Identification of Substance-involved Emergency Department Visits Using Data From the National Hospital Care Survey

by Amy M. Brown, M.P.H., and Carol DeFrances, Ph.D., National Center for Health Statistics;
Elizabeth Crane, Ph.D., M.P.H., and Rong Cai, M.S., Substance Abuse and Mental Health Services Administration; and
Sarah Naeger, Ph.D., M.P.H., IBM Watson Health (previously affiliated with the Substance Abuse and
Mental Health Services Administration)

Abstract

Objective—This report describes the development of methods to identify emergency department (ED) visits involving substance use. Two different algorithms are compared using claims data from the 2013 National Hospital Care Survey (NHCS), a facility-based survey. While NHCS was designed to produce national estimates, this report is based on 2013 data, which are not nationally representative.

Methods—For the 2013 NHCS data collection, 82 out of a sample of 581 hospitals provided claims data for all ED visits for a 12-month period. Two medical code-based algorithms for identification of substance-involved visits were compared: (a) a general algorithm requiring only selected diagnosis or external cause of injury codes; and (b) an enhanced algorithm designed to meet a more specific case definition that adds codes for substance use-related symptoms and procedures. To illustrate both algorithms, distributions of selected patient characteristics were compared across selected types of substance-involved visits within the ED setting.

Results—The first algorithm identified 87,067 ED visits involving at least one priority substance category, while the second algorithm identified 47,992 such visits. Similarities and differences in patient characteristics of visits identified by both algorithms are presented.

Conclusion—These results demonstrate the use of two algorithms that, once finalized and validated, could be used with NHCS data to eventually generate national estimates of ED visits involving substance use.

Keywords: substance use • algorithm

Introduction

The use of substances containing drugs or alcohol continues to be an important national health concern. In 2011, an estimated 2.5 million emergency department (ED) visits resulted from medical emergencies involving drug misuse or abuse (1). More than one-half of these visits involved illicit drugs and more than 1.2 million involved the nonmedical use of pharmaceuticals (1). In 2015, one-third of youths in grades 9–12 reported current alcohol use and 18% reported binge drinking at least five or more drinks in a row at least once in the past month (2). Many substance users experience serious, and sometimes fatal, health consequences. The drug-poisoning death rate more than tripled between 2000 and 2016 (from 6.2 to 19.8 per 100,000) (3), and it has been reported that drugs account for 90% of all poisoning deaths (4). In addition, excessive alcohol use accounts for nearly 88,000 deaths annually (5).

Historically, the Substance Abuse and Mental Health Services Administration's (SAMHSA) Drug Abuse Warning Network (DAWN) served as the primary source of public health surveillance data on drug-related ED visits in the United States. Because of rising costs and a low response rate, SAMHSA discontinued DAWN after the completion of the 2011 data collection. However, SAMHSA's legislative mandate requires information collection on ED visits involving the abuse of alcohol and other drugs. Therefore, to continue fulfilling this mandate following the discontinuation of DAWN, SAMHSA partnered with the National Center for Health Statistics (NCHS) on the National Hospital Care Survey (NHCS). Because NHCS also collects data on ED visits, data from the survey on substance use-related visits would be the source for the SAMHSA Emergency Department Surveillance System (SEDSS). SEDSS will use the data to produce national

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Center for Health Statistics

CDC

estimates on ED visits involving recent substance use. NHCS data will also provide SEDSS with a wider range of information on ED visits (including information about patients admitted to the hospital) and comprehensive data on ED visits related to mental disorders.

The case-identification methods used in DAWN, namely ED visit record abstraction, cannot be directly applied to NHCS due to differences in the sources of data collected by each system. The challenge then was to identify ways to capture the data once collected by DAWN in some comparable way from NHCS. Therefore, a pretest was needed to assess data collection methods in NHCS. Direct ED chart review in DAWN enabled the abstractors to exclude ED visits where the patient's substance use was not recent or related to the ED visit. One element of the NHCS pretest included medical record abstraction modeled after the DAWN approach. While this approach was useful in yielding detailed data, it was not feasible to scale up to the entire survey.

The other component of the pretest relied on the use of Uniform Bill (UB)–04 administrative claims data to identify substance-related ED visits. This option was ultimately selected for the survey but because claims data are designed to facilitate billing, not research, they present several limitations. Claims data do not include the contextual information previously available to DAWN, and claims data contain a limited number of data elements, not all of which are always required to be reported to payers.

Using claims data, the first challenge was to identify ED visits that were related to recent substance use (i.e., where the substance directly caused or contributed to the visit). The algorithms were developed for this reason. The second challenge was to identify which specific substances were involved in the visit. The *International Classification of Diseases, 9th Revision*, *Clinical Modification* (ICD–9–CM) diagnosis codes provided limited information about the context of the substance use; little information was available about the specific substances involved in the visit because ICD–9–CM diagnosis codes classify medications by therapeutic category and most illicit drugs lack a unique code. Consequently,

NCHS and SAMHSA collaborated to develop a way to use additional medical codes available in claims data to identify substance-involved ED visits. This report illustrates two methods to identify substance-involved ED visits using algorithms based on medical codes available in administrative claims data; it does so using the non-nationally representative 2013 NHCS ED data.

Methods

Data source

NCHS' Division of Health Care Statistics gathers statistics on the use, access, and quality of health care provided in the United States. Historically, NCHS has conducted three national surveys annually across five ambulatory and hospital-based settings: physician offices, inpatient settings, EDs, outpatient departments (OPDs), and hospital ambulatory surgery locations. In an effort to streamline data collection across health care settings and move toward collecting health care utilization data electronically, NCHS launched a new survey, NHCS, which integrates the National Hospital Discharge Survey (NHDS), the National Hospital Ambulatory Medical Care Survey (NHAMCS), and DAWN (previously conducted by SAMHSA). More information on each of these surveys can be found here: https://www.cdc.gov/nchs/surveys.htm#tabs-2-3 and https://www.samhsa.gov/data/data-we-collect/dawn-drug-abuse-warning-network.

The target universe of NHCS is inpatient discharges and in-person visits made to EDs and OPDs, including ambulatory surgery, in noninstitutional nonfederal hospitals that have six or more staffed inpatient beds in the 50 states and the District of Columbia. Average length of stay is not used as an exclusion criterion as was done in NHDS and NHAMCS, thus expanding the frame beyond short-stay hospitals with an average length of stay of less than 30 days. No geographic primary sampling units are used in this design, and there are no certainty hospitals defined *a priori*. The sampling frame is from Verispan's 2010 spring release of "Healthcare

Market Index" and "Hospital Market Profiling Solution, Second Quarter." For 2013, the total sample consisted of 581 hospitals: 506 acute care hospitals and 75 other specialty hospitals, including children's, psychiatric, long-term acute care, and rehabilitation hospitals.

NHCS electronically collects UB–04 administrative claims data from participating hospitals. The UB–04 is the administrative claim required by the Centers for Medicare & Medicaid Services and most commercial payers. UB–04 claims include physician and patient identifiers and data on patient demographics, diagnoses, procedures, and revenue codes. Starting in 2011, NHCS participating hospitals were asked to submit their inpatient UB–04 administrative claims data electronically. Beginning in 2013, participating hospitals were also asked to provide ambulatory UB–04 administrative claims, in addition to the inpatient data. The participation rate of NHCS remained at approximately 17% for the 2011–2013 data collection periods. Because of the low participation rate, the data are currently unweighted and are not nationally representative. See the Technical Notes for more information on data collection.

This report uses 2013 NHCS ED data from the 82 hospitals that provided ED claims data. The sample includes several types of hospitals, including general acute care (89%), children's (9%), and psychiatric (2%). The unweighted total number of encounters was 3,784,397 ED visits.

Identification of ED visits involving recent substance use

In 2013, NCHS conducted a pretest of two new modes of data collection for NHCS to identify substance-involved ED visits: (a) medical record abstraction based on sampling ED visits from ED logs; and (b) identification of substance-involved visits from UB–04 claims and subsequent medical record abstraction to verify that the visit was actually substance-involved. The first approach mirrored the methodology used by DAWN to identify ED visits related to recent substance use. Following a major redesign in 2003, the DAWN

case-finding methodology and the case definition were expanded to include all ED visits related to recent drug use. These included ED visits that were directly caused by substances, such as overdoses and poisonings, as well as ED visits where substances were a contributing factor, such as a motor vehicle crash where the driver was under the influence of a substance or an infection from injection drug use. Trained abstractors reviewed the entire ED record, gleaning information from the patient history, presenting complaint, clinical notes, toxicology results, and verbatim diagnoses to identify visits related to recent substance use and classify the visits into 1 of 11 case types. This method, while resource intensive, improved DAWN's ability to measure the magnitude and burden of drug use, misuse, and abuse. More information and a detailed description of the DAWN sample design and data collection instrument is available from: https://archive.samhsa.gov/data/2k13/DAWN2k11ED/rpts/DAWN2k11-Methods-Report.htm.

To simulate this approach in the NHCS pretest, trained field staff were placed in sampled hospitals to collect NHCS data by reviewing and abstracting data from ED records. Resource constraints limited the amount of field-based medical record abstraction that could be performed. For the second method, SAMHSA and NCHS developed a list of ICD–9–CM codes to identify visits involving a wide range of drug, medicinal, nonmedicinal, and biological substances. This single list of ICD–9–CM codes was used to identify visits in submitted UB–04 claims that would be targeted for abstraction. Among the submitted claims, any ED visits with at least one of the substance-related ICD–9–CM codes in any diagnosis position, including, but not limited to, external cause of injury code (E-code) fields or codes for conditions commonly associated with drug use, such as altered mental status or palpitations, were flagged.

To verify substance involvement in the visits identified by ICD–9–CM codes, field staff abstracted a simple random sample of these visits onsite. These records were then reviewed to assess how well the ICD–9–CM method identified ED visits involving substance use. This review showed that many of the visits identified by the ICD–9–CM codes did not meet the case definition of an ED visit involving substance use, even with a substance use ICD–9–CM code on the claim. For many of the abstracted records, the recorded substance use diagnosis represented a patient's history of past substance use and was not directly related to the current reason for the visit. In other cases, a substance use code was included on the claim because of recent substance use, but the substance use was not implicated in the reason for the visit. The use of standalone ICD–9–CM symptom codes also yielded many false positives; the abstraction revealed that the symptoms were related to many conditions and not necessarily indicative of recent substance use. This evaluation showed that using a comprehensive list of diagnostic codes for substances would not meet SAMHSA's data needs for identifying ED visits related to recent substance use.

Algorithm development

The comparison of the 2013 pretest results revealed the limitation of the method that relied on a single diagnostic code to identify an ED visit related to recent substance use. Therefore, the approach for targeting cases was refined. Rather than searching for all eligible substances, a subset of 10 priority substance categories was identified:

- Alcohol (under age 21)
- Antidepressants
- Antipsychotics
- Benzodiazepines or sedatives
- Cannabinoids
- Cocaine
- Hallucinogens
- Heroin
- Opiates or opioids
- Pharmaceutical central nervous system stimulants

Lists of ICD–9–CM diagnostic codes specific to each of the 10 priority substance categories were developed. The substance-specific code lists were augmented with symptom and procedure codes associated with substance use (but not necessarily specific substances).

Specific codes included in the diagnosis, symptom, and procedure lists are presented in the "Definition of terms" section.

Two coding algorithms were developed and applied to each substance category. The first, a general algorithm, requires only a diagnosis of substance abuse, dependence, poisoning, adverse reaction, or E-code. The general algorithm is intended to identify ED visits by patients with any record in their chart of substance use (either recent or past) as noted by the presence of at least one code for a specified priority substance category in any of the diagnosis or E-code fields. An example of an ED visit meeting the criteria for the general algorithm is an ED visit with a diagnosis of cocaine abuse. In this example, it is not possible to determine whether the patient's cocaine abuse contributed to the reason for the ED visit or whether the cocaine abuse was recent.

The second algorithm, referred to throughout this report as the enhanced algorithm, requires added or stricter documentation. With the enhanced algorithm, a visit involving recent substance use can be identified in one of two ways: (a) the presence of at least one code for a specified priority substance category in any of the E-code fields, or (b) a diagnosis code associated with a priority substance category accompanied by a code describing a symptom or procedure commonly associated with substance use. For example, an ED visit with a diagnosis of cocaine abuse accompanied by a diagnosis of abnormal involuntary movements meets the criteria of the enhanced algorithm. The combination of the cocaine abuse diagnosis with the symptom of cocaine use (abnormal involuntary movements) increases the likelihood that the ED visit was related to cocaine use. Although the first criterion is similar to the general algorithm, it requires the presence of a code in the E-code field only. This algorithm was developed to meet SAMHSA's need for data on ED visits related to recent substance use.

In both algorithms, visits that had codes from multiple drug classes were included in the count of each priority substance category listed on the claim. That is, counts of priority substance

categories are not mutually exclusive. The Table describes the different algorithms. There is one criterion for the general algorithm: the presence of at least one diagnosis code or E-code for a specified priority substance category. For the enhanced algorithm, visits that meet either of two criteria are flagged as substance-involved visits. The first criterion requires the presence of at least one E-code for a specified priority substance. During the 2013 pretest, E-codes were found to be predictive of a true substance-involved case regardless of whether any other evidence of substance use was recorded for the visit. Cases without an eligible E-code may still qualify as a case if at least one diagnosis code is present for a specified priority substance category and is accompanied by at least one eligible substance use-related symptom or procedure code. The Technical Notes list the specific ICD–9–CM, Current Procedural Terminology (CPT), and Healthcare Common Procedure Coding System (HCPCS) codes used in each algorithm.

Patient and visit characteristics

To determine if the general and enhanced algorithms captured different populations with different characteristics, selected characteristics of visits identified by each algorithm were compared. Patient and visit characteristics presented in the report include sex, age, expected source of payment, and discharge status. For more information on the definitions used for patient and visit characteristics, see the Technical Notes.

¹CNS is central nervous system.
NOTES: Priority substance categories are not mutually exclusive. *n* = 3,784,397 emergency department visits.
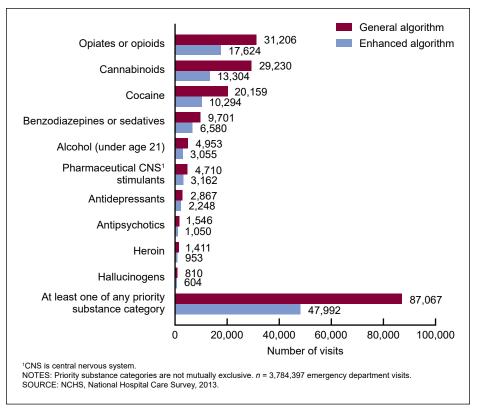SOURCE: NCHS, National Hospital Care Survey, 2013.

Figure 1. Number of emergency department visits identified by the general and enhanced algorithms for each priority substance category: National Hospital Care Survey, 2013

Analysis

Relative percent differences in the number of substance-involved ED visits identified by the general compared with enhanced algorithms are presented. The number of substance-involved visits identified by the enhanced algorithm was set as a reference value and the relative percent difference was calculated using the following formula:

Relative percent difference = [(*n* of *General Algorithm Visits* − *n* of *Enhanced Algorithm Visits*)/ *n* of *Enhanced Algorithm Visits*] × 100

Similarities and differences in patient and visit characteristics, both within and between the algorithms, are also noted. However, statistical testing of differences was not performed due to the nonrepresentative nature of the data and the relatively large counts of records. Due to the low response rate of sampled hospitals, the data are unweighted and are not nationally representative.

Results

ED visits involving priority substance categories

- A total of 87,067 ED visits involved at least 1 priority substance category according to the general algorithm and 47,992 ED visits according to the enhanced algorithm (Figure 1 and Table 1).
- The most frequently identified priority substance category was opiates or opioids (31,206 general; 17,624 enhanced) and the least frequently identified was hallucinogens (810 general; 604 enhanced).
- The general algorithm identified 81% more ED visits involving at least one

Table. Algorithms used to identify emergency department visits involving priority substance categories

Algorithm	Description
General	A case must meet the following criterion: Presence of at least one diagnosis code or E-code for a specified priority substance category in any of the diagnosis or E-code fields.
Enhanced	A case can meet either of two criteria: 1) Presence of at least one E-code for a specified priority substance category in any of the E-code fields. 2) If no E-code is present, then presence of at least one diagnosis code for a specified priority substance category combined with presence of at least one substance use-related symptom or procedure code in any of the diagnosis or procedure fields.

of the priority substance categories compared with the enhanced algorithm (Figure 2 and Table 1).

● The largest relative percent differences in the number of ED visits identified by the general algorithm compared with the enhanced algorithm were for cannabinoids (120%) and cocaine (96%), while the smallest relative percent differences were for antidepressants (28%) and hallucinogens (34%).

Patient and visit characteristics

Patient sex

● For both algorithms, females accounted for the majority of patients in visits involving benzodiazepines or sedatives, antidepressants, and antipsychotics. For the other substances, a higher percentage of visits were among male patients (Figure 3 and Tables 2 and 3).

● The distribution of patient sex was similar across both algorithms.

Patient age group

● For both algorithms, substances with the greatest percentage of ED visits in the youngest age group (0–15) were antidepressants, antipsychotics, hallucinogens, and alcohol use (under age 21). Substances with the greatest percentage of visits in the oldest age group (55 and over) included benzodiazepines or sedatives, antidepressants, and opiates or opioids (Figure 4 and Tables 2 and 3).

● The age distributions were similar for ED visits identified by the general and enhanced algorithms.

Expected source of payment

● The expected source of payment differed widely across priority substance categories. For both algorithms, Medicaid was most frequently used in ED visits involving cocaine, Medicare was most frequently used in ED visits involving benzodiazepines or sedatives, and private insurance was
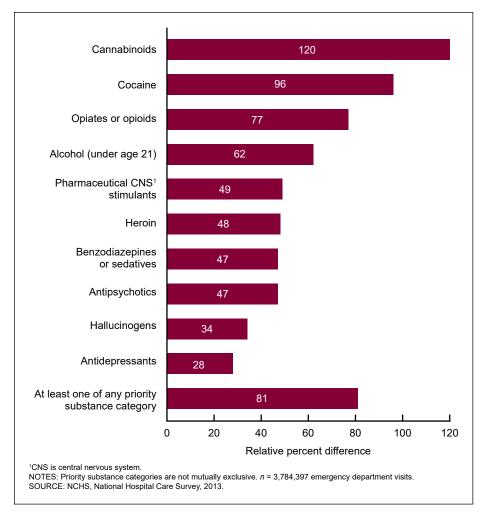

Figure 2. Relative percent difference in the number of emergency department visits identified between the general and enhanced algorithms for each priority substance category: National Hospital Care Survey, 2013

[1]CNS is central nervous system.
NOTES: Priority substance categories are not mutually exclusive. n = 3,784,397 emergency department visits.
SOURCE: NCHS, National Hospital Care Survey, 2013.

most frequently used in ED visits involving alcohol (under age 21) (Figure 5 and Tables 2 and 3).

● The expected source of payment distributions were similar across both algorithms.

Discharge status

● For both algorithms, the majority of ED visits involving alcohol (under age 21), heroin, cannabinoids, and hallucinogens resulted in a discharge home compared with some other discharge status. Across both algorithms, between 54% and 61% of ED visits involving opiates or opioids and benzodiazepines or sedatives resulted in a hospitalization (i.e., admitted to the hospital visited or transferred to a different health care facility) (Figure 6 and Tables 2 and 3).

● Heroin-involved ED visits comprised the greatest percentage of visits in which the patient left against medical advice (7% enhanced, 6% enhanced).

● The discharge status distributions were not as similar between the general and enhanced algorithms across all substance-involved ED visits compared with the other characteristics. For example, the majority of cocaine-involved ED visits identified by the general algorithm ended in a hospitalization, while the majority of such visits identified by the enhanced algorithm resulted in a discharge home.

Discussion

This report describes how the need for a method to identify substance-involved ED visits led to the development
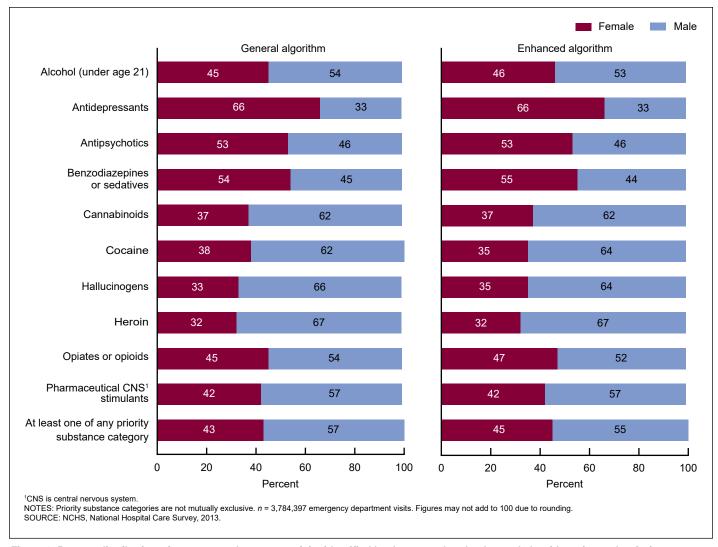
Figure 3. Percent distribution of emergency department visits identified by the general and enhanced algorithms for each priority substance category, by sex: National Hospital Care Survey, 2013

of two potential strategies for visit identification using non-nationally representative data from the 2013 NHCS derived from UB–04 administrative claims. The general algorithm, which uses diagnosis and E-codes indicating substance abuse, dependence, poisoning, and adverse effects, identified 87,067 ED visits involving at least 1 priority substance category. Previous studies have applied algorithms similar to the general algorithm to claims data to calculate national estimates and rates of ED visits for patients presenting with some evidence of substance use, particularly for opioids (6,7). Code-based algorithms are potentially more efficient and less burdensome for monitoring trends in the number and type of substance-involved ED visits compared with facility-based medical record abstraction.

Code-based algorithms are not without their limitations. Research has found that using diagnosis and E-codes alone can overestimate hospital encounters involving narrowly defined types of substance use, such as pediatric opioid toxicity (8) and drug-induced liver injury (9). One criterion of the enhanced algorithm attempts to address this concern by requiring that a substance abuse, dependence, or poisoning diagnostic code be accompanied by a symptom or procedure commonly associated with substance use. The enhanced algorithm identified 47,992 ED visits in the UB–04 claims involving at least 1 priority substance category. By excluding visits that lack evidence of recent substance use beyond diagnosis or E-codes, the enhanced algorithm more closely meets the case definition of ED visits involving recent substance

use (i.e., ED visits where the substance use directly caused or contributed to the reason for the ED visit).

Overall, the general algorithm identified 81% more ED visits involving at least one of the priority substance categories compared with the enhanced algorithm. However, the relative percent difference in the number of ED visits identified between the general and enhanced algorithms varied widely depending on the type of substance involved, ranging from 28% for antidepressants to 120% for cannabinoids. The percentage of ED visits that were identified by the general algorithm and excluded by the enhanced algorithm varied by substance. Visits that were identified by the general algorithm but not by the enhanced algorithm may represent patients with a history of substance use, or patients who are current
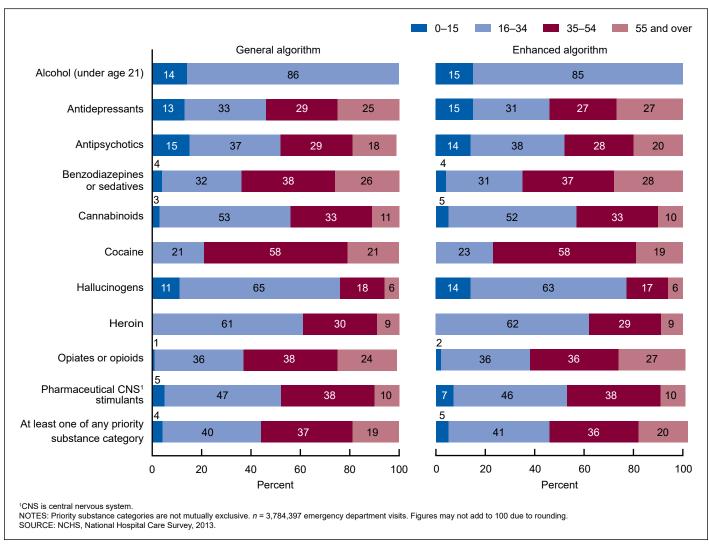
Figure 4. Percent distribution of emergency department visits identified by the general and enhanced algorithms for each priority substance category, by age group: National Hospital Care Survey, 2013

substance users but whose substance use was not related to the ED visit.

This report also demonstrates the ability to explore characteristics of substance-involved ED visits identified by different algorithms. The percent distributions of patient sex, age, and expected source of payment across all substances were similar between the general and enhanced algorithms. In contrast, there were differences in discharge status distributions between both algorithms across all substances. These findings suggest that the two algorithms identify visits with mostly similar characteristics, with the exception of where the patient was discharged upon release from the ED.

This report has several limitations. First, both algorithms may miss some cases and thus produce an undercount of the actual number of substance-

involved visits. Research indicates that this problem may be more likely for the general algorithm than for the enhanced algorithm. A study to validate the use of ICD–9–CM codes to identify opioid overdose ED visits found that when only the opioid overdose codes were used, only about one-quarter of true opioid overdose ED visits were identified (10). A validation study of both NHCS algorithms is planned; it will include an attempt to measure the proportion of missed cases (false negatives) and identify methods to capture these visits. There were also limitations specific to the data source. The UB–04 administrative claims data were designed to facilitate hospital billing rather than research. Some types of ED visits are not well represented in the data set, including those with an expected source of payment of charity or self-pay, because UB–04

claims are not typically generated for these visits. Next, data on some ED visits were submitted as bundled claims, particularly ED visits that resulted in an inpatient stay, in order to more efficiently bill for care. Although attempts were made to identify unique visits on bundled claims when possible, there may be some overcounting of ED visits. Similarly, it was not always possible to distinguish between services delivered in the ED compared with the inpatient department on bundled claims.

This analysis was a first step in determining differences in substance-involved ED visits identified using two algorithms with different criteria. As NHCS continues to move toward the collection of electronic health records (EHRs), some of the limitations of UB–04 data will be overcome. EHR data will include all patients, regardless
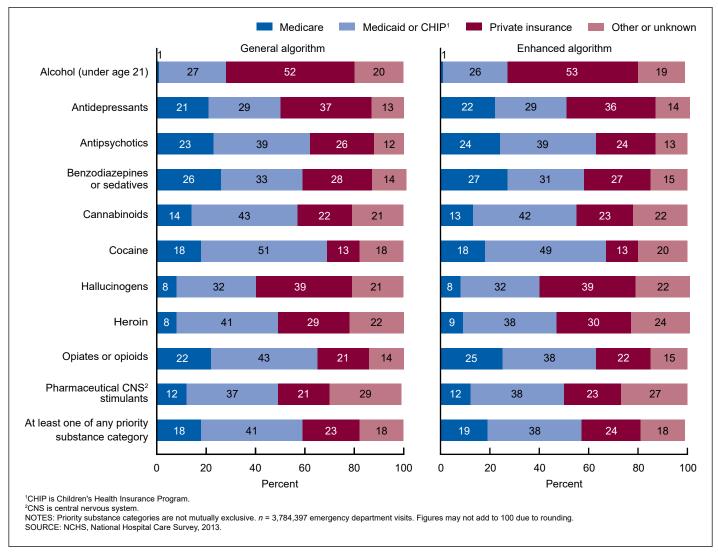
Figure 5. Percent distribution of emergency department visits identified by the general and enhanced algorithms for each priority substance category, by expected source of payment: National Hospital Care Survey, 2013

of the payment source. With EHR data, it will be easier to distinguish unique encounters compared with claims data and the timing and nature of specific services provided in the ED. In addition, algorithms can be further refined to identify substance-involved visits by incorporating more data from the EHR, such as clinical notes capturing patient statements regarding events leading up to their ED visit, positive blood or urine tests for specific substances, and types of medication administered or prescribed during the encounter. Future iterations of the algorithms will also replace existing ICD–9–CM codes with comparable ICD–10–CM codes, which have been used nationwide since October 1, 2015. Once refined, special studies can be conducted to validate algorithms against a gold standard medical record abstraction to determine sensitivity and specificity. Eventually, validated algorithms can be used with NHCS data to generate national estimates of ED visits involving substance use.

References

1. Substance Abuse and Mental Health Services Administration. Drug Abuse Warning Network, 2011: National estimates of drug-related emergency department visits. HHS Publication No. (SMA) 13–4760, DAWN Series D–39. Rockville, MD. 2013.
2. Kann L, McManus T, Harris WA, Shanklin SL, Flint KH, Hawkins J, et al. Youth risk behavior surveillance–United States, 2015. MMWR Surveill Summ 65(6):1–174. 2016.
3. Hedegaard H, Warner M, Miniño AM. Drug overdose deaths in the United States, 1999–2016. NCHS Data Brief, no 294. Hyattsville, MD: National Center for Health Statistics. 2017.
4. Warner M, Chen LH, Makuc DM, Anderson RN, Miniño AM. Drug poisoning deaths in the United States, 1980–2008. NCHS Data Brief, no 81. Hyattsville, MD: National Center for Health Statistics. 2011.
5. Centers for Disease Control and Prevention. Fact sheets–Preventing excessive alcohol use. Atlanta, GA. Available from: https://www.cdc.gov/alcohol/fact-sheets/prevention.htm.
6. Yokell MA, Delgado MK, Zaller ND, Wang NE, McGowan SK, Green TC. Presentation of prescription and nonprescription opioid overdoses to US emergency departments. JAMA Intern Med 174(12):2034–7. 2014.

Figure 6. Percent distribution of emergency department visits identified by the general and enhanced algorithms for each priority substance category, by discharge status: National Hospital Care Survey, 2013

7. Hasegawa K, Brown DF, Tsugawa Y, Camargo CA Jr. Epidemiology of emergency department visits for opioid overdose: A population-based study. Mayo Clinic Proc 89(4):462–71. 2014.

8. Chung CP, Callahan ST, Cooper WO, Murray KT, Hall K, Dudley JA, et al. Development of an algorithm to identify serious opioid toxicity in children. BMC Res Notes 8:293. 2015.

9. Bui CL, Kaye JA, Castellesague J, Calingaert B, McQuay LJ, Rivera-Guardia N, et al. Validation of acute liver injury cases in a population-based cohort study of oral antimicrobial users. Curr Drug Saf 9(1):23–8. 2014.

10. Rowe C, Vittinghoff E, Santos GM, Behar E, Turner C, Coffin PO. Performance measures of diagnostic codes for detecting opioid overdose in the emergency department. Acad Emerg Med 24(4):475–83. 2017.

Table 1. Number and percentage of emergency department visits identified by the general and enhanced algorithms for each priority substance category: National Hospital Care Survey, 2013

Priority substance category	General algorithm		Enhanced algorithm		Relative percent difference
	Number	Percent	Number	Percent	
Alcohol (under age 21)	4,953	0.1	3,055	0.1	62.1
Antidepressants	2,867	0.1	2,248	0.1	27.5
Antipsychotics.	1,546	0.0	1,050	0.0	47.2
Benzodiazepines or sedatives	9,701	0.3	6,580	0.2	47.4
Cannabinoids	29,230	0.8	13,304	0.4	119.7
Cocaine	20,159	0.5	10,294	0.3	95.8
Hallucinogens.	810	0.0	604	0.0	34.1
Heroin.	1,411	0.0	953	0.0	48.1
Opiates or opioids.	31,206	0.8	17,624	0.5	77.1
Pharmaceutical CNS[1] stimulants	4,710	0.1	3,162	0.1	49.0
At least one of any priority substance category	87,067	2.3	47,992	1.3	81.4
Total	3,784,397	100.0	3,784,397	100.0	...

0.0 Quantity more than zero but less than 0.05.
... Category not applicable.
[1]CNS is central nervous system.

NOTES: Priority substance categories are not mutually exclusive. Data are unweighted and not nationally representative.

SOURCE: NCHS, National Hospital Care Survey, 2013.

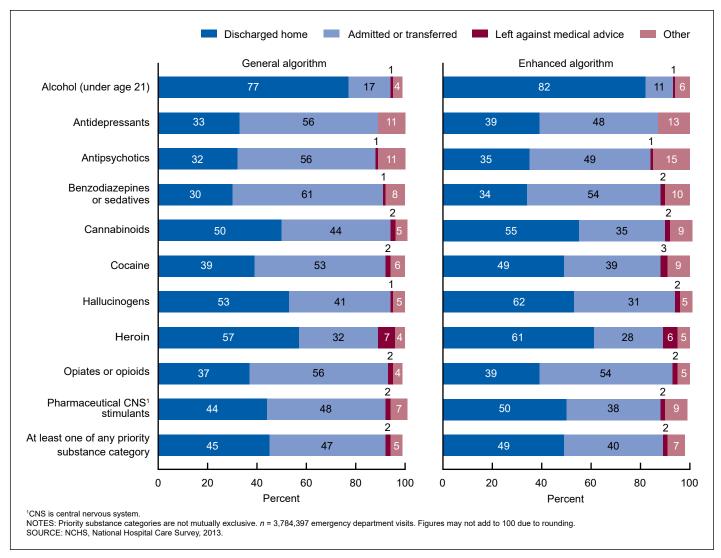**Table 2. Number and percent distribution of emergency department visits identified by the general algorithm for each priority substance category, by selected patient and visit characteristics: National Hospital Care Survey, 2013**

Characteristic	Total	Alcohol (under age 21)	Antidepressants	Antipsychotics	Benzodiazepines or sedatives	Cannabinoids	Cocaine	Hallucinogens	Heroin	Opiates or opioids	Pharmaceutical CNS[1] stimulants	At least one of any priority substance category
					Number							
Total	3,784,397	4,952	2,867	1,546	9,701	29,230	20,159	810	1,411	31,206	4,710	87,067
					Percent distribution							
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Sex												
Female	55.2	45.1	66.5	53.4	54.8	37.1	36.0	33.5	32.5	45.7	42.0	43.0
Male	44.8	55.0	33.5	46.6	45.2	62.9	64.0	66.5	67.5	54.3	58.0	57.0
Age group												
0–15	26.5	13.7	13.4	14.9	3.6	3.4	0.2	11.1	0.1	1.3	5.2	3.5
16–34	24.8	86.3	32.8	37.4	32.1	52.9	21.2	64.7	61.0	35.9	46.6	40.4
35–54	22.2	–	28.7	29.3	37.9	33.0	57.7	18.2	30.1	38.4	38.0	37.2
55 and over.	26.4	–	25.1	18.4	26.4	10.7	20.9	6.1	8.9	24.3	10.2	18.9
Expected source of payment												
Medicare.	18.3	1.1	21.1	22.8	25.8	14.0	18.1	8.4	8.3	22.5	12.5	18.2
Medicaid or CHIP[2]	34.3	26.7	28.9	38.8	32.7	43.1	51.2	32.1	41.1	42.6	37.2	41.3
Private insurance	32.7	52.1	36.6	25.9	27.8	22.0	12.9	38.5	29.0	20.7	21.1	22.9
Other or unknown.	14.7	20.2	13.5	12.5	13.7	20.9	17.8	21.0	21.6	14.3	29.3	17.7
Discharge status												
Discharged home	78.8	77.5	32.9	31.6	29.6	49.9	38.8	53.0	57.4	37.4	43.7	45.5
Transferred or admitted to a hospital	18.5	17.3	55.5	56.5	60.9	43.6	52.8	41.0	32.2	56.4	47.6	47.5
Left against medical advice	1.2	1.0	0.3	0.8	1.4	1.5	2.2	1.4	6.5	2.0	1.9	1.8
Other.	1.5	4.3	11.3	11.1	8.1	5.0	6.2	4.7	4.0	4.2	6.8	5.3

– Quantity zero.
[1] CNS is central nervous system.
[2] CHIP is Children's Health Insurance Program.

NOTES: Priority substance categories are not mutually exclusive. Data are unweighted and not nationally representative.

SOURCE: NCHS, National Hospital Care Survey, 2013.

Table 3. Number and percent distribution of emergency department visits identified by the enhanced algorithm for each priority substance category, by selected patient and visit characteristics: National Hospital Care Survey, 2013

Characteristic	Total	Alcohol (under age 21)	Antidepressants	Antipsychotics	Benzodiazepines or sedatives	Cannabinoids	Cocaine	Hallucinogens	Heroin	Opiates or opioids	Pharmaceutical CNS[1] stimulants	At least one of any priority substance category
					Number							
Total	3,784,397	3,055	2,248	1,050	6,580	13,304	10,294	604	953	17,624	3,162	47,992
					Percent distribution							
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Sex												
Female	55.2	46.3	66.9	53.9	55.2	37.3	35.8	35.1	32.3	47.5	42.3	44.9
Male	44.8	53.8	33.1	46.1	44.8	62.7	64.2	64.9	67.7	52.5	57.7	55.1
Age group												
0–15	26.3	15.0	14.9	14.3	4.2	4.9	0.2	13.9	0.1	1.8	6.5	4.6
16–34	25.0	85.0	30.9	37.8	31.3	52.4	23.0	62.8	62.4	36.0	45.7	39.8
35–54	22.2	–	27.0	27.6	36.7	33.0	58.1	17.4	29.0	35.6	9.8	35.7
55 and over.	26.4	–	27.2	20.3	27.8	9.8	18.6	6.0	8.5	26.6	38.1	19.9
Expected source of payment												
Medicare.	18.3	1.4	21.9	23.7	26.6	13.5	18.2	8.1	8.5	24.9	11.7	19.4
Medicaid or CHIP[2]	34.3	26.3	28.6	38.6	31.4	42.0	49.0	31.6	38.2	37.9	38.5	38.2
Private insurance	32.7	53.2	35.9	24.4	27.4	22.7	12.6	38.7	29.7	22.0	22.9	24.2
Other or unknown.	14.7	19.1	13.6	13.3	14.6	21.9	20.2	21.5	23.6	15.3	26.9	18.2
Discharge status												
Discharged home	78.8	81.9	38.6	35.3	33.9	54.7	49.1	61.8	61.4	38.6	50.1	49.3
Transferred or admitted to a hospital	18.5	11.4	47.7	48.8	54.3	34.8	39.2	31.5	27.8	54.4	38.3	41.3
Left against medical advice	1.2	0.9	0.4	1.1	1.6	2.0	2.8	1.5	5.6	1.8	2.3	1.9
Other.	1.5	5.9	13.4	14.9	10.2	8.5	8.9	5.3	5.3	5.1	9.3	7.4

– Quantity zero.

[1] CNS is central nervous system.

[2] CHIP is Children's Health Insurance Program.

NOTES: Priority substance categories are not mutually exclusive. Data are unweighted and not nationally representative.

SOURCE: NCHS, National Hospital Care Survey, 2013.

Technical Notes

Data collection and processing

All inpatient and ambulatory claims data are transmitted through the contractor's secure transfer system. These data are compiled, processed, and sent to the National Center for Health Statistics (NCHS). In some cases, one encounter for an inpatient discharge or an ambulatory visit had multiple claims because it was resubmitted to insurers for reimbursement due to errors or for other reasons. In addition, there are instances in which hospitals bundled two or more encounters on the same claim for ease of billing. Therefore, data processing involves deduplication and claims splitting procedures to distinguish as many unique encounters as possible.

Emergency department visit patients admitted as inpatients

Emergency department (ED) visit patients who were admitted as inpatients did not have separate ED records. Therefore, the inpatient record was duplicated in the ED file. However, the duplicated ED record maintains the inpatient discharge status. To get an accurate account of ED discharge status, inpatient records in the ED file had the discharge status changed to "admitted as an inpatient."

Definition of terms

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

- Discharged home: 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 or admitted to a hospital: 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.

Note: Receipt of observation services is not captured in the discharge status field, but may be captured in other Uniform Bill (UB)–04 data locations.

Expected source of payment—Represents all sources of payment collapsed into one mutually exclusive variable with the following categories:

- Private insurance: Charges paid in-part or in-full by a private insurer (e.g., BlueCross BlueShield), including those from private insurance-sponsored prepaid plans.
- Medicare: Charges paid in-part or in-full by a Medicare plan, including those from Medicare-sponsored prepaid plans.
- Medicaid or Children's Health Insurance Program (CHIP): Charges paid in-part or in-full by Medicaid or CHIP, including those from Medicaid-sponsored prepaid plans.
- Other or unknown: All other sources of payment not covered by any of the above categories, including self-pay and charity, or when no source of payment was recorded.

Medical codes used in the algorithms—Several systems of universal medical alphanumeric codes were used in the algorithms to identify health care diagnoses, external causes of injury, symptoms, and procedures that are associated with the use of the 10 priority substance categories. The Technical Notes Table identifies the specific coding system and codes used in each algorithm.

Table. Medical coding systems and selected codes used in the general and enhanced algorithms

Category	Coding system and selected codes	Applicable algorithm(s)
Alcohol (under age 21)	*International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD–9–CM) diagnosis codes: 291.0, 291.3, 291.4, 291.9, 291.81–291.82, 291.89, 303.00–303.02, 303.90–303.92, 305.00–305.02, 535.30–535.31, 760.71, 790.3, 977.3, 980.0, 980.9 ICD–9–CM E-codes: E860.0–E860.1, E860.9, E947.3	General and enhanced
Antidepressants	ICD–9–CM diagnosis codes: 305.80–305.82, 969.00–969.05, 969.09 ICD–9–CM E-codes: E854.0, E939.0	General and enhanced
Antipsychotics.	ICD–9–CM diagnosis codes: 969.1–969.3 ICD–9–CM E-codes: E853.0–E853.1, E939.1–E939.2	General and enhanced
Benzodiazepines or sedatives	ICD–9–CM diagnosis codes: 304.10–304.12, 305.40–305.42, 967.6, 967.8, 967.9, 969.4 ICD–9–CM E-codes: E853.2, E939.4, E980.2	General and enhanced
Cannabis	ICD–9–CM diagnosis codes: 304.30–304.32, 305.20–305.22	General and enhanced
Cocaine	ICD–9–CM diagnosis codes: 304.20–304.22, 305.60–305.62, 760.75, 970.81	General and enhanced
Hallucinogens.	ICD–9–CM diagnosis codes: 304.50–304.52, 305.30–305.32, 760.73, 969.6 ICD–9–CM E-codes: E854.1, E939.6	General and enhanced
Heroin.	ICD–9–CM diagnosis code: 965.01 ICD–9–CM E-codes: E850.0, E935.0	General and enhanced
Opiates or opioids[1]	ICD–9–CM diagnosis codes: 304.00–304.02, 304.70–304.72, 305.50–305.52, 760.72, 965.00, 965.02, 965.09, 970.1 ICD–9–CM E-codes: E850.1–E850.2, E935.1–E935.2, E940.1	General and enhanced
Pharmaceutical CNS[2] stimulants	ICD–9–CM diagnosis codes: 304.40–304.42, 305.70–305.72, 969.70–969.73, 969.79, 970.0, 970.89, 970.9 ICD–9–CM E-codes: E854.2–E854.3, E940.0, E940.8–E940.9	General and enhanced
Substance use-related procedures.	Current Procedural Terminology (CPT)/Healthcare Common Procedure Coding System (HCPCS) codes: 80100–80102, 82055, 82075, 90935, 90937, 90997, 91105, 99408, 99409, G0396–G0397, G0430–G0431, G0434, G0442–G0443, G6031, H0001–H0003, H0006–H0007, H0014, H0016, H0020, H0022–H0029, H0047–H0050, H2010, J0592, J0735, J1230, J1990, J2060, J2270–J2271, J2275, J2310, J2315, J2560, J3360, S0093, S0109 ICD–9–CM procedure codes: 39.95, 93.54, 94.45, 94.46, 94.53, 94.61–94.69, 96.33, 99.26	Enhanced
Substance use-related symptoms	ICD–9–CM diagnosis codes: 292.11–292.12, 292.2, 292.81, 292.85, 292.89, 780.09, 780.1–780.2, 780.4, 780.64, 780.79, 780.8, 780.97, 781.0, 781.2–781.3, 783.22, 785.0–785.1, 786.05, 786.50, 787.01–787.02, V62.84, V65.42	Enhanced

[1]Selected ICD–9–CM codes for opiates or opioids include poisoning and adverse effects of opiate antagonists to serve as proxies for emergency department visits involving the treatment of opioid use.
[2]CNS is central nervous system.

NOTES: Both algorithms include only ICD–9–CM codes involving the use of specific substances or specific categories of substances; codes involving the use of unspecified substances are excluded. In addition, both algorithms include ICD–9–CM codes capturing a wide range of substance use, including codes for substance abuse, dependence, poisoning, and adverse reactions.

For more NCHS NHSRs, visit:
https://www.cdc.gov/nchs/products/nhsr.htm.

National Health Statistics Reports ■ Number 114 ■ August 14, 2018

Suggested citation

Copyright information

National Center for Health Statistics