

# Drug Overdose Surveillance Using Hospital Discharge Data

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## ABSTRACT

**Objectives.** We compared three methods for identifying drug overdose cases in inpatient hospital discharge data on their ability to classify drug overdoses by intent and drug type(s) involved.

**Methods.** We compared three International Classification of Diseases, Ninth Revision, Clinical Modification code-based case definitions using Kentucky hospital discharge data for 2000–2011. The first definition (Definition 1) was based on the external-cause-of-injury (E-code) matrix. The other two definitions were based on the Injury Surveillance Workgroup on Poisoning (ISW7) consensus recommendations for national and state poisoning surveillance using the principal diagnosis or first E-code (Definition 2) or any diagnosis/E-code (Definition 3).

**Results.** Definition 3 identified almost 50% more drug overdose cases than did Definition 1. The increase was largely due to cases with a first-listed E-code describing a drug overdose but a principal diagnosis that was different from drug overdose (e.g., mental disorders, or respiratory or circulatory system failure). Regardless of the definition, more than 53% of the hospitalizations were self-inflicted drug overdoses; benzodiazepines were involved in about 30% of the hospitalizations. The 2011 age-adjusted drug overdose hospitalization rate in Kentucky was 146/100,000 population using Definition 3 and 107/100,000 population using Definition 1.

**Conclusion.** The ISW7 drug overdose definition using any drug poisoning diagnosis/E-code (Definition 3) is potentially the highest sensitivity definition for counting drug overdose hospitalizations, including by intent and drug type(s) involved. As the states enact policies and plan for adequate treatment resources, standardized drug overdose definitions are critical for accurate reporting, trend analysis, policy evaluation, and state-to-state comparison.

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Drug overdoses are a very serious and rapidly growing public health problem in the United States.<sup>1–3</sup> In 2010, there were 38,329 deaths due to drug overdoses, with an annual age-adjusted rate of 12.3 deaths per 100,000 population, almost twice the age-adjusted rate recorded in 2000 (6.2 per 100,000 population).<sup>4,5</sup> The increase in drug overdose deaths is associated with increased prescribing of opioid analgesics, inappropriate prescribing practices, profitable diversion of prescription drugs, and illicit practices such as “doctor shopping” (i.e., patients who visit multiple physicians within a defined time period to obtain prescription drugs, presumably for non-legitimate reasons) and “pharmacy shopping” (i.e., patients who visit multiple pharmacies to fill prescriptions)<sup>6</sup> that contribute to increased misuse, abuse, addiction, and accidental overdose.<sup>6–14</sup> Drug overdose hospitalizations from prescription opioids, sedatives, and tranquilizers in the U.S. increased 65% overall from 1999 to 2006. There was also a 130% increase in intentional poisonings from these drugs.<sup>15</sup>

The choice of definitions for identifying drug overdose mortality or morbidity has important implications for surveillance and policy.<sup>16,17</sup> While there is general consensus among researchers on definitions used to identify drug overdose deaths,<sup>17–19</sup> there are a variety of definitions used to identify drug overdose morbidity in administrative data, such as hospital discharge or emergency room use.<sup>20–22</sup> Some definitions are based on the external-cause-of-injury code (E-code) only, some are based on the principal diagnosis only, and others use a combination of the two. The consensus recommendations for national and state poisoning surveillance by the Safe States Alliance’s Injury Surveillance Workgroup on Poisonings (ISW7)<sup>17</sup> suggested two drug overdose surveillance case definitions for International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)-coded data. One of the definitions identified cases based on the principal diagnosis, or first-listed E-code for drug poisoning. The other definition included cases with any diagnosis or any E-code indicating drug poisoning. These two definitions are broader and will likely identify more drug overdose cases than a definition based on the external-cause-of-injury matrix,<sup>23</sup> which is used as a framework to generate state injury indicators.<sup>18</sup> To the best of our knowledge, no study has compared these approaches for identifying drug poisoning cases in a state hospital discharge dataset.

The objectives of this study were to examine three ICD-9-CM code-based case definitions for identifying drug overdose cases in hospitalization data, compare their abilities to classify the drug overdoses by intent and specific drug involved, and recommend an

optimum surveillance definition for drug overdoses to inform policies, health-care resource allocation, substance abuse treatment planning, and prevention.

## METHODS

“Drug overdose” is the commonly accepted name for an “acute drug poisoning.” The meanings of the terms “poisoning” and “drug” in this study were as defined in the ISW7’s consensus recommendations.<sup>17</sup> Three ICD-9-CM code-based case definitions for identifying drug overdose hospitalizations were compared in this study. Definition 1 was derived from the Centers for Disease Control and Prevention’s (CDC’s) definition for the state indicator on total poisoning hospitalizations, currently used by the CDC-funded Core Violence and Injury Prevention Programs.<sup>18</sup> Definitions 2 and 3 were proposed by the ISW7 and were referenced in their consensus recommendations as ICD-9-CM definitions of acute poisoning hospitalizations, Option A and Option B, correspondingly.<sup>17</sup> The definitions are as follows:

1. Definition 1: The first-listed valid E-code is *drug poisoning* (E850–E858, E950 [.0–.5], E962.0, and E980 [.0–.5]) and the principal diagnosis is *injury* (diagnosis codes of 800–909.2, 909.4, 909.9, 910–994.9, 995.5–995.59, and 995.80–995.85).
2. Definition 2: The first-listed E-code is *drug poisoning* (E850–E858, E950 [.0–.5], E962.0, and E980 [.0–.5]) or the principal diagnosis is *drug poisoning* (diagnosis codes of 960–979).
3. Definition 3: At least one E-code is *drug poisoning* or at least one diagnosis (principal or secondary) is *drug poisoning*.

The principal diagnosis is defined as the condition established after studying the patient to be chiefly responsible for admission of the patient to the hospital.<sup>24</sup> All conditions that coexist at the time of admission, develop subsequently, or affect the treatment received and/or the length of stay are coded as secondary diagnoses.

Following CDC recommendations,<sup>18</sup> the first-listed valid E-code was identified in the following manner: (1) search all designated E-code fields and all diagnosis fields, starting with the designated E-code fields; and (2) count the first-listed valid E-code, unless it is E000–E030, E849, E869.4, E870–E879, E930–E949, or E967, in which case search additional E-code fields and diagnostic fields and use the next-listed valid E-code. E-codes E000–E030, E849, E869.4, E870–E879, E930–E949, and E967 are not valid E-codes for describing an injury by cause and intent.

We used data from the Kentucky inpatient hospital discharge (HD) claims for Kentucky residents treated in Kentucky nonfederal, acute-care hospitals during 2000–2011. Reported counts represent the number of hospitalizations (i.e., encounters of care). The Kentucky HD data system contains a principal diagnosis, up to 24 secondary diagnoses, and up to three designated E-code fields. If more than three E-codes are used, they are entered in the diagnosis fields.

Drug overdose characterization by drug type was based on any mention of a particular drug in the principal or secondary diagnosis fields in the cases captured by each definition. Drug overdose hospitalizations by intent were based on the first-listed drug overdose E-code in the range E850–E858 (unintentional), E950 (.0–.5) (self-harm), E962.0 (assault), and E980 (.0–.5) (undetermined), starting the search from the first designated E-code field and continuing throughout the diagnosis fields if necessary. If no E-codes were available for intent, the drug overdose hospitalization was not classifiable.

We calculated age-adjusted rates using age-specific

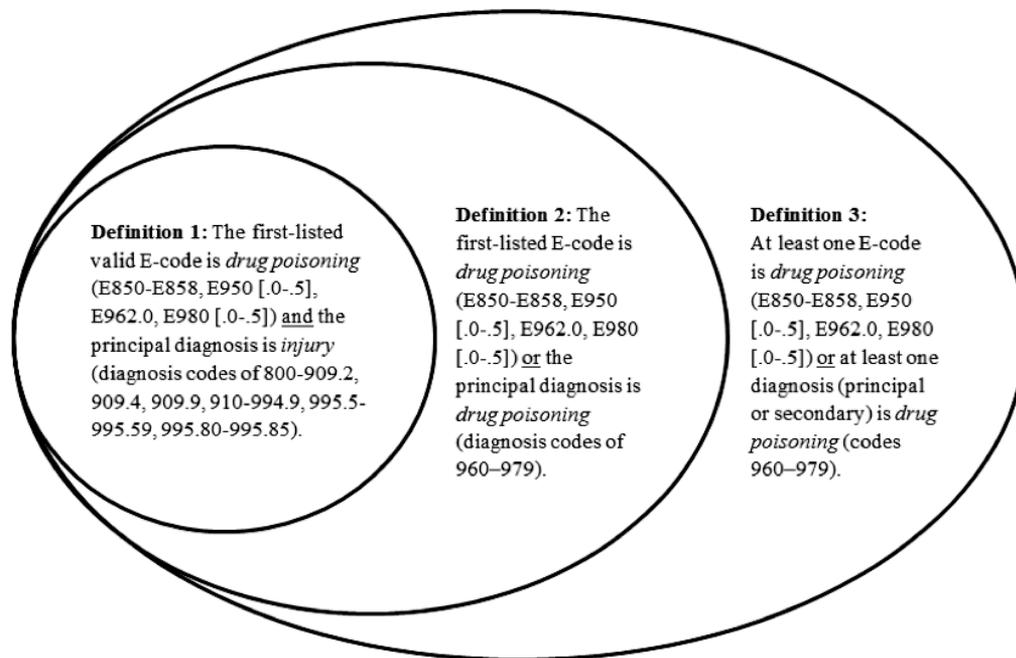
U.S. 2000 standard population weights.<sup>18</sup> Numerators represented drug overdose hospitalizations. Denominators were based on the mid-year population for the calendar year under surveillance, using U.S. Census Bureau population estimates.<sup>25</sup> We performed the descriptive analysis using SAS® version 9.3.<sup>26</sup>

**RESULTS**

Figure 1 shows the relationship among the definitions. The drug poisoning cases identified by Definition 1 are a subset of the drug poisoning cases identified by Definition 2. Definition 3 is the most inclusive definition, and the set identified by Definition 3 includes all cases identified by Definitions 1 and 2.

Definition 3 identified 58,704 drug overdose hospitalizations during the study period, a 46% increase in the number of identified drug overdose cases compared with those identified using Definition 1 (*n*=40,144) and a 5% increase compared with cases captured by Definition 2 (*n*=55,920) (Table 1).

**Figure 1. ICD-9-CM definitions for drug overdose (i.e., acute drug poisoning) hospitalizations**



Note: Definition 1 is derived from the poisoning hospitalizations indicator definition found in: Thomas KE, Johnson RL. State injury indicators report: instructions for preparing 2011 data. Atlanta: Centers for Disease Control and Prevention (US), National Center for Injury Prevention and Control; 2013. Definitions 2 and 3 are the ICD-9-CM definitions of acute poisoning hospitalizations, Option A and Option B, correspondingly, taken from: Safe States. Consensus recommendations for national and state poisoning surveillance: report from the Injury Surveillance Workgroup (ISW7). Atlanta: Safe States; 2012.

ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification  
 E-code = external-cause-of-injury code

**Definition 1**

All hospitalizations identified by Definition 1 ( $n=40,144$ ) had a first-listed valid E-code of drug poisoning. Almost all (99.6%) of the records identified by case Definition 1 also had a principal diagnosis of drug overdose (Table 1). The majority (66%) of the drug overdose hospitalizations had only one listed drug overdose diagnosis code; 22% had two listed drug

overdose diagnosis codes, 8% had three listed drug overdose diagnosis codes, and 4% had  $\geq 4$  drug overdose diagnoses listed (data not shown).

**Definition 2**

There was a 39% increase in the identified drug overdose cases ( $n=55,920$ ) using Definition 2 vs. Definition 1. The cases added by Definition 2 ( $n=15,776$ ) can be

**Table 1. Drug overdose hospitalizations, by principal diagnosis: Kentucky, 2000–2011**

Principal diagnosis and ICD-9-CM code	Definition 1	Definition 2	Definition 3
	N (percent)	N (percent)	N (percent)
1. Infectious and parasitic diseases (001–139)	0 (0.0)	262 (0.5)	303 (0.5)
2. Neoplasms (140–239)	0 (0.0)	90 (0.2)	115 (0.2)
3. Endocrine, nutr. & metabolic diseases, and immunity disorders (240–279)	0 (0.0)	326 (0.6)	451 (0.8)
4. Diseases of the blood and blood-forming organs (280–289)	0 (0.0)	69 (0.1)	95 (0.2)
5. Mental disorders (290–319)	0 (0.0)	6,811 (12.2)	7,552 (12.9)
Episodic mood disorders (296)	0 (0.0)	3,116 (5.6)	3,366 (5.7)
Depressive disorder not elsewhere classified (311)	0 (0.0)	1,116 (2.0)	1,285 (2.2)
Adjustment reaction (309)	0 (0.0)	735 (1.3)	796 (1.4)
Anxiety, dissociative and somatoform disorder (300)	0 (0.0)	314 (0.6)	361 (0.6)
Drug-induced mental disorders (292)	0 (0.0)	311 (0.6)	368 (0.6)
Schizophrenic disorder (295)	0 (0.0)	262 (0.5)	302 (0.5)
Alcohol dependence syndrome (303)	0 (0.0)	208 (0.4)	229 (0.4)
Nondependent abuse of drugs (305)	0 (0.0)	194 (0.3)	231 (0.4)
Drug dependence (304)	0 (0.0)	150 (0.3)	180 (0.3)
6. Diseases of the nervous system and sense organs (320–389)	0 (0.0)	230 (0.4)	278 (0.5)
7. Diseases of the circulatory system (390–459)	0 (0.0)	722 (1.3)	1,052 (1.8)
Heart failure (428)	0 (0.0)	140 (0.3)	271 (0.5)
Cardiac dysrhythmias (427)	0 (0.0)	124 (0.2)	177 (0.3)
Acute myocardial infarction (410)	0 (0.0)	97 (0.2)	128 (0.2)
8. Diseases of the respiratory system (460–519)	0 (0.0)	1,472 (2.6)	1,908 (3.3)
Acute respiratory failure (518.81)	0 (0.0)	511 (0.9)	639 (1.1)
Pneumonia, organism unspecified (486)	0 (0.0)	239 (0.4)	360 (0.6)
Pneumonitis due to inhalation of food and vomitus (507.0)	0 (0.0)	216 (0.4)	270 (0.5)
Chronic bronchitis (491)	0 (0.0)	188 (0.3)	289 (0.5)
9. Diseases of the digestive system (520–579)	0 (0.0)	396 (0.7)	522 (0.9)
10. Diseases of the genitourinary system (580–629)	0 (0.0)	381 (0.7)	533 (0.9)
Acute renal failure (584)	0 (0.0)	213 (0.4)	273 (0.5)
11. Complications of pregnancy, childbirth, and the puerperium (630–679)	0 (0.0)	220 (0.4)	237 (0.4)
12. Diseases of the skin and subcutaneous tissue (680–709)	0 (0.0)	57 (0.1)	84 (0.1)
13. Diseases of the musculoskeletal system & connective tissue (710–739)	0 (0.0)	146 (0.3)	180 (0.3)
14. Congenital anomalies (740–759)	0 (0.0)	5 (0.0)	6 (0.0)
15. Certain conditions originating in the perinatal period (760–779)	0 (0.0)	3 (0.0)	3 (0.0)
16. Symptoms, signs, and ill-defined conditions (780–799)	0 (0.0)	574 (1.0)	741 (1.3)
17. Injury (except poisoning) (800–959)	87 (0.2)	87 (0.2)	240 (0.4)
18. Poisoning by drugs, medicinal, and biological substances (960–979)	39,993 (99.6)	43,857 (78.4)	43,857 (74.7)
19. Toxic effects of substances chiefly nonmedicinal (980–989)	60 (0.1)	60 (0.1)	353 (0.6)
20. Other & unspecified effect of external causes; complications not otherwise specified (990–999)	4 (0.0)	101 (0.2)	130 (0.2)
Total	40,144 (100.0)	55,920 (100.0)	58,704 (100.1)

<sup>a</sup>Definition 1: The first-listed valid external-cause-of-injury code (E-code) is drug poisoning (ICD-9-CM codes E850–E858, E950 [0–5], E962.0, and E980 [0–5]) and the principal diagnosis is injury (ICD-9-CM diagnosis codes of 800–909.2, 909.4, 909.9, 910–994.9, 995.5–995.59, and 995.80–995.85). Definition 2: The first-listed E-code is drug poisoning (ICD-9-CM codes E850–E858, E950 [0–5], E962.0, and E980 [0–5]) or the principal diagnosis is drug poisoning (ICD-9-CM diagnosis codes in the range 960–979). Definition 3: At least one E-code is drug poisoning or at least one diagnosis (principal or secondary) is drug poisoning.

ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification

described as (1) 806 cases with a principal diagnosis of drug overdose and a first-listed valid E-code not in the drug overdose range (E850–E858, E950 [.0–.5], E962.0, and E980 [.0–.5]) (data not shown); (2) 3,058 cases with a principal diagnosis of drug overdose and a missing E-code (data not shown); and (3) 11,912 cases with a first-listed E-code describing a drug overdose but a principal diagnosis different from drug overdose: mental disorders ( $n=6,811$ ), respiratory system diseases ( $n=1,472$ ), circulatory system diseases ( $n=722$ ), or others (Table 1).

### Definition 3

A total of 2,784 cases were added to the Definition 3-captured cases ( $n=58,704$ ), and almost all (99.5%) of them were captured by a secondary diagnosis code of drug overdose. About 13% of the new cases had an E-code indicating drug overdose that was not the first-listed valid E-code (data not shown). The total additional cases compared with Definition 1, based on the principal diagnosis, were coded as mental disorders ( $n=7,552$ ); poisoning by drugs, medicinal, and biological substances ( $n=3,864$ ); respiratory system diseases ( $n=1,908$ ); circulatory system diseases ( $n=1,052$ ); and others (Table 1). Three-quarters of the cases with a principal diagnosis of mental disorder had an E-code indicating a suicide/self-inflicted injury by drug overdose. The most common drug types involved in suicide attempts among patients with a principal diagnosis of mental disease were benzodiazepines (30%), antidepressants (19%), and opiates and related narcotics (7%) (data not shown).

### Drugs involved

Table 2 compares all three definitions in terms of the specificity of drugs involved in drug overdoses. As expected, Definition 3 identified more drug overdose hospitalizations involving specific drugs than Definition 1 (33% more involving opiates/opioids, 44% more involving cocaine, 37% more involving heroin, and 35% more involving benzodiazepines), although the proportion of total cases by each drug type was similar for all three definitions. Regardless of the definition used, more than one-quarter of the drug overdose hospitalizations involved benzodiazepines; opiates/opioids were listed in about one-fifth of the drug overdose hospitalizations. This finding means that any of the three definitions would be able to correctly identify distribution by drug type and priorities for interventions, but the magnitude of the problem in Kentucky would be underestimated using Definition 1.

### Overdose intent

Table 3 shows that, after excluding the cases without an E-code, the three definitions identified similar distributions by intent, but Definition 1 significantly underestimated the counts by intent. More than half of the drug overdose hospitalizations were due to suicide attempt/self-harm, regardless of the definition. However, the total number of suicide attempts identified was 1.3 times higher when Definition 3 was used ( $n=28,048$ ) compared with Definition 1 ( $n=21,620$ ). The percentage of unintentional drug overdoses was about 32%, regardless of the definition, but Definition 3 identified 4,387 more cases (35% increase) than Definition 1 ( $n=12,626$ ).

### Overdose hospitalization rates

Age-adjusted drug overdose hospitalization rates were highest using Definition 3, but the trends over time were similar for all three definitions. The 2011 age-adjusted rate using Definition 3 was 146 per 100,000 population compared with 107 per 100,000 population using Definition 1 and 142 per 100,000 population using Definition 2 (Figure 2).

## DISCUSSION

Definition 3 identified more drug overdose hospitalizations than did Definitions 1 and 2. The highest percentages of additional cases were for drug overdose hospitalizations coded with a principal diagnosis of mental health disorders or respiratory system disorders. According to the National Institute on Drug Abuse's Brief on Prescription Drug Abuse, abuse of central nervous system depressants, alone or with alcohol or other drugs, can depress respiration and lead to death. Episodic mood disorders or depressive disorders could be induced by an overdose with substances such as stimulants (e.g., amphetamine, methamphetamine, and cocaine). Jones et al. found that people with mental health disorders are at increased risk for heavy therapeutic or nonmedical use of drugs and consequent drug overdose.<sup>19</sup> Benzodiazepine overdose, especially in combination with alcohol, opioids, or antidepressants, can result in either respiratory or cardiac arrest;<sup>27</sup> therefore, it may be coded as a respiratory or circulatory system failure as a principal diagnosis while in fact it may be a direct result of a drug overdose.

Shin et al. found that benzodiazepine therapy in psychiatric outpatients is associated with intentional self-poisoning.<sup>28</sup> In our study, 30% of the drug overdose suicide attempts involved benzodiazepines, and the majority of the drug overdose hospitalizations

**Table 2. Drug overdose hospitalizations, by drug type: Kentucky, 2000–2011**

Drug type	ICD-9-CM diagnosis code <sup>a</sup>	Definition 1 <sup>b</sup> N (percent)	Definition 2 <sup>b</sup> N (percent)	Definition 3 <sup>b</sup> N (percent)
Nonopioid analgesics, antipyretics, and antirheumatics	965 (.1–.8)	6,746 (16.8)	9,008 (16.1)	9,252 (15.8)
4-aminophenol derivatives (e.g., acetaminophen or acetophenetidin)	965.4	4,403 (11.0)	5,703 (10.2)	5,837 (9.9)
Opiates/opioids	965.0	8,035 (20.0)	10,340 (18.5)	10,660 (18.2)
Heroin	965.01	262 (0.7)	352 (0.6)	359 (0.6)
Pharmaceutical opioids <sup>c</sup>	965 (.00, .02–.09)	7,790 (19.4)	10,015 (17.9)	10,329 (17.6)
Methadone	965.02	1,553 (3.9)	1,953 (3.5)	1,993 (3.4)
Cocaine	968.5, <sup>d</sup> 970.81	383 (0.9)	525 (0.9)	550 (0.9)
Antidepressants, barbiturates and other antiepileptics, sedative-hypnotics, and psychotropic drugs not elsewhere classified	966, 967, 969, 970 (.0, .1, .89)	23,042 (57.4)	30,480 (54.5)	31,524 (53.7)
Benzodiazepines	969.4	12,060 (30.0)	15,770 (28.2)	16,262 (27.7)
Psychostimulants with abuse potential including methamphetamine, MDMA (ecstasy)	969.7	988 (2.5)	1,221 (2.2)	1,256 (2.1)
Anticoagulants	964.2	395 (1.0)	778 (1.4)	1,164 (2.0)
Other specified and unspecified drugs	909 (.0, .5), 960–963, 964 (.0, .1, .3–.9), 965.9, 968 (.0–.4, .6–.9), 970.9, 971–979, 995 (.2, .4, .86, .89), 999 (.4–.7)	11,769 (29.3)	16,261 (29.1)	17,290 (29.4)
Total number of drug overdose hospitalizations <sup>e</sup>		40,144	55,920	58,704

<sup>a</sup>Any diagnosis code, principal or secondary

<sup>b</sup>Definition 1: The first-listed valid external-cause-of-injury code (E-code) is drug poisoning (ICD-9-CM codes E850–E858, E950 [.0–.5], E962.0, and E980 [.0–.5]) and the principal diagnosis is injury (ICD-9-CM diagnosis codes of 800–909.2, 909.4, 909.9, 910–994.9, 995.5–995.59, and 995.80–995.85). Definition 2: The first-listed E-code is drug poisoning (ICD-9-CM codes E850–E858, E950 [.0–.5], E962.0, and E980 [.0–.5]) or the principal diagnosis is drug poisoning (ICD-9-CM diagnosis codes in the range 960–979). Definition 3: At least one E-code is drug poisoning or at least one diagnosis (principal or secondary) is drug poisoning.

<sup>c</sup>The term “pharmaceutical” is used to denote the availability of these agents through prescription and does not necessarily reflect the actual source of these agents for any given poisoning.

<sup>d</sup>Not the only poison in this category

<sup>e</sup>The column counts do not add up to the total number of hospitalizations because when a drug overdose case involved multiple types of drugs, it was counted separately under each type.

ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification

MDMA = (3,4- methylenedioxymethamphetamine)

were related to suicide attempt. Definition 3 identified 30% more self-inflicted drug poisonings than did Definition 1.

The American Public Health Association position statement on preventing overdose through education and naloxone distribution<sup>29</sup> calls for improved surveillance efforts and data collection regarding opioid use and misuse at federal and local levels to ensure adequate program design and planning. Definition 3 provides the most comprehensive surveillance for opioid overdose morbidity, quantifying the need for access to naloxone education, treatment, and recovery among those patients who might be at high risk for repeating opioid overdose.<sup>30</sup>

The dataset captured by Definition 1 underestimated the total number of drug overdose hospitalizations in Kentucky by more than 40%. The utility of the definition is limited when E-codes are not well populated. CDC developed action recommendations<sup>31</sup> for improving E-code coding in state-based hospital discharge and ED data systems that could be a useful framework for addressing this issue in the state.

CDC’s National Center for Injury Prevention and Control publishes State Injury Indicators Reports that track, among other injuries, the total poisonings (i.e., deaths, hospitalizations, and emergency department [ED] visits) by state. Because drug poisonings are the reason for the increase in the total poisonings, the 2011

indicator on poisoning deaths was supplemented with an indicator on drug poisoning deaths.<sup>18</sup> It is expected that the state indicators on poisoning hospitalizations will be supplemented with a specific measure on the drug poisoning hospitalizations as well. Definition 1 was derived from CDC's indicator for total poisoning hospitalizations<sup>18</sup> and could be the natural candidate for measuring drug poisoning hospitalizations within the framework used by the state injury indicators. However, as this study showed, Definition 1 missed almost half of the hospitalizations involving drug overdose in Kentucky and will likely significantly undercount these events in other states as well. Definitions 2 and 3 were proposed by the ISW7 in 2012 and could be used to develop new state drug poisoning indicators. The ISW7<sup>17</sup> recommended that the use of the principal diagnosis, first-listed diagnosis, or any diagnosis should be examined with state data to determine the limitations of the different case selections before the definitions are implemented as standardized surveillance tools. The results from a study on the ED visits for drug-related poisonings in the U.S.<sup>21</sup> suggested that mild or moderate poisoning cases were likely to have poisoning as their primary diagnosis, but severe poisoning cases were likely to have critical condition as the primary diagnosis. Our study showed that Definition 3, using any diagnosis code or E-code, may have sensitivity that is almost 50% higher than the sensitivity of Definition 1.

In our opinion, Definition 1 is too conservative and underestimates the prevalence of the drug overdoses requiring hospital care in our state. The correct interpretation of the ICD-9-CM coding rules and the

health outcomes of a severe drug overdose will often require a hospitalization with an underlying cause of drug overdose to be coded with a critical condition principal diagnosis (e.g., respiratory or heart failure). Definition 3 identified the largest number of drug overdose-related hospitalizations and is the best definition, in our opinion, to be used when planning for health-care resource allocation, substance abuse treatment, mental health services, and prevention. The proportion of cases identified by Definitions 2 and 3 differed by approximately 5% in our state. This finding is important. As discussed by the ISW7,<sup>17</sup> analysis of drug overdose hospitalizations based on Definition 3 can create potential problems when making comparisons across states that collect different numbers of ICD-9-CM diagnosis codes and E-codes per hospitalization. In general, more cases will be identified as the number of available diagnoses and/or E-code fields increases. Therefore, the number of the fields to be searched should be the same across states and over time. ISW7 suggested that analysts who intend to compare indicators across states should restrict their analyses to the lowest number of diagnostic fields and dedicated E-code fields in use among all states for which comparison is planned. In such a case, the underreporting of drug overdoses requiring hospitalizations will be <5% for Kentucky, as our analysis showed.

The results from this study could be used to inform a future multi-state study using different drug poisoning definitions for ICD-9-CM-coded data. Such a study is needed to explore possible state variations in the use of ICD-9-CM codes and evaluate how the interstate comparison could be affected by the number of diagnoses

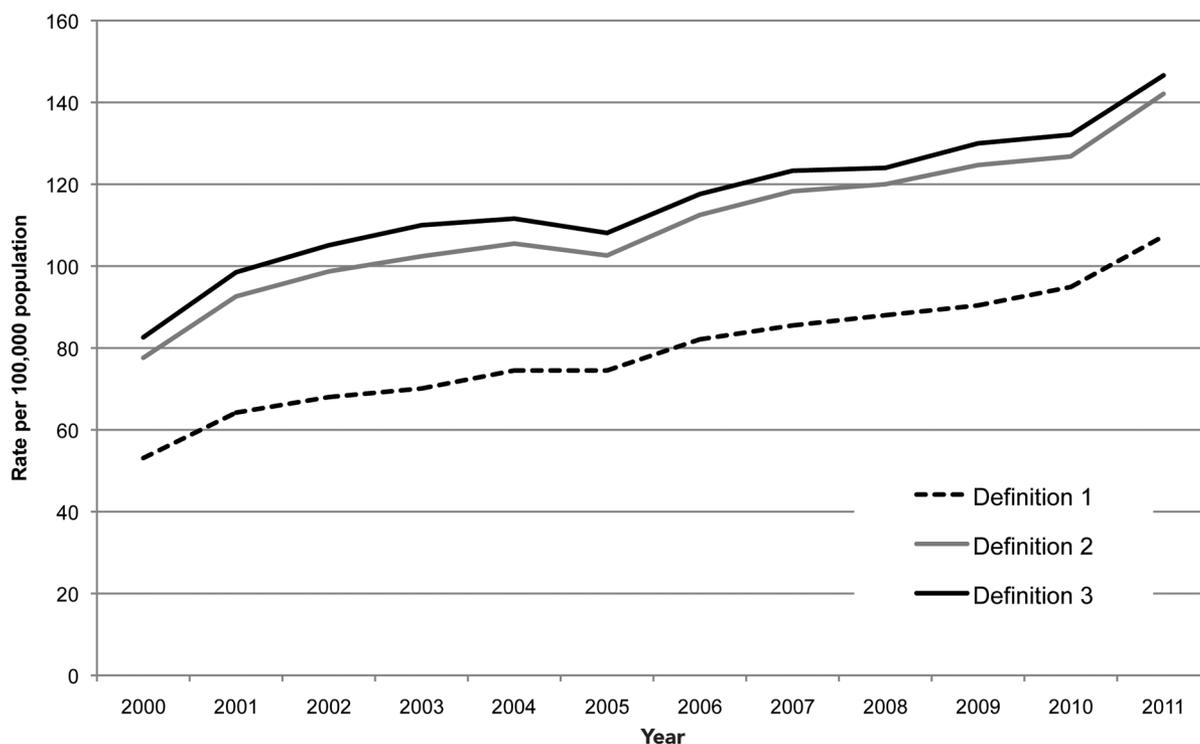
**Table 3. Drug overdose hospitalizations, by intent: Kentucky, 2000–2011**

Poisoning by intent	ICD-9-CM code	Definition 1 N (percent)	Definition 2 N (percent)	Definition 3 N (percent)
Unintentional	E850–E858	12,626 (31.4)	16,895 (32.3)	17,013 (32.3)
Self-harm	E950 (.0–.5)	21,620 (53.9)	27,867 (53.3)	28,048 (53.3)
Assault	E962.0	21 (0.1)	27 (0.1)	27 (0.1)
Undetermined	E980 (.0–.5)	5,877 (14.6)	7,508 (14.4)	7,569 (14.4)
Total number of hospitalizations with an E-code pertaining to drug overdoses	E850–E858, E950 (.0–.5), E962.0, E980 (.0–.5)	40,144 (100.0)	52,297 (100.0)	52,657 (100.0)
Hospitalizations without drug overdose E-codes		0	3,623	6,047
Total		40,144	55,920	58,704

<sup>a</sup>Definition 1: The first-listed valid E-code is drug poisoning (ICD-9-CM codes E850–E858, E950 [.0–.5], E962.0, and E980 [.0–.5]) and the principal diagnosis is injury (ICD-9-CM diagnosis codes of 800–909.2, 909.4, 909.9, 910–994.9, 995.5–995.59, and 995.80–995.85). Definition 2: The first-listed E-code is drug poisoning (ICD-9-CM codes E850–E858, E950 [.0–.5], E962.0, and E980 [.0–.5]) or the principal diagnosis is drug poisoning (ICD-9-CM diagnosis codes in the range 960–979). Definition 3: At least one E-code is drug poisoning or at least one diagnosis (principal or secondary) is drug poisoning.

ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification

E-code = external-cause-of-injury code

**Figure 2. Kentucky resident age-adjusted drug overdose hospitalization rates, by case definition,<sup>a</sup> 2000–2011**

<sup>a</sup>Definition 1: The first-listed valid external-cause-of-injury code (E-code) is drug poisoning (ICD-9-CM codes E850–E858, E950 [.0–.5], E962.0, and E980 [.0–.5]) and the principal diagnosis is injury (ICD-9-CM diagnosis codes of 800–909.2, 909.4, 909.9, 910–994.9, 995.5–995.59, and 995.80–995.85). Definition 2: The first-listed E-code is drug poisoning (ICD-9-CM codes E850–E858, E950 [.0–.5], E962.0, and E980 [.0–.5]) or the principal diagnosis is drug poisoning (ICD-9-CM diagnosis codes in the range 960–979). Definition 3: At least one E-code is drug poisoning or at least one diagnosis (principal or secondary) is drug poisoning.

ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification

and designated E-code fields collected by the state hospital discharge databases, and by the completeness and level of specificity of the E-codes used.

### Limitations

This study was subject to several limitations. One limitation was that medical chart review was not available to ascertain drug overdose diagnoses. A medical chart review study is needed to determine how often the hospitalization cases captured with Definition 3 were not a direct result of the drug overdose and if a mental disorder led the person to a drug overdose, or vice versa. Another limitation of the study was that hospital discharge records for residents treated in out-of-state acute-care hospitals were not available. Therefore, the reported drug overdose hospitalization rates underestimated the extent of the drug overdose epidemic among the state residents.

Additionally, only administrative billing data were used and we were not able to calculate and compare the sensitivity of the definitions because we did not

know the number of true-positive and false-negative drug overdose hospitalizations. Hospital discharge data are collected for billing purposes and reflect care for which the payers were billed. A chart review study is needed to estimate the sensitivity and specificity of the three definitions.

### CONCLUSION

As states enact policies and plan for adequate treatment resources for the drug overdose epidemic, standardized drug overdose definitions are critical for accurate reporting, trend analysis, policy evaluation, and state-to-state comparison. The ISW7 drug overdose definition using any drug poisoning diagnosis/E-code (Definition 3) is potentially the highest sensitivity definition for counting drug overdose hospitalizations, including by intent and drug type(s) involved. A chart review study is needed to further estimate and compare the sensitivity and specificity of the three definitions.

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## REFERENCES

- Warner M, Chen LH, Makuc DM, Anderson RN, Minino AM. Drug poisoning deaths in the United States, 1980–2008. NCHS Data Brief 2011;81:1-8. Also available from: URL: <http://www.cdc.gov/nchs/data/databriefs/db81.pdf> [cited 2014 Mar 7].
- Centers for Disease Control and Prevention (US). Unintentional drug poisoning in the United States. Atlanta: CDC; July 2010.
- Paulozzi LJ, Kilbourne EM, Desai HA. Prescription drug monitoring programs and death rates from drug overdose. *Pain Med* 2011;12:747-54.
- QuickStats: drug-poisoning death rates—National Vital Statistics System, United States, 2010. *MMWR Morb Mortal Wkly Rep* 2012;61(48):995.
- Centers for Disease Control and Prevention (US). Multiple cause of death data [cited 2014 May 1]. Available from: URL: <http://wonder.cdc.gov/mcd.html>
- Peirce GL, Smith MJ, Abate MA, Halverson J. Doctor and pharmacy shopping for controlled substances. *Med Care* 2012;50:494-500.
- Vital signs: overdoses of prescription opioid pain relievers—United States, 1999–2008. *MMWR Morb Mortal Wkly Rep* 2011;60(43):1487-92.
- Paulozzi LJ, Weisler RH, Patkar AA. A national epidemic of unintentional prescription opioid overdose deaths: how physicians can help control it. *J Clin Psychiatry* 2011;72:589-92.
- Office of National Drug Control Policy (US). Epidemic: responding to America's prescription drug abuse crisis. 2011 [cited 2014 May 1]. Available from: URL: [http://www.whitehouse.gov/sites/default/files/ondcp/issues-content/prescription-drugs/rx\\_abuse\\_plan.pdf](http://www.whitehouse.gov/sites/default/files/ondcp/issues-content/prescription-drugs/rx_abuse_plan.pdf)
- Maxwell JC. The prescription drug epidemic in the United States: a perfect storm. *Drug Alcohol Rev* 2011;30:264-70.
- CDC grand rounds: prescription drug overdoses—a U.S. epidemic. *MMWR Morb Mortal Wkly Rep* 2012;61(01):10-3.
- Bohnert ASB, Valenstein M, Bair MJ, Ganoczy D, McCarthy JF, Ilgen MA, et al. Association between opioid prescribing patterns and opioid overdose-related deaths. *JAMA* 2011;305:1315-21.
- Modarai F, Mack K, Hicks P, Benoit S, Park S, Jones C, et al. Relationship of opioid prescription sales and overdoses, North Carolina. *Drug Alcohol Depend* 2013;132:81-6.
- Sauber-Schatz EK, Mack KA, Diekman ST, Paulozzi LJ. Associations between pain clinic density and distributions of opioid pain relievers, drug-related deaths, hospitalizations, emergency department visits, and neonatal abstinence syndrome in Florida. *Drug Alcohol Depend* 2013;133:161-6.
- Coben JH, Davis SM, Furbee PM, Sikora RD, Tillotson RD, Bossarte RM. Hospitalizations for poisoning by prescription opioids, sedatives, and tranquilizers. *Am J Prev Med* 2010;38:517-24.
- Jauncey ME, Taylor LK, Degenhardt LJ. The definition of opioid-related deaths in Australia: implications for surveillance and policy. *Drug Alcohol Rev* 2005;30:401-9.
- Safe States. Consensus recommendations for national and state poisoning surveillance: report from the Injury Surveillance Workgroup (ISW7). Atlanta: Safe States; 2012. Also available from: URL: <http://www.safestates.org/?page=ISWReports> [cited 2014 Mar 7].
- Thomas KE, Johnson RL. State injury indicators report: instructions for preparing 2011 data. Atlanta: Centers for Disease Control and Prevention (US), National Center for Injury Prevention and Control; 2013.
- Jones CM, Mack KA, Paulozzi LJ. Pharmaceutical overdose deaths, United States, 2010. *JAMA* 2013;309:657-9.
- Harmon KJ, Proescholdbell S, Waller A, Barnett C. A response to the Safe States Alliance Injury Surveillance Workgroup (ISW)-7 ICD-9-CM poisoning matrix. Chapel Hill (NC): Carolina Center for Health Informatics and the Injury Prevention Research Center (ICRC), the University of North Carolina at Chapel Hill; February 2013.
- Xiang Y, Zhao W, Xiang H, Smith GA. ED visits for drug-related poisoning in the United States, 2007. *Am J Emerg Med* 2012;30:293-301.
- White AM, Hingson RW, Pan JJ, Yi HY. Hospitalizations for alcohol and drug overdoses in young adults ages 18–24 in the United States, 1999–2008: results from the Nationwide Inpatient Sample. *J Stud Alcohol Drugs* 2011;72:774-86.
- Centers for Disease Control and Prevention (US). Matrix of E-code grouping [cited 2013 Aug 14]. Available from: URL: [http://www.cdc.gov/injury/wisqars/ecode\\_matrix.html](http://www.cdc.gov/injury/wisqars/ecode_matrix.html)
- National Committee on Vital and Health Statistics. Core health data elements: report of the National Committee on Vital and Health Statistics. Rockville (MD): Department of Health and Human Services (US); 1996. Also available from: URL: <http://www.ncvhs.hhs.gov/ncvhsr1.htm#Core> [cited 2014 May 5].
- Census Bureau (US). Population estimates [cited 2014 May 5]. Available from: URL: <http://www.census.gov/popest/index.html>
- SAS Institute, Inc. SAS®: Version 9.3 for Windows. Cary (NC): SAS Institute, Inc.; 2011.
- Gaudreault P, Guay J, Thivierge RL, Verdy I. Benzodiazepine poisoning. *Drug Saf* 1991;6:247-65.
- Shin HI, Lin MC, Lin CC, Hsu HC, Lee HL, Chi CH, et al. Benzodiazepine therapy in psychiatric outpatients is associated with deliberate self-poisoning events at emergency departments—a population-based nested case-control study. *Psychopharmacology (Berl)* 2013;229:665-71.
- American Public Health Association. Preventing overdose through education and Naloxone distribution. 2012 [cited 2012 Aug 10]. Available from: URL: <http://www.apha.org/advocacy/policy/policysearch/default.htm?id=1443>
- Stoove MA, Dietze PM, Jolley D. Overdose deaths following previous non-fatal heroin overdose: record linkage of ambulance attendance and death registry data. *Drug Alcohol Rev* 2009;28:347-52.
- Annest JL, Fingerhut LA, Gallagher SS, Grossman DC, Hedegaard H, Johnson RL, et al. Strategies to improve external cause-of-injury coding in state-based hospital discharge and emergency department data systems. Recommendations of the CDC Workgroup for Improvement of External Cause-of-Injury Coding. *MMWR Recomm Rep* 2008;57(RR-01):1-15.