Zip Code: _____		
		44. IF TRANSPORTATION INJURY, SPECIFY: <input type="checkbox"/> Driver/Operator <input type="checkbox"/> Passenger <input type="checkbox"/> Pedestrian <input type="checkbox"/> Other (Specify) _____		
45. CERTIFIER (Check only one):				

Drug Overdose Death Rates, United States, 1999-2017



SOURCE: National Center for Health Statistics. National Vital Statistics System Mortality File, 1999-2017.

Drug Overdose Death Rates, United States, 1999-2017



SOURCE: National Center for Health Statistics. National Vital Statistics System Mortality File, 1999-2017.

Examples of common drugs found on death certificates without specific ICD-10 code

Opioids

- Fentanyl
- Fentanyl analogs
- Oxycodone
- Hydrocodone
- Morphine
- Hydrocodone
- Tramadol

Stimulants

- Methamphetamine
- MDMA

Benzodiazepines

- Alprazolam
- Diazepam
- Clonazepam

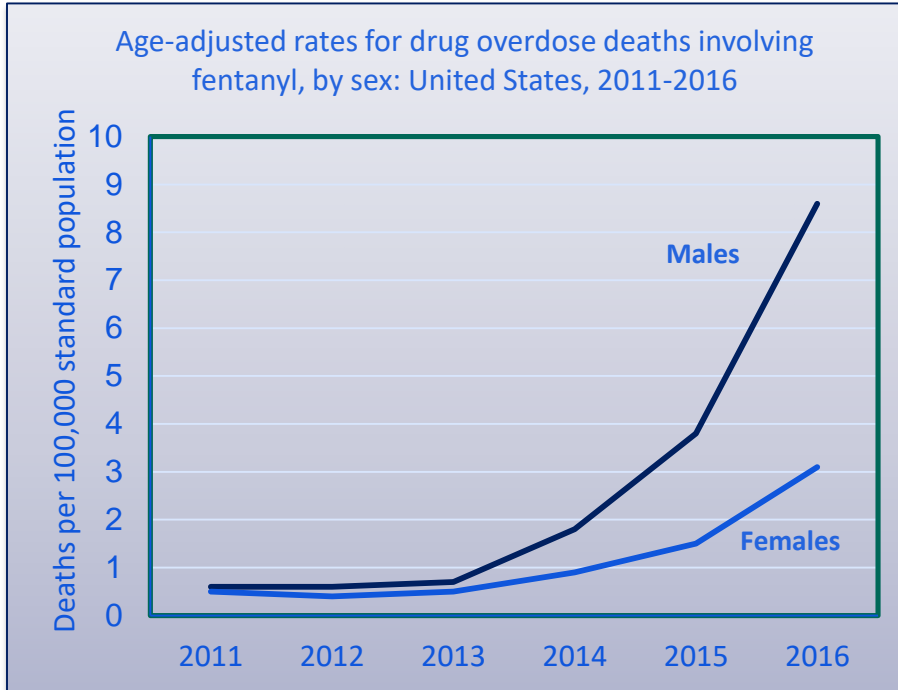
3-Methylfentanyl	Despropionyl-fentanyl
4-ANPP	Furanyl fentanyl
4-MeO-Butyrylfentanyl	Methylfentanyl
Acetylfentanyl	Para-fluorobutyryl-fentanyl
Acrylfentanyl	Para-fluoroisobutyrylfentanyl
Acryloylfentanyl	P-Fluoro-butyrylfentanyl
Alfentanil	Remifentanil
Butyrylfentanyl	Sufentanil
Carfentanil	...

Methods to Identify Specific Drugs on Death Records

- Collaboration between NCHS and FDA
- Developed methods to analyze literal text for mentions of specific drugs
 - Preprocessed text (e.g., remove stop words, special characters)
 - Examined and reviewed string terms and phrases
 - Categorized terms into categories (i.e., principal variants)
 - Considered context (e.g., “history of”, “insulin-dependent”)
- Referred to as the Drugs Mentioned with Involvement (DMI) methodology¹

¹ Drugs Mentioned with Involvement (DMI) methodology : https://www.cdc.gov/nchs/data/nvsr/nvsr65/nvsr65_09.pdf

Selected Results



SOURCE: Spencer MR, Warner M, Bastian BA, et al. Drug overdose deaths involving fentanyl, 2011-2016. Natl Vital Stat Rep. 2019 Mar;68(3):1-19.

Top drugs involved in drug overdose deaths, 2011 and 2016				
	2011		2016	
Rank	Referent drug	# of deaths	Referent drug	# of deaths
1	Oxycodone	5,587	Fentanyl	18,335
2	Cocaine	5,070	Heroin	15,961
3	Heroin	4,571	Cocaine	11,316
4	Methadone	4,545	Methamphetamine	6,762
5	Alprazolam	4,066	Alprazolam	6,209
6	Morphine	3,290	Oxycodone	6,199
7	Hydrocodone	3,206	Morphine	5,014
8	Methamphetamine	1,887	Methadone	3,493
9	Diazepam	1,698	Hydrocodone	3,199
10	Fentanyl	1,662	Diazepam	2,022

SOURCE: Hedegaard H, Bastian BA, Trinidad JP, Spencer MR, Warner M. Drugs most frequently involved in deaths: United States, 2011-2016. Natl Vital Stat Rep. 2018 Dec;67(9):1-14.

Considerations and Next Steps

- Literal text analyses can enable researchers to report with more granularity, the specific drugs involved in deaths
- Challenges
 - Identification of specific drugs is dependent on testing, interpretation and reporting by death certifiers
 - Temporal changes in reporting of the specific drugs can impact trends analyses
- Future steps
 - Automate these processes (e.g., machine learning), while recognizing that we must also identify terms that appear a small number of times

Questions?

Merianne Rose T. Spencer, M.P.H.

Epidemiologist
Division of Analysis and Epidemiology
National Center for Health Statistics
301-458-4377 | kvd1@cdc.gov

Brigham A. Bastian, B.S.

Statistician (Demography)
Division of Vital Statistics
National Center for Health Statistics
301-458-4517 | xcb7@cdc.gov

Margaret Warner, Ph.D.

Injury Epidemiologist
Division of Vital Statistics
National Center for Health Statistics
301-458-4556 | mmw9@cdc.gov

The findings and conclusions of this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.