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# National Health Statistics Reports

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Number 173 ■ July 25, 2022

## National Hospital Care Survey Demonstration Projects: Characteristics and Mortality Outcomes of Opioid-involved Hospital Encounters With Co-occurring Disorders

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### Abstract

*Objective*—This report demonstrates the use of National Hospital Care Survey (NHCS) data to describe characteristics of patients experiencing opioid-involved hospital encounters with co-occurring disorders, defined as lifetime diagnoses of both a substance use disorder (SUD) and a selected mental health issue (MHI), that is, diagnosed at any point in the past or during the present encounter.

*Methods*—Enhanced algorithms using searches of medical codes and natural language processing of clinical notes were applied to the 2016 NHCS data linked to the 2016–2017 National Death Index (NDI) and 2016–2017 Drug-Involved Mortality (DIM) data. Opioid-involved emergency department (ED) visits and hospitalizations for patients with co-occurring disorders were analyzed to describe specific types of SUDs, MHIs, and opioids or opioid antagonists taken. Comparisons between patients with and without co-occurring disorders were also examined by patient characteristics and several hospital outcomes, including discharge status, repeat ED visits, and mortality. The data are unweighted and not nationally representative.

*Results*—In the 2016 NHCS, 7.8% of opioid-involved ED visits and 15.0% of opioid-involved hospitalizations were among patients with co-occurring disorders. Tobacco use disorder and opioid use disorder were the most common SUDs, and anxiety and depressive disorders were the most common MHIs. Differences in age, discharge status, and the number of opioid-involved encounters were observed between patients with and without co-occurring disorders. A greater percentage of patients with co-occurring disorders died either at the hospital or within 1 year after discharge from any cause, as well as from a drug overdose.

*Conclusion*—Although these data are not nationally representative, the 2016 NHCS data linked to the 2016–2017 NDI data and 2016–2017 DIM data provide insight into hospital use and mortality outcomes of patients experiencing opioid-involved encounters with co-occurring disorders.

**Keywords:** opioids • algorithm • co-occurring disorders

### Introduction

According to the 2020 National Survey on Drug Use and Health, the total number of adults aged 18 and over with both a substance use disorder (SUD) and co-occurrence of any mental health illness was 17 million (6.7%), and the number of adults with a co-occurrence of an SUD and severe mental illness was 5.7 million (2.2%) (1). In 2019, adults with any mental illness or severe mental illness were more likely to report past year misuse of prescription pain relievers or the use of heroin: 8.8% for adults with any mental illness and 13.8% for adults with severe mental illness compared with 2.5% for adults who reported no mental health illness in the past year (2). Other studies have identified SUDs and mental health issues (MHIs) as risk factors for fatal and nonfatal opioid overdose (3,4).

The National Hospital Care Survey (NHCS), conducted by the National Center for Health Statistics (NCHS), provides a unique opportunity to examine the relationship between co-occurring SUD and MHI and opioid-involved morbidity and mortality outcomes among patients with opioid-involved hospital encounters. NCHS received support from the Department of Health and Human Services’ Office of the Secretary Patient-



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Centers for Disease Control and Prevention  
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Centered Outcomes Research Trust Fund (PCORTF) for two projects to enhance the identification of opioid-involved visits; co-occurring disorders, including MHIs; and subsequent health outcomes in linked hospital and mortality data (5,6). Both projects were designed to build on previous efforts to create algorithms that identify hospital encounters related to substance use (6) and incorporate newly available data and data science methods.

Since 2011, NHCS has electronically collected data from Uniform Bill (UB)–04 administrative claims files. Starting in 2015, participating hospitals had the option to submit data from electronic health records (EHR) or data collected by Vizient Incorporated, a large, provider-driven, health care performance improvement organization. These new data sources include a greater range of standard medical codes describing diagnoses, medications, procedures, and laboratory tests than what is available in existing UB–04 claims data. Additionally, some hospitals submitting EHR data opted to submit text-based clinical notes. A new set of enhanced algorithms was developed for both PCORTF projects to search all available code fields and use natural language processing (NLP) to search clinical notes for evidence of opioid use, type of opioid or opioid antagonist taken, and the presence of co-occurring disorders.

This report describes the numbers and characteristics of opioid-involved emergency department (ED) visits and hospitalizations among patients with co-occurring disorders, captured by the enhanced algorithms. Differences in opioid-involved hospital encounters between patients with and without co-occurring disorders are also presented by patient characteristics and hospital outcomes (discharge status, repeat ED visits, and in-hospital and postacute mortality).

## Methods

### Data sources

These analyses use data linked across three sources: the 2016 NHCS, 2016–2017 National Death Index (NDI), and 2016–2017 Drug-Involved Mortality

(DIM) restricted-use data. Additional information about the linked NHCS data files can be accessed through the NCHS Research Data Center: <https://www.cdc.gov/rdc/b1datatype/dt1224h.htm>.

### NHCS

NHCS collects data on inpatient discharges, in-person visits made to EDs, and outpatient departments at noninstitutional nonfederal hospitals with six or more staffed inpatient beds in the 50 states and District of Columbia (7). Data are extracted from hospital billing or EHR systems and transmitted electronically to NCHS for processing. Data for this report are from 158 sample hospitals in the 2016 NHCS, with an unweighted total of 6,288,173 ED visits and 2,591,722 inpatient hospitalizations. With an overall response rate of 27.2%, data are currently unweighted and are not nationally representative. More information on NHCS methodology is published elsewhere (8).

The type of data fields in the 2016 NHCS varies for each data source. The UB–04 administrative claims data contain information on patient demographics, patient identifiers, conditions, services, and discharge status. EHR data include similar data items available in UB–04 administrative claims and items that provide more detail about a patient’s hospital encounter, including medications, clinical notes, and laboratory results. Diagnosis codes and discharge status are often missing from EHR records, but this information is often available in EHR text data fields. Vizient collects UB–04 administrative claims and obtains data on medications and laboratory tests, but does not include patient identifiers and cannot be linked to external data sources.

### NDI

NDI is a centralized database of death record information maintained by NCHS (9). Since 1979, NDI has been used to identify mortalities in the 50 U.S. states, District of Columbia, New York City, Puerto Rico, and the U.S. Virgin Islands (10). The database contains over 100 million death records, including information on the decedent’s date of death, underlying cause of death, and

multiple causes of death. All deaths are categorized using the *International Classification of Diseases, 10th Revision* (ICD–10) for underlying and multiple causes of death (11).

### DIM restricted-use data

The DIM restricted-use data provides information on over-the-counter, prescription, and illicit drugs mentioned on death certificates of residents of the United States (12). A search term list developed in collaboration with the U.S. Food and Drug Administration was used to flag specific drugs in literal text from three fields on the death certificate: Part I, cause of death; Part II, significant conditions contributing to death; and item number 43, a verbatim description of how the injury occurred (13). Each search term was then mapped to a “principal variant,” the overarching label assigned to a drug, a drug class, or exposure not otherwise specified (13).

### Data linkage processes

A description of the linkage, conducted by the NCHS Data Linkage Program, of the 2016 NHCS to the 2016–2017 NDI is published elsewhere (14). All 2016 NHCS patient records that were eligible for and successfully linked to the 2016–2017 NDI were then linked to the 2016–2017 DIM files using a unique identifier consisting of the year of death, jurisdiction of death, and death certificate number.

### Algorithm development

The Enhanced Opioid Identification Algorithm was designed to identify all forms of use (past or present) of all opioids and selected opioid antagonists, while the Co-occurring Disorders Algorithm was designed to identify lifetime diagnoses of both SUD and a selected MHI, that is, diagnosed at any point in the past or during the current encounter. The algorithms were designed to capture all forms of opioid use, including use of prescription opioids as directed by a physician, misuse of prescription opioids other than as directed by a physician, and any use of illicit opioids. Each algorithm included

a code component to search structured data elements and an NLP component to search unstructured data elements. For the code component, the initial phase involved extracting relevant codes and search terms from existing lists provided by federal government and academic sources (15). The lists were reviewed by study team members and external subject-matter experts trained in pharmacology and emergency medicine. In the second phase, these codes and search terms were further refined to meet inclusion and exclusion criteria of the case definitions, including all licit and illicit opioids and all forms of use, use disorders involving all psychoactive substances, and selected MHIs that are especially prevalent among patients with past opioid use disorders (15).

Additional steps were taken to handle variability in code systems and data completeness across hospitals. Diagnostic information submitted in the older *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD–9–CM), *Systematized Nomenclature of Medicine–Clinical Terms*, or in vendor-specific code systems were mapped to the equivalent newer ICD–10–CM codes as much as possible. Encounters with either missing or nonstandard service codes for procedures, medications, or laboratory tests were instead searched for the presence of search terms if a text description or label was provided. The final list of medical codes and search terms was then used to search all available diagnosis and service code fields in the 2016 NHCS.

Text-based clinical notes in the 2016 NHCS provided an additional area to search for evidence of opioid involvement and behavioral health conditions that may have otherwise been missed by strictly code-based algorithms. The NLP component incorporated a rule-based approach to develop NLP processors to search hospital encounters with available clinical notes. This process involved identifying and classifying hospital encounters through upfront exclusions, finding opioid-related and behavioral health search terms, negation detection (identifying terms or phrases that indicate a patient did not use an opioid), and assignment of specific opioid or opioid antagonist mentions to

17 drug categories, and behavioral health mentions to specific SUD and MHI categories. More detailed information about the methodology for the code and NLP code components is published elsewhere (15,16).

Specific codes and search terms used in the Enhanced Opioid Identification Algorithm are available from: <https://www.cdc.gov/nchs/data/nhcs/Task-3-Doc-508.pdf>. Those used in the Co-occurring Disorders Algorithm are available from: <https://www.cdc.gov/nchs/data/nhcs/FY19-RDC-2021-06-01-508.pdf>.

## Case definitions

### Opioid-involved encounter

An opioid-involved hospital encounter was defined as an ED visit or hospitalization with evidence of past or present opioid (including opium, heroin, methadone, and other opiates and related narcotics) use, abuse, dependence, poisoning, adverse effect, underdosing, and other forms of opioid use (including using as prescribed), as indicated by any of three criteria: (1) presence of at least one selected medical code in any diagnosis, reason for visit, problem, procedure, or medication code fields, (2) evidence of a positive laboratory test indicating presence of an opiate, or (3) classification by the NLP processor based on opioid use indicators in the text clinical notes.

### Co-occurring disorders encounter

A co-occurring disorders encounter was defined as an opioid-involved ED visit or hospitalization with evidence of a lifetime SUD diagnosis (alcohol, opioid, cannabis, sedative, cocaine, other stimulants, hallucinogen, inhalant, tobacco, and other psychoactive substance-related disorders) and a lifetime MHI diagnosis (anxiety, trauma, obsessive compulsive disorder, depression, and self-harm thoughts or behaviors) as indicated by any of three criteria: (1) presence of at least one selected diagnostic code in any diagnosis, reason for visit, or problem code fields, (2) presence of at least one selected service code in any procedure code fields,

or (3) classification by the NLP processor based on SUD and MHI indicators in the text clinical notes.

## Analysis

This report presents the unweighted total numbers and percentages of opioid-involved ED visits and hospitalizations by the presence of co-occurring disorders. This report is a demonstration of the analytic capabilities of NHCS data and is not intended to provide official national estimates with nationally representative results. No statistical comparisons were conducted because this report is intended as an illustrative example of what can be done with these data, rather than to produce official representative estimates of opioid-involved ED visits and hospitalizations.

Selected characteristics of opioid-involved hospital encounters among patients with co-occurring disorders are presented, including type of SUD, type of MHI, and type of opioid or opioid antagonist taken. The report presents results for opioid-involved hospital encounters for patients with and without co-occurring disorders by patient characteristics (sex and age) and hospital outcomes (discharge status, repeat opioid-involved encounters, and mortality outcomes, including in-hospital and postacute mortality, cause of death, and specific drugs mentioned in opioid overdose deaths).

In the mortality analyses, a patient's last chronological opioid-involved hospital encounter was the record used to identify if a patient died at the hospital or to determine the length of time between the patient's discharge and date of death using linked NDI data. Drug overdose deaths were identified using ICD–10 underlying cause-of-death codes X40–X44 (unintentional), X60–X64 (intentional self-harm or suicide), X85 (homicide), and Y10–Y14 (undetermined intent). Opioid-involved drug overdose deaths were those that also had at least one multiple cause-of-death code of T40.0–T40.4 or T40.6 (includes opium, heroin, other natural and semisynthetic opioids, methadone, other synthetic opioids, and unspecified narcotics). Specific drugs identified on death certificates for drug overdose deaths were

based on selected principal variants in the linked DIM data across three drug classes: opioids, benzodiazepines, and stimulants.

## Results

### Opioid-involved hospital encounters among patients with co-occurring disorders

In the 2016 NHCS, 12.2% of ED visits and 21.8% of hospitalizations were identified as opioid-involved by the Enhanced Opioid Identification Algorithm (Table 1). Figure 1 shows that co-occurring disorders were more common in opioid-involved hospitalizations (15.0%) than in opioid-involved ED visits (7.8%).

Figures 2–4 show the distribution of specific types of SUDs, MHIs, and opioids or opioid antagonists mentioned in opioid-involved ED visits and hospitalizations among patients with co-occurring disorders.

- The distribution of categories indicating a specific type of SUD was similar across both settings. Tobacco use disorder was the most common type of SUD (85.0% in ED,

82.8% in hospitalizations), followed by opioid use disorder (28.9% in ED, 23.1% in hospitalizations). However, the unspecified substance category (other psychoactive use disorder) differed by setting (3.9% in ED, 12.8% in hospitalizations) (Figure 2).

- More than one-half of encounters had evidence of anxiety disorders (60.9% in ED, 61.1% in hospitalizations) or depressive disorders (55.7% in ED, 62.7% in hospitalizations). However, the ED setting had more encounters involving self-harm thoughts or behaviors (17.2%) than hospitalizations (9.1%) (Figure 3). Among ED visits, the five most common types of opioids mentioned were morphine (22.8%), hydrocodone (20.0%), oxycodone (15.5%), hydromorphone (15.4%), and tramadol (12.0%). This distribution differed among hospitalizations with the five most common types of opioids being taken: oxycodone (33.9%), fentanyl or fentanyl analogs (33.6%), hydromorphone (25.0%), morphine (23.8%), and hydrocodone (13.1%) (Figure 4).

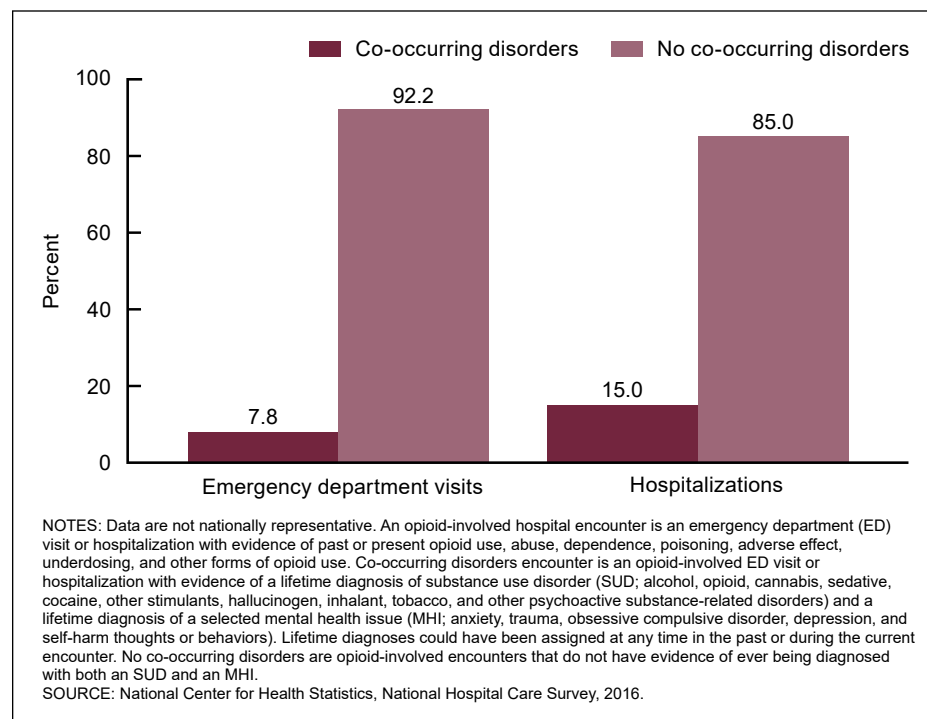
### Comparisons by the presence of co-occurring disorders

#### Patient characteristics

Figures 5 and 6 compare the sex and age distributions of opioid-involved ED visits and hospitalizations by the presence of co-occurring disorders.

- Females accounted for 58.1% of encounters with an opioid-involved ED visit with co-occurring disorders and 57.3% of encounters with an opioid-involved ED visit without co-occurring disorders (Figure 5).
- Females accounted for 55.8% of opioid-involved hospitalizations with co-occurring disorders and 53.5% of those without co-occurring disorders.
- Hospitalized patients were generally older than ED patients, and this age distribution was similar for those with and without co-occurring disorders. Nearly one-half of hospitalized patients were aged 55 and over, including 48.0% with co-occurring disorders and 50.9% without co-occurring disorders. The largest age group represented among ED patients were those aged 35–54, which included 40.8% with co-occurring disorders and 34.9% without co-occurring disorders (Figure 6).

**Figure 1. Percentage of opioid-involved emergency department visits and hospitalizations, by presence of co-occurring disorders: National Hospital Care Survey, 2016**



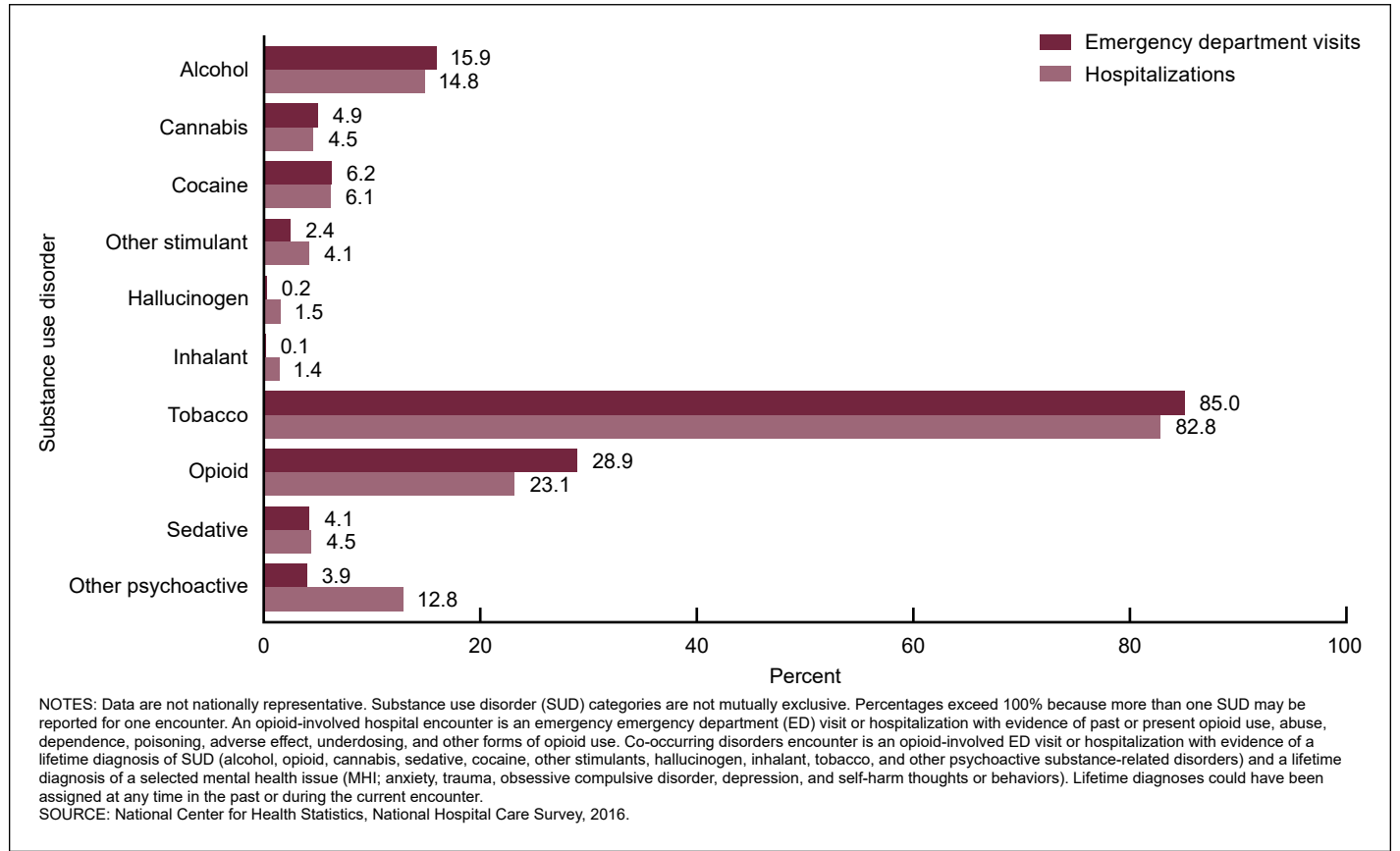
#### Hospital outcomes

Figure 7 compares the discharge status of opioid-involved ED visits and hospitalizations by the presence of co-occurring disorders encounters. Figure 8 compares the total number of opioid-involved encounters with and without co-occurring disorders during 2016. Figures 9 and 10 and Table 2 compare mortality outcomes among patients with an opioid-related hospital encounter by the presence or absence of co-occurring disorders.

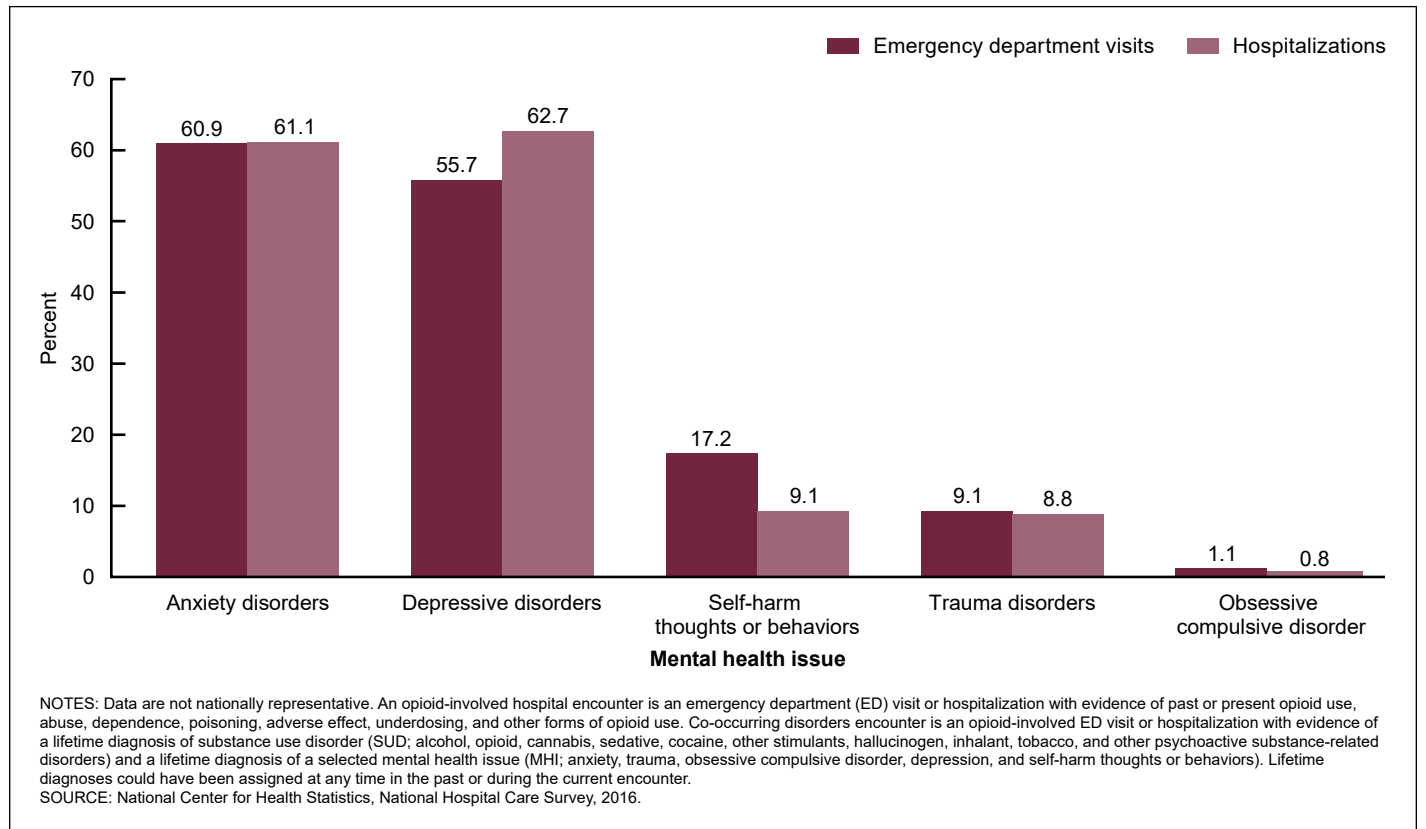
#### Discharge status

- Among ED visits, a routine home discharge was less common for patients with co-occurring disorders (68.6%) compared with patients without co-occurring disorders

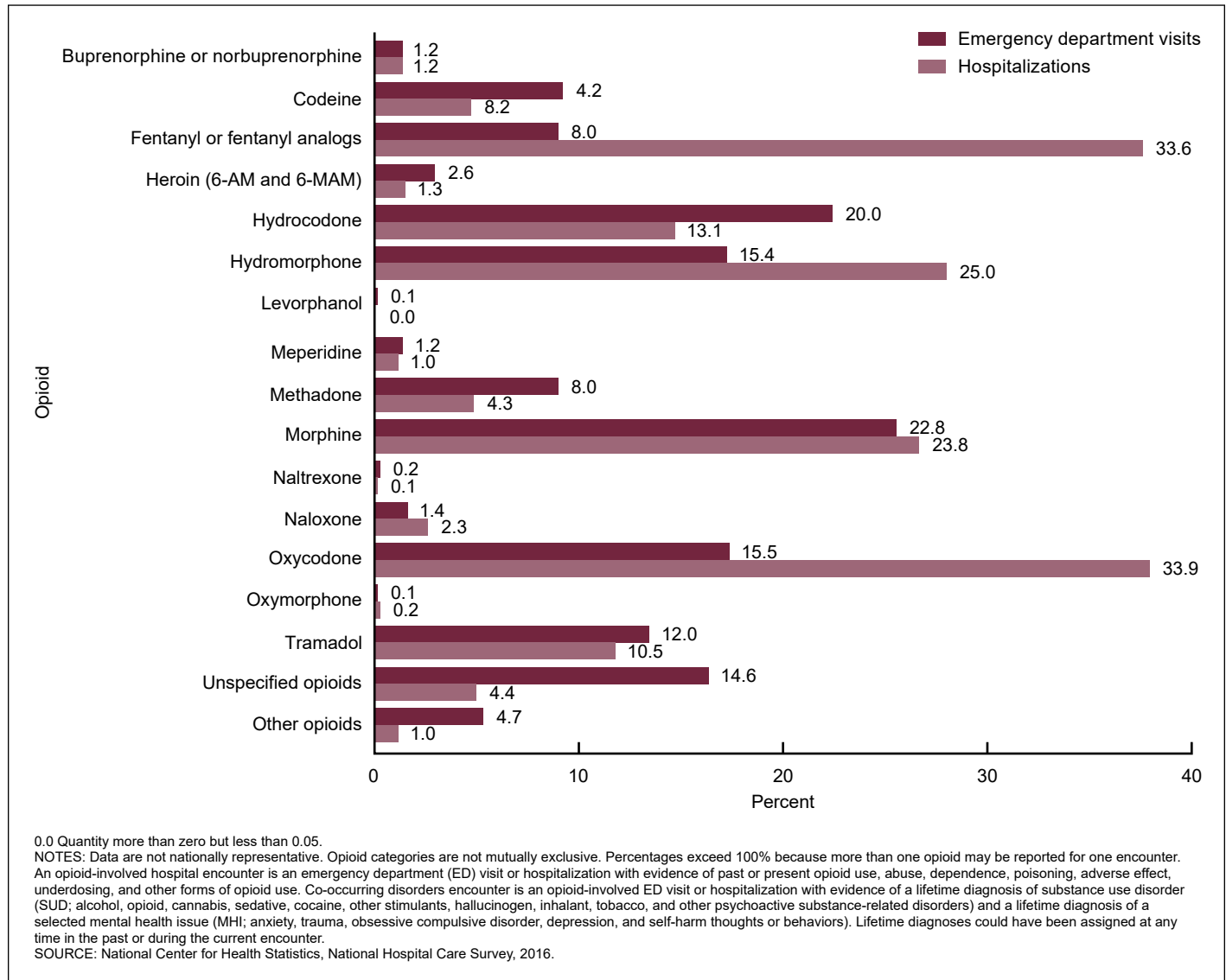
**Figure 2. Percentage of opioid-involved hospital encounters among patients with co-occurring disorders, by type of substance use disorder: National Hospital Care Survey, 2016**



**Figure 3. Percentage of opioid-involved encounters with co-occurring disorders, by type of mental health issue: National Hospital Care Survey, 2016**



**Figure 4. Percentage of opioid-involved encounters with co-occurring disorders, by type of opioid or opioid antagonist taken: National Hospital Care Survey, 2016**



(78.7%) (Figure 7). The percentage of visits resulting in a transfer to another health care facility was more than twice as high among patients with co-occurring disorders (13.7%) compared with patients without co-occurring disorders (5.8%). The percentage of visits that ended in the patient leaving against medical advice was also higher among patients with co-occurring disorders (2.9%) compared with patients without co-occurring disorders (1.5%).

- Among hospitalizations, a routine home discharge was similar for patients with co-occurring disorders (53.8%) and those without co-occurring disorders (56.6%).

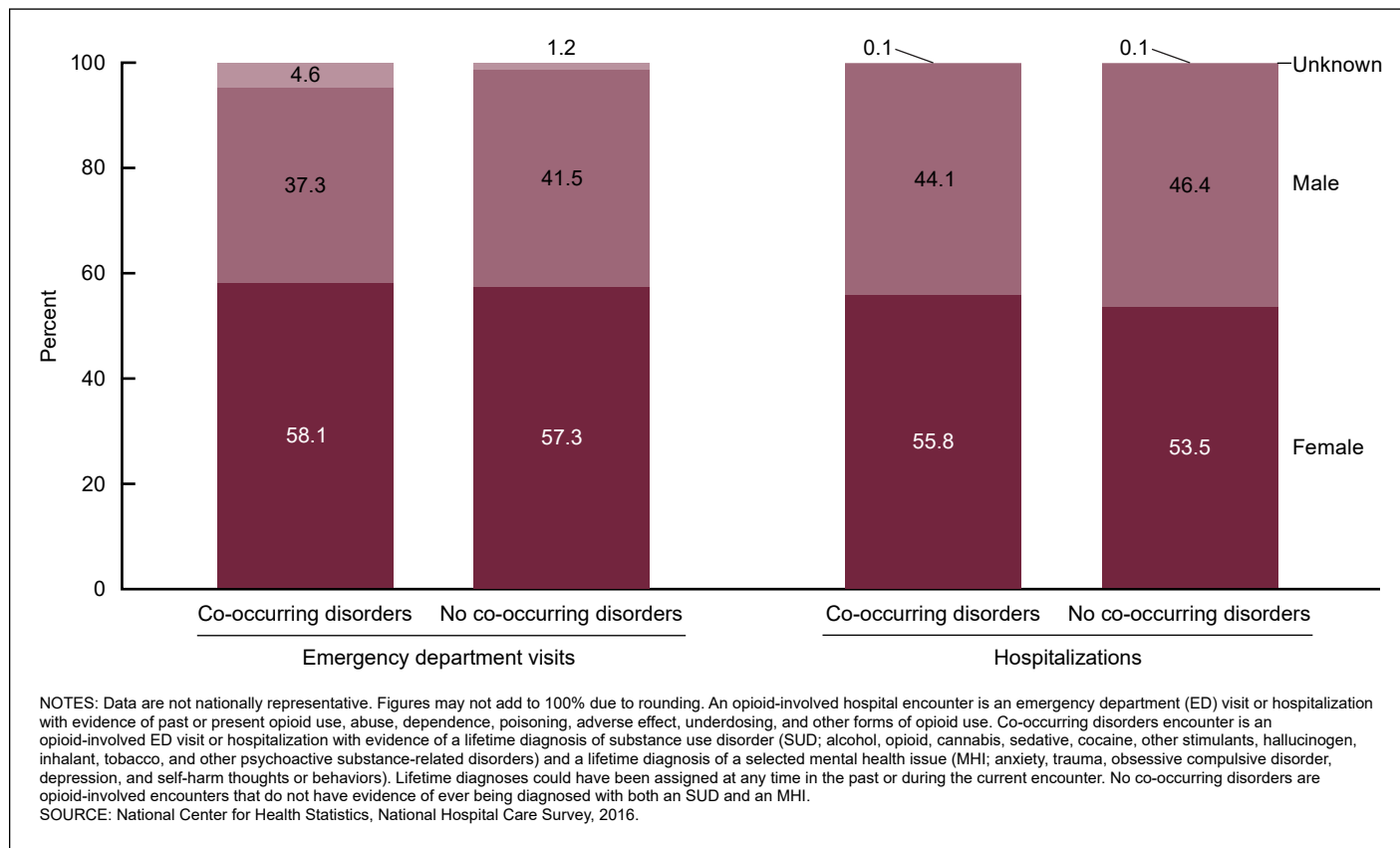
The percentage of encounters resulting in a transfer to another health care facility was 18.6% among patients with co-occurring disorders compared with 14.0% among patients without co-occurring disorders. The percentage of hospitalizations that ended in the patient leaving against medical advice was higher among patients with co-occurring disorders (2.9%) compared with patients without co-occurring disorders (1.0%) (Figure 7).

### Repeat opioid-involved hospital encounters

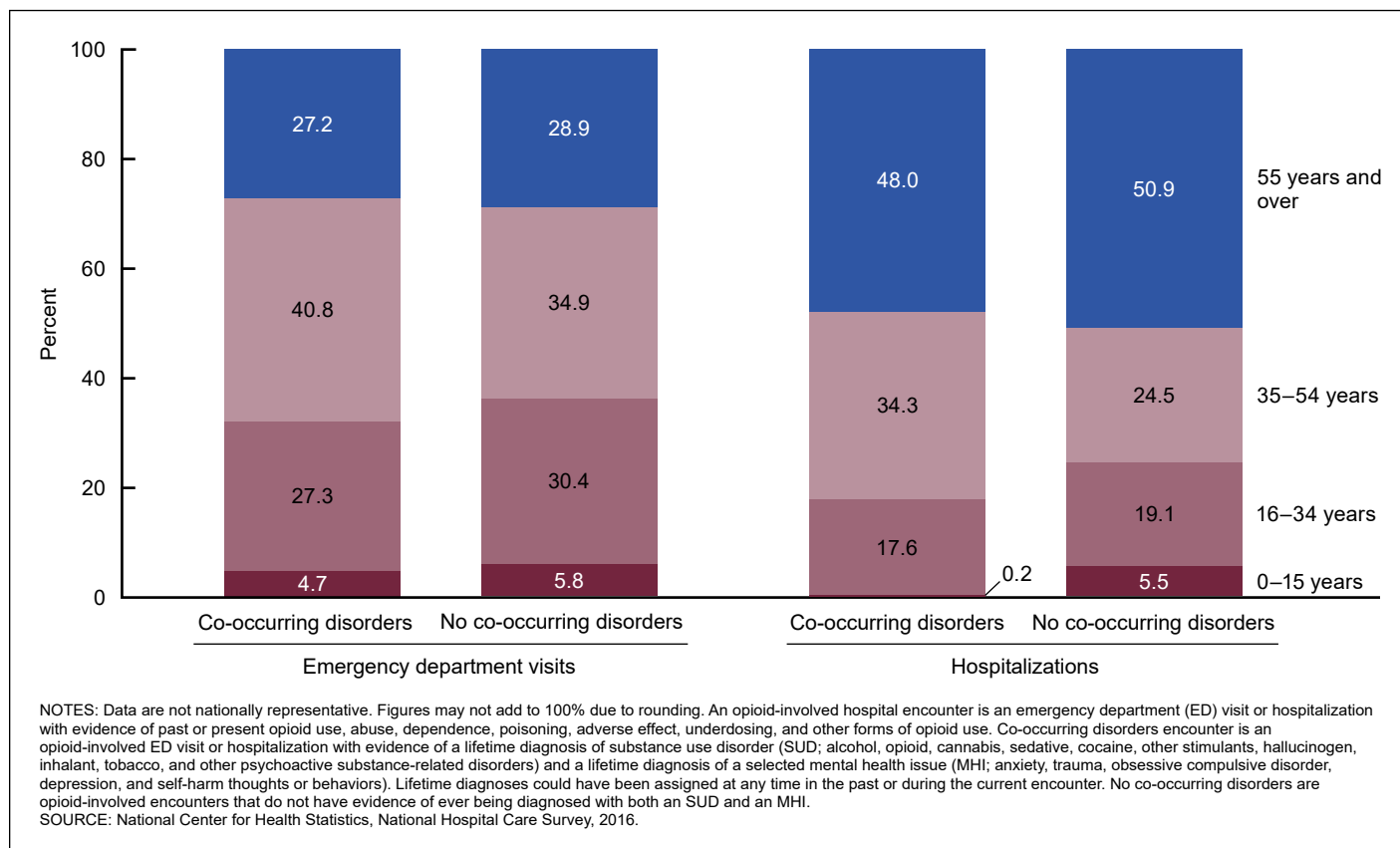
Figure 8 shows the percentage of unique patients who had multiple opioid-involved encounters by the presence of co-occurring disorders.

- Among patients with an opioid-involved hospital encounter, most with and without co-occurring disorders had one opioid-involved encounter (62.3% and 83.9%, respectively) within the calendar year of data collection. The percentage of patients with co-occurring disorders with two or more hospital encounters (37.7%) more than doubled the percentage of patients without co-occurring disorders (16.1%).

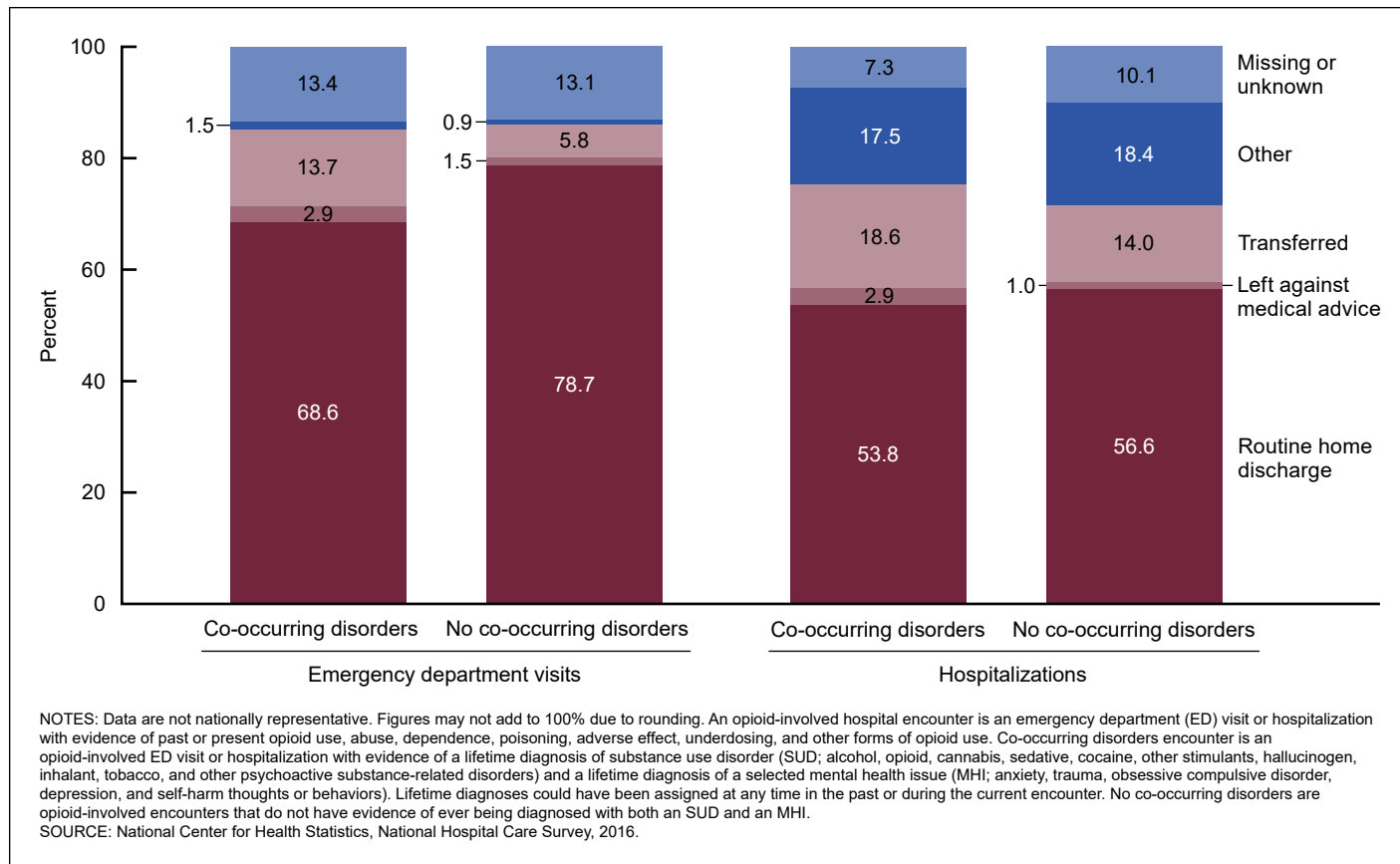
**Figure 5. Percent distribution of opioid-involved emergency department visits and hospitalizations, by sex and presence of co-occurring disorders: National Hospital Care Survey, 2016**



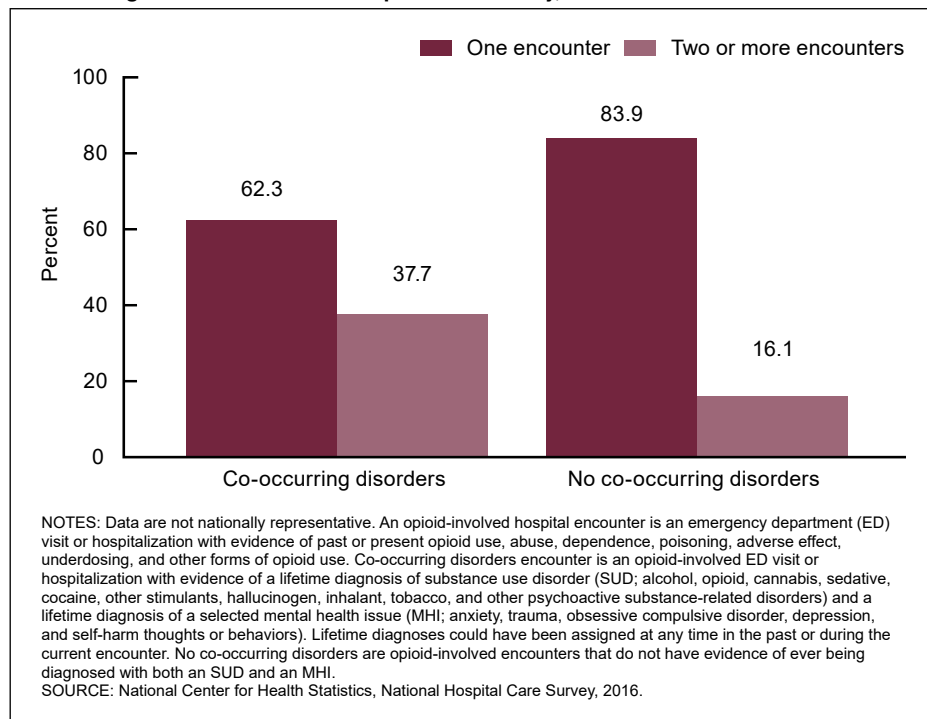
**Figure 6. Percent distribution of opioid-involved emergency department visits and hospitalizations, by age group and presence of co-occurring disorder: National Hospital Care Survey, 2016**



**Figure 7. Percent distribution of opioid-involved emergency department visits and hospitalizations, by discharge status and presence of co-occurring disorders: National Hospital Care Survey, 2016**



**Figure 8. Percentage of opioid-involved encounters, by patients with and without co-occurring disorders: National Hospital Care Survey, 2016**



**Mortality outcomes**

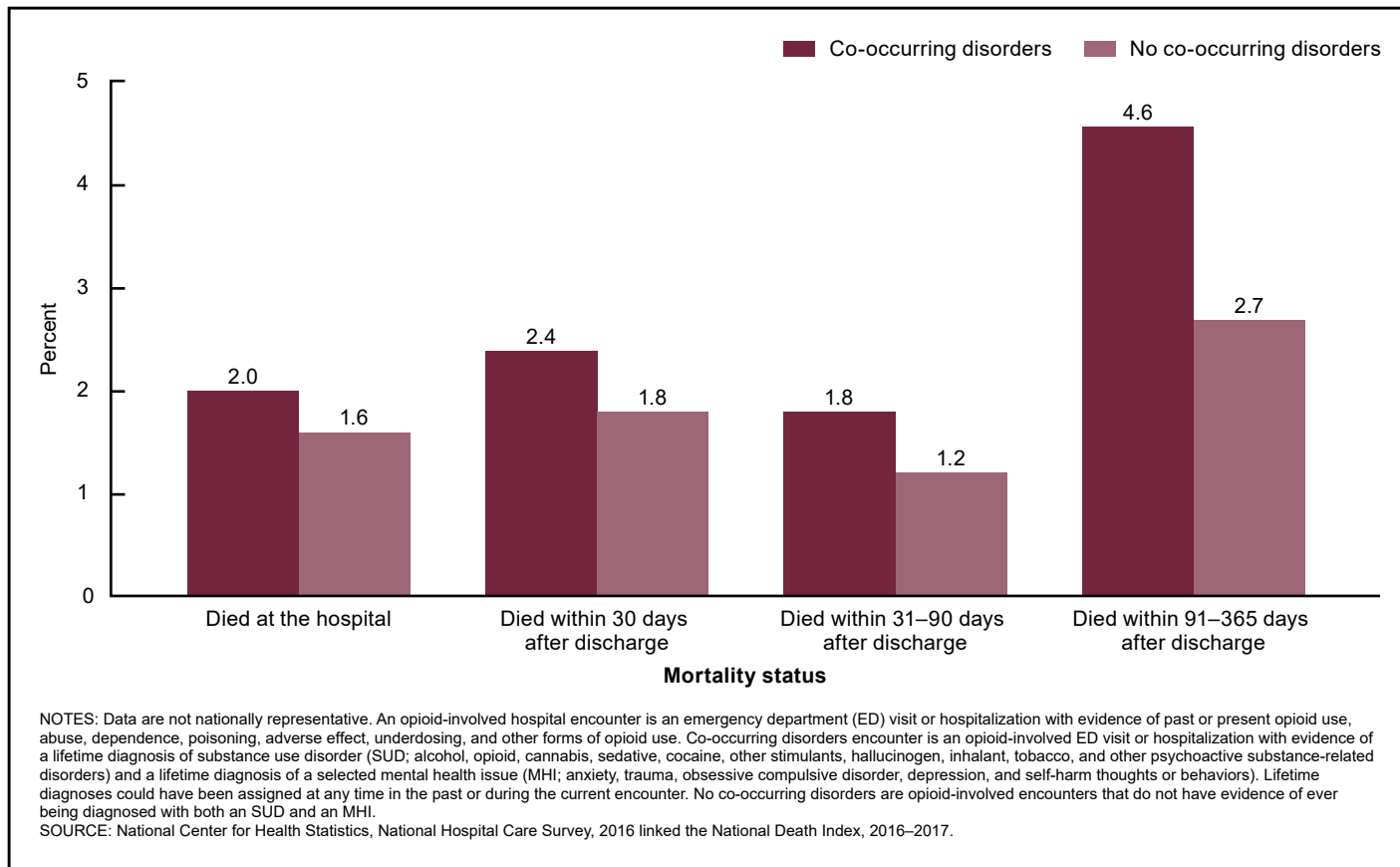
***In-hospital and post-discharge mortality***

The percentage of patients who died up to 1 year after their last opioid-involved hospital encounter in 2016 is shown in Figure 9.

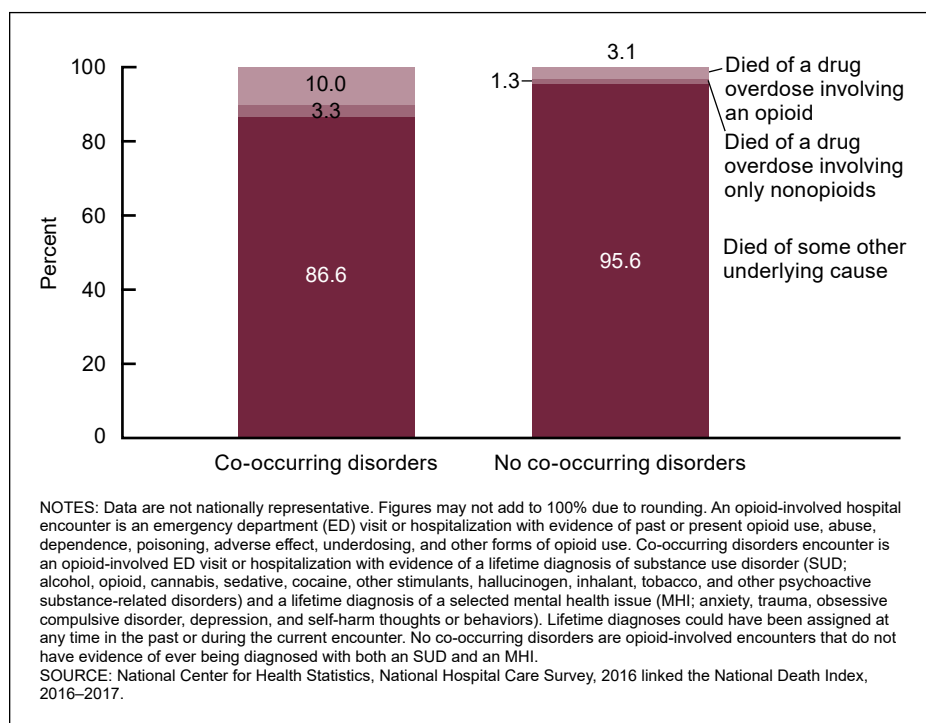
- Patients with co-occurring disorders accounted for a higher percentage of deaths across all in-hospital and post-discharge mortality status indicators compared with patients without co-occurring disorders. This difference was smallest for deaths at the hospital, with 2.0% among patients with co-occurring disorders and 1.6% among patients without co-occurring disorders. This difference was greatest for deaths within 91–365 days after discharge, at 4.6% for patients with co-occurring disorders compared with 2.7% for patients without co-occurring disorders.



**Figure 9. Percentage of in-hospital and postacute mortality of opioid-involved encounters, by patients with and without co-occurring disorders: National Hospital Care Survey, 2016, linked to the National Death Index, 2016–2017**



**Figure 10. Cause of death, by presence of co-occurring disorders among patients who died within 1 year of their last opioid-involved hospital encounter: National Hospital Care Survey, 2016, linked to the National Death Index, 2016–2017**



**Cause of death**

The underlying and multiple cause-of-death codes available in the linked NHCS and NDI data enabled identification of deaths due to drug overdose. Figure 10 shows the percentage of each cause of death for patients with and without co-occurring disorders who died within 1 year of their last opioid-involved ED visit or hospitalization in 2016.

- Patients with co-occurring disorders had a higher total percentage of drug overdose deaths involving either opioids or nonopioids (13.3%) compared with patients without co-occurring disorders (4.4%).
- One in 10 patients with a co-occurring disorder died from a drug overdose involving an opioid (10.0%), and 1 in 30 patients without co-occurring disorders died from a drug overdose involving only nonopioids (3.3%).

### Specific drugs identified in opioid overdose deaths

When NHCS data are linked to the NDI and DIM data, specific drugs involved in deaths can be identified. [Table 2](#) presents the percentage of drugs across three classes (opioids, selected benzodiazepines, and selected stimulants) listed on 2016 or 2017 death certificates for a total of 1,335 patients with and without co-occurring disorders who died within 1 year after discharge of an opioid overdose.

- The distribution of drugs identified on death certificates was similar across all drug classes between patients with and without co-occurring disorders.
- Among patients with co-occurring disorders who died of a drug overdose involving an opioid, the most common opioids were fentanyl (49.0%) and heroin (37.2%), the most common benzodiazepines were alprazolam (11.7%) and diazepam (5.4%), and the most common stimulants were cocaine (19.6%) and methamphetamine (5.3%).
- Among patients without co-occurring disorders who died of a drug overdose involving an opioid, the most common opioids were fentanyl (45.7%) and heroin (41.2%), the most common benzodiazepines were alprazolam (10.0%) and diazepam (5.0%), and the most common stimulants were cocaine (17.4%) and methamphetamine (7.2%).

## Discussion

As the opioid crisis continues in the United States, patients with co-occurring disorders may have different morbidity and mortality experiences compared with patients without co-occurring disorders. Although the data are not nationally representative, analyses from this report demonstrate the potential of the enhanced algorithms to identify an important subgroup of opioid-involved hospital encounters and to explore a wide range of hospitalization and mortality outcomes using linked data.

A total of 12% of ED visits and 22% of hospitalizations were identified as opioid-involved by the Enhanced

Opioid Identification Algorithm in the 2016 NHCS. Earlier iterations of this algorithm identified a lower percentage of opioid-involved ED encounters in the 2013 NHCS (0.8%) (17) and 2014 NHCS (0.9%) (18). This disparity likely reflects several factors, including the integration of NLP methods to identify evidence in clinical notes that may have been missed by a code-only search, and the use of an expanded set of case definition inclusion criteria for the PCORTF projects. Additionally, the newer algorithms are designed to capture all forms of opioid use, including use of prescription opioids as directed by a physician, misuse of prescription opioids in a manner other than as directed by a physician, and any use of illicit opioids. The algorithms also flag encounters indicating that an opioid was taken or prescribed in the past (for example, as noted in the “Medication History” section of the EHR), given during the encounter, or prescribed upon discharge. Lastly, previous research has found that more opioid-involved hospital encounters may be identified under the ICD-10-CM coding system because of the greater number of opioid-related diagnosis codes compared with those available in the ICD-9-CM coding system (19,20).

The Co-occurring Disorders Algorithm identified 8% of opioid-involved ED visits and 15% of opioid-involved hospitalizations among patients with co-occurring disorders. Among these patients, tobacco use disorder and opioid use disorder were the most common SUDs, while anxiety and depressive disorders were the most common MHIs across both settings. The types of opioids mentioned differed by setting, with morphine, hydrocodone, and oxycodone being the most frequently mentioned drug products in opioid-involved ED visits, and oxycodone, fentanyl or fentanyl analogs, and hydromorphone being the most frequently mentioned drug types in opioid-involved hospitalizations.

This report also demonstrates the ability to explore differences in health outcomes of opioid-involved hospital encounters between patients with and without co-occurring disorders. Patients with an opioid-involved encounter with co-occurring disorders were more likely to have a discharge that resulted in a

transfer to another health care facility or the patient leaving against medical advice.

Also, patients with co-occurring disorders were more likely to experience two or more opioid-involved encounters during 2016. At each time interval, patients with co-occurring disorders were more likely to die than patients without co-occurring disorders. This difference was most noticeable for patients who died 91–365 days after hospital discharge. These patients were also more likely to have died of a drug overdose involving an opioid or some other drug. In examining the specific drugs identified on death certificates, both opioids and other drug classes (benzodiazepines and stimulants) were involved in opioid overdoses, indicating that multiple drugs were involved in overdose deaths in patients with and without co-occurring disorders.

Interpretation of the study results should consider several limitations. First, reported estimates from the 2016 NHCS are unweighted and, consequently, are not nationally representative. Additionally, the case definition for co-occurring disorders includes both past and present SUDs and MHIs, which could have been diagnosed at different points in time. It is possible that some flagged encounters included SUDs or MHIs that were not active issues at the time of the encounter. “Unknown” sex indicates that the patient’s sex was not recorded or that the patient chose not to identify as male or female. Also, although about 99% of encounters had at least one medical code that could be searched by the code component of the enhanced algorithms, these codes may not represent all available codes for each encounter because UB-04 and Vizient submissions were limited to up to 3 reason for visit codes and up to 25 diagnosis codes. The availability and quality of clinical notes for the NLP component were also not uniform across encounters. Only 8.7% of all patients with opioid-involved encounters had at least one clinical note record, which in some cases could contain truncated (shortened) text or highly variable formatting. Additional details about the development of the code and the NLP components of the

Co-occurring Disorders Algorithm are described elsewhere (16).

As a next step, a formal validation study will be conducted to rigorously assess the performance of the enhanced algorithms and, if needed, identify areas for improvement. The validation study involves abstracting data directly from the hospital's medical record system and comparing it to the output of the algorithms. Once validated, the final set of algorithms will be applied to NHCS data. Resulting variables on opioid use and co-occurring disorders will be available in updated data sets in the NCHS Research Data Center for researchers, and in a secure, web-based interactive portal for participating hospitals. Additionally, the algorithms will be updated annually to account for changes in standard medical coding systems, and to ensure code and search terms lists reflect emerging trends in opioid use and behavioral health.

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**Table 1. Percentage and number of opioid-involved emergency department visits and hospitalizations: National Hospital Care Survey, 2016**

Characteristic	Emergency department visits	Hospitalizations
Percentage of opioid-involved hospital encounters.....	12.2	21.8
Number of opioid-involved hospital encounters:		
Total opioid-involved hospital encounters .....	766,569	565,371
Total hospital encounters .....	6,288,173	2,591,722

NOTES: Data are unweighted and not nationally representative. An opioid-involved hospital encounter is an emergency department visit or hospitalization with evidence of past or present opioid use, abuse, dependence, poisoning, adverse effect, underdosing, and other forms of opioid use.

SOURCE: National Center for Health Statistics, National Hospital Care Survey, 2016.

**Table 2. Opioids and selected other drugs identified on death certificates, by presence of co-occurring disorders among patients with an opioid-involved emergency department visit or hospitalization, who died within 1 year after discharge of an opioid-involved drug overdose: National Hospital Care Survey, 2016, linked to the 2016–2017 National Death Index and 2016–2017 Drug-Involved Mortality File**

Drug <sup>1</sup>	Co-occurring disorders		No co-occurring disorders	
	Number	Percent	Number	Percent
Drug overdose involving an opioid . . . . .	514	100.0	821	100.0
Opioids				
Fentanyl . . . . .	252	49.0	375	45.7
Heroin . . . . .	191	37.2	338	41.2
Oxycodone . . . . .	84	16.3	118	14.4
Morphine . . . . .	42	8.2	73	8.9
Methadone . . . . .	41	8.0	44	5.4
Hydrocodone . . . . .	26	5.1	43	5.2
Buprenorphine . . . . .	10	1.9	17	2.1
Codeine . . . . .	*	*	16	1.9
Hydromorphone . . . . .	*	*	19	2.3
Oxymorphone . . . . .	14	2.7	24	2.9
Tramadol . . . . .	13	2.5	20	2.4
The term "opioid" or "opiate" was noted, but no specific drug was named . . . . .	31	6.0	40	4.9
Selected benzodiazepines				
Alprazolam . . . . .	60	11.7	82	10.0
Diazepam . . . . .	28	5.4	41	5.0
Clonazepam . . . . .	21	4.1	32	3.9
Lorazepam . . . . .	*	*	10	1.2
Temazepam . . . . .	*	*	*	*
Selected stimulants				
Cocaine . . . . .	101	19.6	143	17.4
Methamphetamine . . . . .	27	5.3	59	7.2
Amphetamine . . . . .	13	2.5	*	*

\* Estimate does not meet National Center for Health Statistics standards of reliability. Encounters are fewer than 10 cases and are not reported.

<sup>1</sup>Percentages exceed 100% because more than one drug may be reported for the same patient. A death may involve more than one drug.

NOTES: An opioid-involved hospital encounter is an emergency department (ED) visit or hospitalization with evidence of past or present opioid use, abuse, dependence, poisoning, adverse effect, underdosing, and other forms of opioid use. Co-occurring disorders encounter is an opioid-involved ED visit or hospitalization with evidence of a lifetime diagnosis of substance use disorder (SUD; alcohol, opioid, cannabis, sedative, cocaine, other stimulants, hallucinogen, inhalant, tobacco, and other psychoactive substance-related disorders) and a lifetime diagnosis of a selected mental health issue (MHI; anxiety, trauma, obsessive compulsive disorder, depression, and self-harm thoughts or behaviors). Lifetime diagnoses could have been assigned at any time in the past or during the current encounter. No co-occurring disorders are opioid-involved encounters that do not have evidence of ever being diagnosed with both an SUD and an MHI. There were 514 decedents with co-occurring disorders and 821 decedents without co-occurring disorders who died of a drug overdose involving an opioid. Data are not nationally representative.

SOURCES: National Center for Health Statistics, National Hospital Care Survey, 2016, data linked to the 2016–2017 National Death Index and the 2016–2017 Drug-Involved Mortality File.

## Technical Notes

### Data collection and processing

For detailed information on sample design, data collection, claims deduplication (removal of duplicate UB–04 claims), and patient identification in the 2016 National Hospital Care Survey, see the “National Hospital Care Survey—Research Data Center Documentation,” available from: [https://www.cdc.gov/rdc/data/b1/NHCS\\_RDC\\_USERS\\_GUIDE.pdf](https://www.cdc.gov/rdc/data/b1/NHCS_RDC_USERS_GUIDE.pdf).

### Definition of terms

*Co-occurring disorders*—Evidence of a lifetime diagnosis of a substance use disorder (SUD) and a lifetime diagnosis of a selected mental health issue (MHI). Lifetime diagnoses could have been assigned at any time in the past or during the current encounter.

*Discharge status*—Identifies where the patient is or their status at the conclusion of the emergency department (ED) visit or at the end of a billing cycle (that is, the “through” date of a claim). All discharge statuses were collected and then collapsed into one mutually exclusive variable with the following categories:

- Routine home discharge: Patients discharged to return home.
- Left against medical advice: Patients who left the ED before their treating provider(s) considered them ready for discharge.
- Transferred: Patients who were admitted to the current hospital as inpatients or transferred to another hospital for further treatment.
- Other: Patients discharged with a status not covered by any of the above categories.

*Mental health issue*—Evidence of a lifetime diagnosis (assigned at any time in the past or during the current encounter) for any of the selected MHI categories:

- Anxiety: Includes generalized anxiety disorder, panic disorders, social phobias, unspecified anxiety disorder, or other anxiety disorder.

- Depression: Includes major depressive disorder single episode, major depressive disorder recurrent episode, and other depressive disorder. Depression comorbidities of bipolar disorder and schizophrenia are not categorized as depression.
- Obsessive compulsive disorder: Includes obsessive compulsive disorder.
- Self-harm: Includes personal history of self-harm, suicidal ideation, or suicide attempt.
- Trauma and stressor-related disorders: Includes acute stress reaction and post-traumatic stress disorder.

*No co-occurring disorders*—No evidence of ever being diagnosed with both an MHI and a SUD.

*Opioid involved*—Evidence of past or present opioid (including opium, heroin, methadone, and other opiates and related narcotics) use, abuse, dependence, poisoning, adverse effect, underdosing, and other forms of opioid use.

*Substance use disorder*—Evidence of a lifetime diagnosis (assigned at any time in the past or during the current encounter) of a use disorder for any of the following substances: alcohol, cannabis, cocaine, hallucinogen, inhalant, tobacco, opioid, other stimulants, sedative, hypnotic, or anxiolytic, or other psychoactive substance.

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National Health Statistics Reports ■ Number 173 ■ July 25, 2022

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**Suggested citation**

Brown AM, White DG, Badwe R, Adams N, O'Jiaku-Okorie A, Shaikh S, et al. National Hospital Care Survey demonstration projects: Characteristics and mortality outcomes of opioid-involved hospital encounters with co-occurring disorders. National Health Statistics Reports; no 173. Hyattsville MD: National Center for Health Statistics. 2022. DOI: <https://dx.doi.org/10.15620/cdc:118082>.

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