

ICD-10-CM–Based Definitions for Emergency Department Opioid Poisoning Surveillance: Electronic Health Record Case Confirmation Study

Public Health Reports
2020, Vol. 135(2) 262-269
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DOI: 10.1177/0033354920904087
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Abstract

Objectives: Valid opioid poisoning morbidity definitions are essential to the accuracy of national surveillance. The goal of our study was to estimate the positive predictive value (PPV) of case definitions identifying emergency department (ED) visits for heroin or other opioid poisonings, using billing records with *International Classification of Diseases, Tenth Revision, Clinical Modification* (ICD-10-CM) codes.

Methods: We examined billing records for ED visits from 4 health care networks (12 EDs) from October 2015 through December 2016. We conducted medical record reviews of representative samples to estimate the PPVs and 95% confidence intervals (CIs) of (1) first-listed heroin poisoning diagnoses (n = 398), (2) secondary heroin poisoning diagnoses (n = 102), (3) first-listed other opioid poisoning diagnoses (n = 452), and (4) secondary other opioid poisoning diagnoses (n = 103).

Results: First-listed heroin poisoning diagnoses had an estimated PPV of 93.2% (95% CI, 90.0%-96.3%), higher than secondary heroin poisoning diagnoses (76.5%; 95% CI, 68.1%-84.8%). Among other opioid poisoning diagnoses, the estimated PPV was 79.4% (95% CI, 75.7%-83.1%) for first-listed diagnoses and 67.0% (95% CI, 57.8%-76.2%) for secondary diagnoses. Naloxone was administered in 867 of 1055 (82.2%) cases; 254 patients received multiple doses. One-third of all patients had a previous drug poisoning. Drug testing was ordered in only 354 cases.

Conclusions: The study findings suggest that heroin or other opioid poisoning surveillance definitions that include multiple diagnoses (first-listed and secondary) would identify a high percentage of true-positive cases.

Keywords

opioid poisoning, positive predictive value, heroin poisoning, case definition

Since 1999, trends in the use of 3 related but distinct substances—opioid analgesics, heroin, and illicitly manufactured fentanyl—have characterized the US opioid poisoning epidemic.¹⁻⁴ Emergency department (ED) administrative billing data can provide critical information to guide and evaluate the public health response to this rapidly shifting crisis. In 2012, the Safe States Alliance's Injury Surveillance Workgroup on Poisoning released recommendations for opioid poisoning morbidity indicators using *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) codes.⁵ The workgroup's recommendations highlighted the need to validate the proposed definitions before adopting them as consensus surveillance measures. Several studies, conducted in various populations and health care settings, validated some opioid poisoning definitions for ICD-9-CM–coded data.⁶⁻⁹

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Table 1. ICD-10-CM diagnosis codes for identifying cases of opioid poisoning in an electronic health record case confirmation study in Kentucky^a

Type of Poisoning	ICD-10-CM Diagnosis Code	AND a Sixth Character of 1, 2, 3, or 4	AND a Seventh Character of A or D ^b
Heroin	T40.1X: poisoning by heroin	1: Accidental (unintentional)	A: Initial encounter
Other opioid poisoning, excluding heroin	T40.0X: Poisoning by opium	2: Intentional self-harm	D: Subsequent encounter
	T40.2X: Poisoning by other opioids	3: Assault	
	T40.3X: Poisoning by methadone	4: Undetermined intent	
	T40.4X: Poisoning by other synthetic narcotics		
	T40.60: Poisoning by unspecified narcotics		
	T40.69: Poisoning by other narcotics		

Abbreviations: CDC, Centers for Disease Control and Prevention; ICD-10-CM, *International Classification of Diseases, 10th Revision, Clinical Modification*.¹⁸

^aMedical records from 12 emergency departments in Kentucky dated from October 2015 through December 2016 were reviewed by emergency medicine physicians to assess the positive predictive values of 4 case definitions: first-listed heroin poisoning diagnosis, secondary (ie, not first-listed) heroin poisoning diagnosis, first-listed other opioid (not heroin) poisoning diagnosis, and secondary other opioid poisoning diagnosis.

^bIn 2018, after the inception of this study, CDC revised its provisional guidance for drug poisoning morbidity surveillance indicators, directing epidemiologists to include only cases with a seventh character of A or a missing seventh character and to include both the first-listed diagnosis code and secondary diagnosis codes.¹⁹ In 2019, the Council of State and Territorial Epidemiologists issued concurring guidance in the Nonfatal Opioid Overdose Standardized Surveillance Case Definition.²⁰

Complicating the consensus process for standardized indicators for opioid poisoning morbidity, the US coding system for inpatient and outpatient administrative billing transitioned from the ICD-9-CM to the *International Classification of Diseases, Tenth Revision, Clinical Modification* (ICD-10-CM) on October 1, 2015.¹⁰ The differences between ICD-9-CM-coded data (used in Rowe et al,⁶ Reardon et al,⁸ and Green et al⁹) and ICD-10-CM-coded data are notable. The ICD-10-CM includes structural and conceptual changes pertaining to poisoning coding (eg, integration of external cause-of-injury codes into poisoning diagnosis codes, new concept for encounter/stage of poisoning treatment). Thus, validation results from ICD-9-CM-based definitions are not informative for selecting ICD-10-CM-based surveillance definitions or indicators for opioid poisoning morbidity. No recent data on estimated positive predictive values (PPVs) of ICD-10-CM opioid poisoning codes are available to generate plausible hypotheses for the PPVs of opioid poisoning surveillance measures.

The Centers for Disease Control and Prevention (CDC) developed provisional ICD-10-CM-based indicator definitions of drug poisoning morbidity for recipients of the Prevention for States and Data-Driven Prevention Initiative cooperative agreements.^{11,12} Without access to nationally available ICD-10-CM-coded data, CDC relied on individual states to begin testing provisional indicator definitions.

One way to validate definitions is to evaluate PPVs (ie, the extent to which cases identified in medical records are “true” cases). The PPV of a case definition can be established through a medical record case confirmation study. A case confirmation study tests the internal validity of surveillance definition codes (ie, how well definition codes represent the diagnoses of treating physicians).¹³ Several commonly accepted strategies exist for improving the accuracy of and minimizing inconsistency in reviewing medical records.¹⁴⁻¹⁶

The primary objective of this study was to estimate the PPVs of CDC’s provisional indicator definitions for ED visits precipitated by heroin poisoning and other opioid poisoning, using ICD-10-CM-coded billing records and limiting cases to those with relevant first-listed diagnoses.¹⁷ A secondary objective was to evaluate the ability of secondary diagnoses to identify heroin poisoning or other opioid poisoning cases beyond those already identified by the first-listed diagnosis codes.

Methods

Study Case Definitions

Case definitions for ICD-10-CM-coded ED data were the following:

- Definition H-F (heroin-first): ED visits for heroin poisoning (Table 1), capturing only cases with a first-listed diagnosis of heroin poisoning;
- Definition OO-F (other-opioid-first): ED visits for other opioid (excluding heroin) poisoning, capturing only cases with a first-listed diagnosis of opioid poisoning (excluding heroin);
- Definition H-S (heroin-second): ED visits for heroin poisoning, capturing only cases with a secondary diagnosis of heroin poisoning (ie, all diagnoses except the first-listed); and
- Definition OO-S (other-opioid-second): ED visits for other opioid (excluding heroin) poisoning, capturing only cases with a secondary diagnosis of opioid poisoning (excluding heroin).

When this study was initiated in mid-2017, definitions H-F and OO-F were CDC’s provisional indicator definitions

for recipients of the Prevention for States and Data-Driven Prevention Initiative cooperative agreements.

Data Sources, Study Population, and Sampling

Four Kentucky health care networks, including 12 EDs, participated in the study. The catchment areas of the participating hospitals include both urban and rural regions. The sampling frame for each case definition included ED visits identified by the study case definition using billing records from the participating facilities from October 2015 through December 2016. The ED billing records have 1 first-listed and 24 secondary diagnosis fields.

For the validation of definition H-F (a first-listed diagnosis of heroin poisoning), we used stratified sampling by health care network, with different sampling rates within each stratum. The H-F sample consisted of 398 records (125 records from each of the 3 large health care networks and all 23 records from the smallest system). Thus, the selection probability for a record from a large health care network was equal to 125 divided by the total number of H-F records for the network during the study period. This approach was based on several considerations, including substantial differences in the volume of heroin poisoning cases among the 4 networks, the need to balance work among study physicians within networks, and the need for a large enough sample from each stratum to evaluate data quality in each network. We drew a simple random sample of 452 cases for the validation of definition OO-F and smaller simple random samples for the validation of definitions H-S ($n = 102$) and OO-S ($n = 103$). Of the total sampled 1055 records, only 5 (0.5%) represented subsequent encounters (ICD-10-CM code with a seventh character D).

The sample sizes for definitions H-F and OO-F provided margins of error no larger than 5% for the 95% confidence intervals (CIs) of the estimated PPVs. For the validation of definitions H-S and OO-S, the sample sizes provided margins of error no greater than 10% for the 95% CIs of the estimated PPVs.

Abstraction of Medical Records

We developed, refined, and finalized a data collection form with input from physicians, medical coders, and epidemiologists. The form included relevant medical record information to allow the research team to determine whether an ED visit represented a confirmed case for the case definition that identified the sampled record. For example, for a case sampled from the H-F or the H-S definition, a confirmed status meant that after review of the medical record, including notes on symptoms and response to treatment, the study physician identified the record as representing a heroin overdose (Figure).

The 8 study abstractors were experienced emergency medicine physicians practicing in the recruited health care networks and identified by the networks' emergency medicine leadership. The physicians were blinded to the study's aims but not to the topic of the medical record review. Study data were collected via a secure, Web-based application and managed by using REDCap (Research Electronic Data Capture) tools.²¹ Each study physician received REDCap training and an account allowing access to a personal dashboard populated with the physician's assigned medical records. The dashboards provided tracking features accessible to study research personnel that displayed each physician's progress. After completion of the medical record review, the research team interviewed 3 of the physicians on clinical decision making in treatment of suspected opioid poisonings in ED settings to inform the discussion of the study results (Box).

Box. Questions used in interviews of emergency medicine physicians in diagnosis of opioid overdose in an electronic health record case confirmation study in Kentucky, 2018

1. How do you make the clinical decision that a patient encounter is a suspected opioid overdose?
2. How do you make the decision to request a drug test or not?
3. What is the typical turnaround time to receive drug screening results? For confirmatory testing?
4. If a patient is discharged before you receive test results, how do you document test results?
5. What would you like to see in every medical record to help confirm/not confirm a diagnosis of opioid overdose (eg, clinical symptoms, intake, drug screen, naloxone administration)?
6. If a continuing education course for physicians on improved documentation of drug overdoses in electronic health records was developed, what main topics should the course cover?

Statistical Analysis

We conducted all analyses in 2018. Analyses for the H-F sample incorporated the sampling weights from the stratified sampling with unequal selection probability sampling design. We reported the weighted estimated PPVs, proportions, and 95% CIs for the H-F definition. We estimated the PPVs and 95% CIs of each study case definition using SAS version 9.4.²² We used the Pearson χ^2 test and the t test with an α of 0.05 to determine significant differences in proportions and means, respectively, obtained from 2 independent samples. The University of Kentucky Institutional Review Board approved the study.

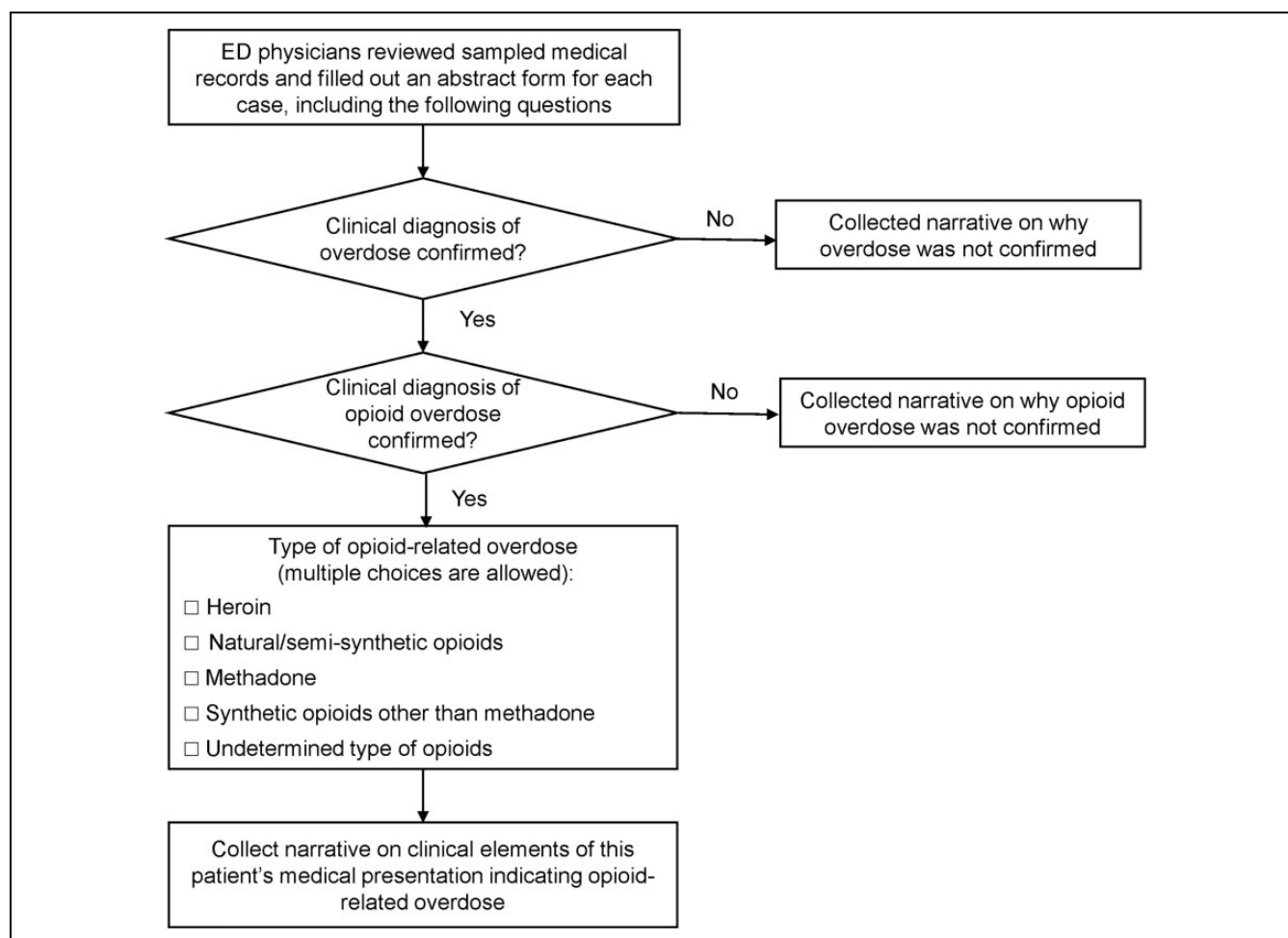


Figure. Steps in the medical record case confirmation study in Kentucky. Medical records from 12 emergency departments (EDs) in Kentucky dated from October 2015 through December 2016 were reviewed by emergency medicine physicians to assess the positive predictive values of 4 case definitions: first-listed heroin poisoning diagnosis, secondary (ie, not first-listed) heroin poisoning diagnosis, first-listed other opioid (not heroin) poisoning diagnosis, and secondary other opioid poisoning diagnosis.

Results

About 60% of ED records with a first-listed diagnosis of heroin or other opioids were for male children, adolescents, and adults (250 of 398 [62.8%] in the H-F sample, 270 of 452 [59.7%] in the OO-F sample). A significantly higher proportion of the H-F sample than the OO-F sample was from metropolitan counties (weighted 95.0%, H-F sample; 89.8%, OO-F sample; $\chi^2[1] = 18.59$; $P < .001$). The mean age in the H-F sample (34 years) was significantly lower than the mean age in the OO-F sample (40 years; $t = -6.4$; $P < .001$). PPVs varied across the 4 health care systems, from 91.2% to 97.6% for definition H-F and from 68.8% to 84.4% for definition OO-F (data not shown).

The estimated weighted PPV for definition H-F was 93.2% (95% CI, 90.0%-96.3%; Table 2). An estimated weighted 6.8% of sample records were not confirmed as heroin poisoning; weighted 67% of the nonconfirmed records indicated other types of opioid-related poisoning, weighted 19% had ingested heroin (heroin bags) to conceal

opioids from law enforcement, and weighted 5% indicated intoxication but not poisoning (data not shown).

The estimated PPV for definition H-S was 76.5% (95% CI, 68.1%-84.8%), which was significantly lower than the estimated PPV for definition H-F ($\chi^2[1] = 39.04$; $P < .001$). Twenty-four of the 102 ED visits with a secondary diagnosis of heroin poisoning were not confirmed as heroin poisoning. Of these, 19 records were not confirmed as acute poisonings by any drug because the study physicians believed these patients presented or were evaluated for withdrawal without documented poisoning, and 5 records indicated poisoning by opioids other than heroin (data not shown).

The estimated PPV of definition OO-F was 79.4% (95% CI, 75.7%-83.1%). Ninety-three of 452 sampled records (20.6%) were not confirmed as nonheroin opioid poisoning. The study physicians determined that 77 of these 93 cases were drug poisonings (but not poisoning by opioids other than heroin); 72 of the 77 cases were determined to be heroin-related poisonings. The 16 cases that the physicians did not confirm as poisoning by any drug included patients

Table 2. Estimated positive predictive values (PPVs) for opioid poisoning for 4 ICD-10-CM case definitions to capture data on heroin poisoning or other opioid poisoning, in an electronic health record case confirmation study in 12 emergency departments in Kentucky, October 2015–December 2016^a

Definition	No. of Visits	Estimated PPV, % (95% CI)
ED visits for treatment of heroin poisoning		
Definition H-F (first-listed diagnosis)	398	93.2 (90.0-96.3)
Definition H-S (secondary diagnosis)	102	76.5 (68.1-84.8)
ED visits for treatment of poisoning involving opioids other than heroin		
Definition OO-F (first-listed diagnosis)	452	79.4 (75.7-83.1)
Definition OO-S (secondary diagnosis)	103	67.0 (57.8-76.2)

Abbreviations: ED, emergency department; ICD-10-CM, *International Classification of Diseases, 10th Revision, Clinical Modification*.¹⁸

^aMedical records from 12 EDs in Kentucky dated from October 2015 through December 2016 were reviewed by emergency medicine physicians to assess the PPVs of 4 case definitions. A diagnosis of heroin poisoning was defined by the first 5 characters (excluding the period) of ICD-10-CM code T40.1X; a sixth character of 1 (unintentional poisoning), 2 (intentional self-harm), 3 (assault), or 4 (undetermined intent); and a seventh character of A (initial encounter) or D (subsequent encounter). A diagnosis of poisoning by other opioid (excluding heroin) was defined by an ICD-10-CM code with the first 5 characters in the range T40.0X, T40.2X, T40.3X, T40.4X, T40.60, or T40.69; sixth character from 1-4; and seventh character A or D.

who had symptoms of withdrawal without documentation of acute poisoning, ingestions without signs of acute poisoning, and reports of narcotic use without documented acute poisoning symptoms.

Definition OO-S had the lowest PPV (67.0%; 95% CI, 57.8%-76.2%). Thirty-four (33.0%) of these 103 cases were not confirmed as other opioid poisoning, including 7 determined to be heroin poisoning, 3 determined to be nonopioid poisoning, and 24 that did not involve poisoning by any drug. Ten records described patients in withdrawal without documentation of previous poisoning; the rest had a history of opioid use, ingestion, or a positive toxicology test without symptoms of acute poisoning.

Study physicians reported that in 99% of the sampled records, information in the physician notes was sufficient to determine the clinical diagnosis (Table 3). In the remaining sampled records, study physicians used information on patient history and notes from nurses and emergency medical services personnel to determine clinical diagnosis.

Only 29.9% (n = 119) of the 398 records identified by definition H-F and 34.1% (n = 154) of the 452 records identified by definition OO-F were cases in which toxicology testing was ordered, and most were drug screening rather than confirmatory testing. Of the 154 records identified by definition OO-F with toxicology testing, 49.4% (n = 76) were coded with T40.6xxx (other and unspecified narcotics), whereas 56.4% (168 of 298) of records without toxicology testing were coded with T40.6xxx

($\chi^2[1] = 2.02$; $P = .16$). Toxicology testing was not associated with decreased use of the nonspecific code (T40.6xxx) for opioid involvement. However, toxicology testing was associated with increased identification or presence of synthetic opioids. Among records identified by definition OO-F, 9.1% (14 of 154) of cases with toxicology testing compared with 3.7% (11 of 298) of cases without toxicology testing were coded with T40.4xxx (synthetic opioids other than methadone; $\chi^2[1] = 5.67$; $P = .02$).

Naloxone was administered in 867 (82.2%) of all 1055 cases (total cases from the 4 samples); 254 received multiple doses. Naloxone was administered in 89.2% (n = 355) of 398 cases identified by definition H-F and 85.0% (n = 384) of 452 cases identified by definition OO-F (Table 3). Prehospital emergency medical services administered naloxone in 78.4% (n = 312) of ED cases identified by definition H-F and 65.0% (n = 294) of ED cases identified by definition OO-F. We found no significant difference in the proportion of patients with administered naloxone who received multiple naloxone doses among the 4 definition samples ($\chi^2[3] = 0.60$; $P = .90$).

Of the patients in the sample identified by definition H-F, an estimated weighted 46.3% (147 of 396) had a history of previous poisoning, compared with 29.5% (132 of 447) of patients identified by definition OO-F ($\chi^2[1] = 42.6$; $P < .001$; Table 3). The percentages were similar (45.4% vs 29.2%) when the comparison was limited to cases from both samples that were confirmed by study physicians ($\chi^2[1] = 32.7$; $P < .001$).

The most common clinical elements of patients' medical presentation indicating opioid-related overdose were recorded as unresponsive patient with positive response to naloxone, admitted/self-reported substance use, a positive drug test, and emergency medical services reports on patient status and response to naloxone at the scene.

Interviews With ED Physicians

Three ED physicians participated in focused interviews. They explained that an initial diagnosis of drug poisoning in the ED is informed by a patient's physical examination and history. Classic signs of opioid poisoning include altered mental status, decreased respiratory rate, and pinpoint pupils. The standard protocol for treating opioid poisoning is naloxone administration. An opioid poisoning patient generally responds to naloxone quickly and would be observed for only 1 or 2 hours before being discharged or leaving against medical advice. If a patient is awake and alert during the ED visit, a toxicology test generally would not be ordered. Toxicology testing in the ED uses a rapid urine test, and results are typically not available for 30-45 minutes. Urine drug testing can confirm the presence of opiates, but the ED physician may have already ascertained the opiate/opioid overdose by using standard criteria. Typical urine drug screening does not identify specific opioids

Table 3. Clinical description of emergency department visits with first-listed heroin poisoning or other opioid (other than heroin) poisoning diagnosis, in an electronic health record case confirmation study in 12 emergency departments in Kentucky, October 2015–December 2016^a

Characteristic	Cases With First-Listed Diagnosis of Heroin Poisoning (n = 398)		Cases With First-Listed Diagnosis of Other Opioid Poisoning (Excluding Heroin) (n = 452)	
	No. of Cases (%)	Weighted % (95% CI)	No. of Cases	% (95% CI)
Physician notes were sufficient to determine diagnosis	384 (98.5) ^b	99.1 (98.6–99.7)	434	99.3 ^c (98.5–100.0)
Clinical diagnosis of drug poisoning confirmed (any drug)	391 (98.2)	98.0 (96.3–99.7)	436	96.5 (94.8–98.1)
Cases determined to be opioid-related poisoning, by type of opioid involved (not mutually exclusive categories)				
Heroin	377 (94.7)	93.2 (90.0–96.3)	87	19.2 (15.5–22.9)
Natural/semisynthetic	9 (2.3)	2.3 (0.5–4.0)	134	29.6 (25.4–33.9)
Methadone	1 (0.3)	0.5 (0–1.5)	13	2.9 (1.3–4.4)
Synthetic other than methadone	4 (1.0)	0.9 (0–1.9)	69	15.3 (11.9–18.6)
Underlined type of opioid	12 (3.0)	4.6 (1.9–7.3)	148	32.7 (28.4–37.1)
Cases in which toxicology testing was ordered	119 (30.0) ^d	27.0 (22.0–32.0)	154	34.2 ^e (30.0–38.5)
Drug screening	117 (29.4)	26.7 (21.8–31.7)	141	31.2 (26.9–35.5)
Confirmatory drug testing	16 (4.0)	1.8 (1.2–2.5)	21	4.6 (2.7–6.6)
Indication of previous poisoning(s)	147 (37.1) ^f	46.3 (40.6–52.0)	132	29.5 ^g (25.3–33.8)
Naloxone was administered	355 (89.2)	92.9 (90.0–95.7)	384	85.0 (81.7–88.2)
Person who administered naloxone, % ^f				
Prehospital emergency medical services	312 (78.4)	78.8	294	65.0
Law enforcement	9 (2.3)	1.6	5	1.1
Family friend	4 (1.0)	1	6	1.3
Emergency department	54 (13.6)	14.6	95	21.0
Firefighters	0	0	1	0.2
Cases with documented multiple-dose naloxone administration, %	106 (26.6)	27.6	113	25.0

^aMedical records from 12 emergency departments in Kentucky dated from October 2015 through December 2016 were reviewed by emergency medicine physicians to assess the positive predictive values of 4 case definitions. All values are percentage (95% CI) unless otherwise indicated.

^bEight records had missing values.

^cFifteen records had missing values.

^dOne record had missing values.

^eTwo records had missing values.

^fMultiple categories could apply; percentages were calculated as a percentage of the total sample.

^gFive records had missing values.

except those prescribed for pain management. Confirmatory testing can identify specific opioids, including synthetic opioids, but results would not be available in time to influence patient care. For a patient with suspected opiate/opioid overdose, the results of confirmatory drug testing would not affect the clinical care provided. The interviewed physicians commented that most hospitals do not have the ability to perform on-site confirmatory testing. Where ordered, ED drug screening typically serves to assist with outpatient follow-up and inform consultants, especially when drug abuse and mental health issues are suspected. Drug screening would also be ordered when polysubstance overdose (eg, opioids, benzodiazepines) is suspected. The decision to order confirmatory testing would be based on considerations such as suspected polypharmacy or atypical clinical presentation suggesting unknown substances. The interviewed physicians stated that patients are generally honest about the drugs used.

Discussion

The estimated PPVs of 93.2% for definition H-F and 79.4% for definition OO-F suggest that the proposed ICD-10-CM opioid poisoning morbidity indicators that use first-listed diagnoses alone identify clinical cases targeted by the surveillance definitions. However, more than two-thirds of cases identified by secondary diagnosis codes (76.5% for definition H-S and 67.0% for definition OO-S) were also confirmed as clinical diagnoses after medical record review. This latter finding suggests that expanding surveillance definitions to include all diagnoses (first-listed and secondary) would still result in a high percentage of true-positive cases.

In September 2017, the Council of State and Territorial Epidemiologists (CSTE) in partnership with the CDC's National Center for Injury Prevention and Control convened the ICD-10-CM Drug Poisoning Indicators Workgroup to pilot test several proposed drug poisoning definitions. The preliminary results from our case confirmation study

informed the workgroup's discussion on expanding proposed surveillance definitions to include both first-listed and secondary diagnosis codes. In 2018, CDC revised its provisional guidance for drug poisoning morbidity surveillance indicators, directing epidemiologists to include only cases with a seventh character of A or a missing seventh character and to include both the first-listed diagnosis code and secondary diagnosis codes.¹⁹ In 2019, CSTE issued concurring guidance in the Nonfatal Opioid Overdose Surveillance Case Definition.²⁰

The effectiveness of the definitions in identifying true cases also relies on the adequacy of physician notes for medical coding. In most reviewed cases, study physicians found that physician notes in the medical record were sufficient to determine the clinical diagnosis. When physician notes were insufficient, the study relied on other portions of the medical record, patient report of drug use, and emergency medical services and nursing notes to determine clinical diagnoses. Under ICD-10-CM coding guidelines, medical coders cannot use these other parts of the medical record to code cases.¹⁸ This restriction limits the ability of the code-based definition to identify all cases. The percentage of cases that relied on other parts of the patient record, although small, still indicates potential undercounting. Physicians should be encouraged to compose robust notes that provide the necessary documentation for medical coding and identify true opioid poisoning cases.

Toxicology testing provides surveillance data for opioid involvement but has limited value for clinical treatment of opioid poisoning and is rarely ordered by ED physicians. The lack of confirmatory toxicology testing data impedes the use of ICD-10-CM codes to track the involvement of synthetic opioids. Inferences about involvement of specific drugs based on clinical impressions, anecdotal information, signs, and symptoms could be inaccurate. Because confirmatory toxicology testing is commonly performed only for fatal overdoses, opioid surveillance is impeded by "a huge loss of surveillance data, since the vast majority of patients who overdose on opioids and present for healthcare do not die."²³ Toxicology testing of nonfatal overdoses in ED settings should be supported by public health and safety funding, because it is essential to supply missing information on public health threats from changes in the opioid drug supply, particularly with new designer drugs. CDC recognized the need for dedicated funding for toxicology testing in the ED in its call for "innovative surveillance of the illicit opioid drug supply."²⁴

Limitations

Our study had several limitations. First, we recruited study physicians from among physicians who already had access to the electronic medical records in their health care networks. This recruitment approach alleviated data privacy concerns voiced by some health system administrators, but it raised the possibility of recall bias. The risk of recall bias was mitigated

by the large case volume at the participating health care facilities and by the lag in time between the provision of ED services and data abstraction. When physicians were asked whether they recalled treating the patients whose records they reviewed, they responded that they did not. A second limitation was that the findings and inferences may not be representative of other EDs. This study, however, can be replicated to estimate the PPVs of the proposed definitions in different settings.

Conclusions

The use of ED physicians as reviewers eliminated the need to create a prespecified algorithm for true-positive identification. Future studies can use the interviewed physicians' open responses on decision making for diagnosing opioid-involved overdoses to develop and validate a checklist of clinical characteristics and an algorithm for confirming heroin and other opioid-involved overdoses for use in future medical record review studies involving nonphysician reviewers.

It is not widely understood that medical coders cannot assign codes based on clinical criteria used by physicians to establish the diagnosis.¹⁸ Medical coders can code only conditions that are explicitly diagnosed and documented by the medical provider in the physician discharge summary or progress notes. Drug overdose morbidity surveillance would benefit from more detailed physician notes for accurate ICD-10-CM coding. Practical and nonburdensome solutions are needed for enhanced physician documentation.

This case confirmation study provides evidence that the ICD-10-CM codes for heroin poisoning and poisoning by other opioids had high PPV when listed as secondary diagnoses. These results partially informed CDC's decision to revise its surveillance definitions to identify relevant ICD-10-CM codes among all diagnoses (first-listed and secondary)¹⁹ so as to represent the magnitude of opioid-related poisoning more accurately than it has been represented previously.

Acknowledgments

The authors thank Renee Johnson, MSPH, RPT, and Holly Hede-gaard MD, MSPH, for their contributions to the study design and their insight during the preparation of the article. The authors also acknowledge support from the Office of Health Data and Analytics, Kentucky Cabinet for Health and Family Services, for providing administrative billing data for this study. The findings and conclusions in this article are solely the responsibility of the authors and do not necessarily represent the official views of the Centers for Disease Control and Prevention (CDC) or the US Department of Health and Human Services.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: grant/cooperative agreement no. 5 NU17CE002732-04 from CDC.

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