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Differences and similarities between emergency department syndromic surveillance and hospital discharge data for nonfatal drug overdose

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Abstract

Purpose: Emergency department syndromic surveillance and hospital discharge data have been used to detect and monitor nonfatal drug overdose, yet few studies have assessed the differences and similarities between these two data sources.

Methods: The Centers for Disease Control and Prevention Drug Overdose Surveillance and Epidemiology system data from 14 states were used to compare these two sources at estimating monthly overdose burden and trends from January 2018 through December 2019 for nonfatal all drug, opioid-, heroin-, and stimulant-involved overdoses.

Results: Compared to discharge data, syndromic data captured 13.3% more overall emergency department visits, 67.8% more all drug overdose visits, 15.6% more opioid-involved overdose visits, and 78.8% more stimulant-involved overdose visits. Discharge data captured 18.9% more heroin-involved overdoses. Significant trends were identified for all drug (Average Monthly Percentage Change [AMPC] = 1.1, 95% CI = 0.4,1.8) and stimulant-involved overdoses (AMPC = 2.4, 95% CI = 1.2,3.7) in syndromic data; opioid-involved overdoses increased in both discharge and syndromic data ($AMPC_{Discharge}$ = 0.9, 95% CI = 0.2,1.7; $AMPC_{Syndromic}$ = 1.9, CI = 1.1,2.8).

Conclusions: Results demonstrate that discharge data may be better for reporting counts, yet syndromic data are preferable to detect changes quickly and to alert practitioners and public health

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Authors' contributions

Dr. Vivolo-Kantor conceptualized and designed the study, drafted the initial manuscript, and reviewed and revised the manuscript. Mr. Smith helped conceptualize the study, conducted all analyses, and reviewed and revised the manuscript. Dr. Scholl assisted with data analysis and reviewed and revised the manuscript. All authors critically reviewed the manuscript for important intellectual content and approved the final manuscript as submitted and agree to be accountable for all aspects of the work

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officials to local overdose clusters. These data sources do serve complementary purposes when examining overdose trends.

Keywords

Syndromic surveillance; Hospital discharge; Drug overdose; Heroin; Opioid; Stimulant; Chief complaint; Diagnosis codes; ICD-10-CM

Drug overdoses caused 70,630 deaths in the U.S. in 2019 [1], and 967,615 nonfatal drug overdoses were treated in an emergency department (ED) in 2017 [2]. To combat this epidemic, the Centers for Disease Control and Prevention (CDC) implemented the Overdose Data to Action (OD2A; https://www.cdc.gov/drugoverdose/od2a/index.html) program, which funds health departments to obtain high quality, more comprehensive, and timelier overdose data to inform prevention and response efforts. Nonfatal overdose surveillance under OD2A (i.e., Drug Overdose Surveillance and Epidemiology; https://www.cdc.gov/drugoverdose/data/nonfatal/case.html) leverages two ED visit data sources - syndromic surveillance and hospital discharge data - to monitor overdose trends. Drug Overdose Surveillance and Epidemiology estimates overdose burden by analyzing discharge data and can detect sharp changes in overdoses with the much timelier syndromic data. Accurately describing and monitoring trends in nonfatal overdoses using injury surveillance data is necessary for development and evaluation of prevention and response efforts.

There is a need to better understand differences and similarities in these two sources. Traditional injury surveillance using ED visit data has relied on hospital discharge diagnosis codes captured in patient records, used primarily for billing, because most states have access to statewide, centralized, electronic databases for all ED visits [3]. These data commonly use the standardized uniform billing form, UB-04 [4], which captures patient demographics (e.g., age, sex) and visit information (e.g., date of admission, confirmed clinical diagnoses) [5]. Discharge data often are considered the most reliable to assist in estimating disease burden because of the standardized coding scheme (i.e., International Classification of Diseases, 9th Revision, Clinical Modification [ICD-9-CM] and 10th Revision, Clinical Modification [ICD-10-CM]). Discharge data are less expensive to obtain than survey data or medical chart abstraction and may be more reliable than patient self-report [6,7], but they are less timely than other data sources using electronic health records (EHR; i.e., availability of discharge data can range from one quarter to two years following an ED visit) [8]. Assignment of diagnosis codes in discharge data also is subject to decisions made by billing coders that might not provide a fully accurate, comprehensive account of medical conditions treated in EDs [9].

Because discharge data may not be timely, syndromic surveillance data are key to quickly identifying overdose spikes in order to implement actionable prevention and response activities. Unlike curated discharge data files, syndromic data rely mostly on unstandardized text [10], such as chief complaint (i.e., purpose of the visit), clinical impression (i.e., healthcare professional's assessment), and triage notes (i.e., additional context provided by the patient, law enforcement, emergency medical services [EMS], or patient's family/friends). These unstandardized fields are rich in data but difficult to analyze due to

considerable variability in the depth and breadth of information provided. Syndromic data also often include diagnosis codes, but they may not represent final clinical diagnoses. Therefore, challenges in data quality and completeness can hamper the ability to analyze syndromic data [11,12]. However, syndromic data are captured in near real-time; oftentimes chief complaint text is transmitted from EHRs to local surveillance systems within 24–48 hours of a visit [13].

Several studies have compared diagnosis codes from discharge datasets and patient records using medical chart abstraction [14–19]. Comparisons of computer-designated codes and expert reviewer-provided ICD-9-CM codes showed high overall agreement for mechanism of injury (87%), intent of injury (95%), and complete external cause code (66%) with a 94% positive predictive value (PPV) for all drug poisonings [15]. Other studies identified over 80% PPV for opioid poisonings [9, 16]. However, Rowe and colleagues acknowledged that, “limiting surveillance to opioid poisoning codes in our sample only identified about a quarter of opioid-involved overdose cases. Yet to achieve 100% sensitivity would involve identifying 13.6 false-positive cases for every true-positive” (9, p. 481). Using ICD-10-CM diagnosis coded data, researchers found that first-listed heroin poisoning diagnoses had a PPV of 93.2% while secondary heroin poisoning diagnoses had a PPV of 76.5% [17]. One comparison of syndromic and discharge data found that, although total volume of injuries (e.g., traffic-related, firearm-related) treated in EDs varied between the two data sources, the temporal trends were highly correlated (correlation range: 0.67–0.87) [18]. Another study reported a high degree of reliability when comparing mental and substance use disorder syndromes to discharge diagnosis codes [19].

Because no studies have documented the similarities and differences between ED syndromic and hospital discharge data for *nonfatal drug overdose*, the current study seeks to address this gap. Building on previous studies that analyzed data from one state or several facilities, our study includes data from over 1600 facilities in 14 states. Our study also specifically focuses on four drug overdose categories using ICD-9-CM, ICD-10-CM, and Systematized Nomenclature of Medicine (SNOMED) diagnosis codes; whereas previous studies have mostly focused on ICD-9-CM diagnosis codes. This study compares syndromic and discharge data with four aims to describe and compare differences in: (1) total ED visit volume and drug overdose counts; (2) drug overdose rates; (3) relative percentage change estimates for drug overdose; and (4) drug overdose trends.

Materials and methods

Data sources

Syndromic surveillance data—Forty-two OD2A-funded health departments share aggregate syndromic data monthly with a month time lag (e.g., data for December 2019 were submitted in February 2020) using a secure server or allowing access to their data in CDC’s National Syndromic Surveillance Program’s BioSense platform [12]. Queries include only data from facilities designated as EDs and patients who were seen in the ED.

Discharge data—Twenty-five OD2A-funded health departments share aggregate ED discharge data with a 3.5-month time lag (e.g., data from October, November, and December

2019 were submitted in April 2020) using a secure server. Health departments were instructed to remove patients treated in an ED but were subsequently admitted to the hospital for further treatment.

Sample—Seventeen states share both ED syndromic and discharge data in DOSE. Our analysis included 14 states with consistently available and analyzable data from January 2018–December 2019. For all but one state, syndromic data coverage ranged from 70%–100%; one state's coverage ranged from 55%–89.2%. Visit coverage ranged from 82%–100% for discharge data. Each month, on average, syndromic data included 100 facilities and discharge data included 119 facilities (total $N = 1435_{Syndromic}$ and $N = 1660_{Discharge}$). Syndromic chief complaint text had a median string length of 3.2 words and included a mean of 3.3 diagnosis codes, while discharge data had a mean of 4.7 diagnosis codes. On average, 3.4% of syndromic visits were missing chief complaint and 20.8% were missing diagnosis codes.

Case definitions—Case definitions were developed for four overdose categories: all drugs, opioids, heroin, and stimulants. Syndromic data case definitions utilized both chief complaint free text and diagnosis codes. Visits with discharge (e.g., ICD-9/10-CM) [20] or clinical (e.g., SNOMED; https://www.nlm.nih.gov/healthit/snomedct/index.html) diagnosis codes for unintentional or undetermined initial encounter drug poisonings were automatically included as suspected drug overdoses. Suspected opioid-involved overdoses, specifically, were automatically included if visits contained ICD-10-CM codes for opioid use, abuse, and dependence *with intoxication* or mention of naloxone administration in chief complaint text. Additional overdose visits were identified if chief complaint text contained an indication of (1) overdose or poisoning and (2) drug involvement or an ICD-10-CM code for opioid use, abuse, and dependence (i.e., F11). Common misspellings of key terms in chief complaint text were also included (e.g., "herion" instead of "heroin").

Discharge data case definitions only included diagnosis codes from ICD-10-CM Chapter 19 section T36-T50 with initial encounter and unintentional and undetermined intent coding. All diagnosis fields were queried to identify drug overdoses. More information on the specific codes and chief complaint text for the definitions can be found elsewhere [21,22].

Analysis—Results report counts of total ED visit volume and visits for the drug overdose categories. We calculated crude monthly rates for each drug overdose category (e.g., drug overdose visits divided by total ED visits, multiplied by 10,000) and data source (i.e., syndromic and discharge). We then calculated month-to-month relative rate percentage change. To examine trends from January 2018 through December 2019, regression models were estimated using JoinPoint version 4.7.0.0 (https://surveillance.cancer.gov/joinpoint/) to calculate average monthly percentage change (AMPC), monthly percentage change (MPC), and 95% confidence intervals (CIs). P values <.05 were considered statistically significant.

Results

Total emergency department visits

ED visit volume for syndromic data in 2018 (N = 47,388,903) and 2019 (N = 48,531,908) was greater than for discharge data (N = 42,042,306 and 41,868,821, respectively). On average, syndromic data included 13.3% more total ED visits than discharge data; however, differences varied by month (Fig. 1). No significant trend or joins were identified for either data source.

All drug overdose

Syndromic data captured 284,663 (60.1 per 10,00 0 total ED visits) and 326,545 all drug overdoses (67.2) in 2018 and 2019, respectively, while discharge data captured 149,384 (35.5) and 151,262 all drug overdoses (36.1) in 2018 and 2019, respectively. Counts for all drug overdose were, on average, 67.8% higher in syndromic data than in discharge data, and rates were on average, 55.8% higher in syndromic data than in discharge data (Fig. 2–1a and 2–1b). Only slight differences were identified when examining the differences between syndromic data and discharge data in terms of month-to-month percentage change of drug overdose rates (Mdn = 1.4%, range = 0.05%–6.3%; see Supplemental Materials Fig. 1a).

Opioid overdose

Syndromic data captured 68,524 (14.5 per 10,000 total ED visits) and 85,982 opioid-involved overdoses (17.7) in 2018 and 2019, respectively. Discharge data captured 64,569 (15.4) and 66,616 opioid-involved overdoses (15.9) in 2018 and 2019, respectively. The counts and rates for opioid-involved overdose were discordant and the differences in counts increased over time; counts were 15.6% higher in syndromic data compared to discharge data (Fig. 2–2a). Meanwhile, discharge data rates were approximately 5.9% higher in 2018 and syndromic data became 10.5% higher in 2019 (Fig. 2–2b). Month-to-month percentage change of rates of overdoses involving opioids also varied slightly between both data sources (Mdn = 2.3%, range = 0.01%–7.0%; see Supplemental Materials Fig. 1b).

Heroin overdose

Syndromic data captured 31,770 (6.7 per 10,000 total ED visits) and 36,203 heroin-involved overdoses (7.4) in 2018 and 2019, respectively. Discharge data captured 42,413 (10.1) and 39,498 heroin-involved overdoses (9.4) in 2018 and 2019, respectively. The counts and rates for heroin-involved overdose were, on average, 18.9% and 32.0% higher in discharge data than in syndromic data, respectively (Fig. 2–3a and 2–3b). The count differences between the data sources did decrease over time. Month-to-month percentage change of rates of overdoses involving heroin also varied slightly in between data sources (Mdn = 1.5%, range = 0.06%–8.6%; see Supplemental Materials Fig. 1c).

Stimulant overdose

Syndromic data captured 17,578 (3.7 per 10,000 total ED visits) and 23,526 stimulant-involved overdoses (4.8) in 2018 and 2019, respectively. Discharge data captured 8,817 (2.1) and 8,707 stimulant-involved overdoses (2.1) in 2018 and 2019, respectively. The counts

and rates for stimulant-involved overdose were, on average, 78.8% and 67.4% higher in syndromic data than in discharge data, respectively (Fig. 2–4a and 2–4b). Starker differences in month-to-month percentage change of rates of overdoses involving stimulants were demonstrated for syndromic data and discharge data (Mdn = 4.8, range = 0.5–24.4; see eFigure 1d). For example, analysis of syndromic data indicated a 9.6% *increase* in the stimulant-involved overdose rate from May 2019 to June 2019, however, discharge data showed a 14.9% *decrease* from May 2019 to June 2019.

Trend analysis

Analyses indicated a significant upward trend for all drug overdose in syndromic data from January 2018 through December 2019 (AMPC = 1.1, 95% CI: 0.4, 1.8), whereas, no significant trend was identified in discharge data (AMPC = 0.6, 95% CI: −0.4, 1.7). Analysis of both syndromic data (AMPC = 1.9, 95% CI: 1.1, 2.8) and discharge data (AMPC = 0.9, 95% CI: 0.2, 1.7) identified a significant increasing trend for opioid-involved overdose; however, neither syndromic data nor discharge data identified a significant trend for heroin-involved overdose. Syndromic data identified a significant increasing trend for stimulant-involved overdose (AMPC = 2.4, 95% CI: 1.2, 3.7), whereas, discharge data did not (AMPC = 0.67, 95% CI: −0.97, 2.12).

Similar monthly joins were identified across drug categories and data sources. Table 1 presents MPCs for all segments, Table 1 in the Supplemental Materials presents the counts and rates specific to each drug category, and Figure 2 in the Supplemental Materials visualizes all inflection points. Apart from all drug overdoses in discharge data, all final models identified three joins. Across all drug categories and both data sources, trends increased from January 2018 to summer months in 2018. Trends for most drug categories subsequently decreased from the summer months in 2018 to winter months in 2019. A similar pattern was observed for both syndromic data and discharge data during 2019, with significant increasing trends from winter to summer months, following by subsequent declines.

Discussion

This study compared nonfatal drug overdoses treated in EDs identified in syndromic and hospital discharge data. Findings reveal several differences and similarities that can inform epidemiological analysis of ED data to monitor overdose burden and trends. Syndromic data captured more total ED visits and higher counts and rates for all drug, opioid-, and stimulant-involved overdose visits. Conversely, discharge data captured higher counts and rates for heroin-involved overdose ED visits. Few differences were found when examining month-to-month percentage change and trends between the two sources. In both data sources, a seasonality trend was identified for all four drug overdose categories.

Some findings were unexpected, for example, syndromic had fewer facilities than discharge (n=1435 vs. 1660) yet included approximately 13% more total ED visits than discharge. CDC guidance to OD2A-funded health departments requested submission of mutually exclusive discharge files, removing patients who visited an ED and were subsequently admitted to the hospital for further care. However, it was not possible to remove patients

admitted to the hospital for further treatment from syndromic data. The National Hospital Ambulatory Medical Care Survey estimated that, in 2017, approximately 10% of ED visits resulted in hospital admission [23], which could account for these differences. This may also account for the differences seen in counts for overdose visits. Future analyses should explore these differences in facilities and visits both within and across states.

For three of the four overdose categories, those reflective of broader drug classes, syndromic data captured higher counts and rates than discharge, with all drug and stimulant overdose counts more than two-thirds greater in syndromic than in discharge data. Though additional exploration is necessary, these findings are plausible due to case definition differences and potential discrepancies in what is written in chief complaint text versus the codes added for billing purposes. For example, chief complaint text may say “overdose,” but the discharge code assigned may be for another purpose of the visit. Thus, syndromic data may capture more visits because our definitions include both chief complaint text and discharge codes. Conversely, more heroin-involved overdoses were identified in discharge data. With syndromic data based mostly on patient self-report, patients might not disclose to medical staff specific substances used when describing reasons for their ED visits. Consequently, medical personnel may use less specific language when entering chief complaint text (e.g., “overdose”), and a specific discharge code (e.g., T40.1X for heroin poisoning) may then be applied to the health record only after obtaining a confirmed clinical diagnosis. The final confirmed clinical diagnosis code would then be included in the discharge data file but may not be updated in the syndromic patient record. These coding differences point to one reason why discharge data may be better for presenting counts, and highlights that timelier syndromic data can be discordant with discharge data as more visit information is gathered; yet syndromic data are preferable to detect changes quickly and to alert practitioners and public health officials to local overdose clusters.

Monthly percentage change was comparable between both data sources for all four overdose categories. Although both data sources reliably estimated changes over time, syndromic data are timelier (i.e., data for December 2019 were available for CDC’s use in February 2020) than discharge data (i.e., data for December 2019 were available by April 2020, but in most states discharge data are not available for analysis until the following year). In fact, a majority of the states participating in the Agency for Health Research and Quality’s Healthcare Cost and Utilization Project (HCUP) [8], which collects discharge data from EDs, have a two-year time lag in reporting. This significant time lag limits accurate depictions of the ever-evolving drug overdose landscape in communities, making timelier syndromic data a reliable complement to discharge data to monitor trends several months to years before discharge data are available.

We identified markedly similar trends between the two data sources for all four drug overdose categories. Apart from discharge data for all drug overdose, overdoses peaked in summer months (e.g., June, July, August) and decreased through winter months (e.g., December, January, February). Several studies corroborate this trend, but only one study found a seasonal variation in nonfatal overdose *ED visits in the U.S.* Analysis of Ohio data revealed a slight seasonal trend with higher all drug overdose ED visits in spring and summer [24]. An international study identified a similar trend using EMS data [25] and

studies of drug overdose deaths have demonstrated mixed results, some identifying peaks in the spring and summer [26,27] and others finding increases in winter months [28,29].

There are several plausible theories for this seasonal trend, but this remains largely unexplained. First, opioid prescribing and substance use patterns change over the course of the year. Increases occur in the summer and decreases in the winter [30,31], thus increasing overdose risk, particularly if substances are used for the first time. Second, these changes may reflect drug supply availability and purity - weekly fluctuations in heroin purity are correlated with heroin-related overdose deaths [32]. Previous research in Genesee County, Michigan found that overdose events were more intense during summer months in certain locations with specific demographic characteristics, for example, lower than average socio-economic distress [29]. Nonetheless, these findings require further exploration. Additional analyses should explore state-specific variability in addition to potential clustering of overdoses at more granular levels. A better understanding of how both data sources converge within different geographic areas would strengthen potential intervention effectiveness.

Limitations

Several limitations are noted. Syndrome definitions may under-estimate or overestimate overdoses due to coding differences in hospitals, availability of diagnosis codes, and variable quality of chief complaint text. Additional diagnosis codes and chief complaint text may be received in delayed updates to visit data. Therefore, more overdoses may be identified as syndromic visit data are updated. Toxicology screens completed in EDs can determine drugs classes; however, they are limited [33] and rarely completed in time for clinical treatment decisions [34]. Consequently, diagnosis codes may not be assigned using drug screen results or confirmatory testing. Because the purpose of having standardized discharge coding is for medical billing; numbers and types of diagnosis codes may be reported strategically to optimize reimbursement [35] and counts from discharge data might not provide truly accurate estimates of overdose burden [36,37]. Unfortunately, our study cannot determine the sensitivity, specificity, or PPV for drug overdoses in either data source. Finally, findings are only generalizable to the facilities and states participating in DOSE.

Nonetheless, our findings provide important comparisons of syndromic and discharge data for drug overdose-related ED visits. When determining local response, health departments and public safety may allocate resources based on burden counts, but caution is warranted given differences in counts across drug indicators and data sources. Syndromic data alone may lead to overestimation of burden in certain communities, and is not the intended purpose of syndromic data, whereas relying on discharge data alone may lead to underestimation of burden, except for heroin overdose. The timeliness of syndromic data is advantageous in guiding outbreak and response efforts, while time lags for discharge data inhibit use for these purposes. Although counts and rates may differ substantially between the two sources, the trends in both counts and rates largely mirror one another for total ED visits and for overdoses, thus the true value likely exists between the two and is a function of many factors including self-reporting (e.g., patient not lucid enough to report accurately); clinical judgment absent laboratory findings at ED intake, delayed application of diagnosis codes following clinical testing, billing codes applied strategically

for reimbursement purposes, and a potential proportion of patients admitted to the hospital that are being picked up by syndromic but not discharge data.

Altogether, syndromic and discharge data serve complementary purposes when examining overdose trends and should be examined together. Future studies should consider patient-record linkage of the two data sources to better understand the above noted discrepancies. That said, timely syndromic data can build the foundation for health department drug overdose surveillance with the lagged discharge data being used as a complementary resource with the standard coding scheme used to assign diagnoses. In addition, triangulation with other data sources (e.g., EMS, laboratory data) could provide communities with clearer direction to guide ongoing resource deployment for prevention and response efforts. Similar rates and trends across both data sources indicate that syndromic data can be used as a proxy for discharge data to detect changes in near-real time. Although syndromic data may be less specific with respect to identifying the type of substance, the prevention and response implications would largely be the same. Our analyses also detected a clear seasonal trend in overdoses, which can assist communities with preparing necessary resources for overdose spikes in the summer including the provision of naloxone, establishing linkages to care, or increasing access to medications for opioid use disorder [38].

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations:

CDC	Centers for Disease Control and Prevention
ED	emergency department
NSSP	National Syndromic Surveillance Program
OD2A	Overdose Data to Action
DOSE	Drug Overdose Surveillance and Epidemiology
ICD-9-CM	International Classification of Diseases, ninth Revision, Clinical Modification
ICD-10-CM	International Classification of Diseases, 10th Revision, Clinical Modification

SNOMED	Systematized Nomenclature of Medicine
EMS	Emergency Medical Services
EHR	electronic health record
AMPC	Average Monthly Percentage Change
MPC	Monthly Percentage Change
CI	Confidence Interval
HCUP	Healthcare Cost and Utilization Project

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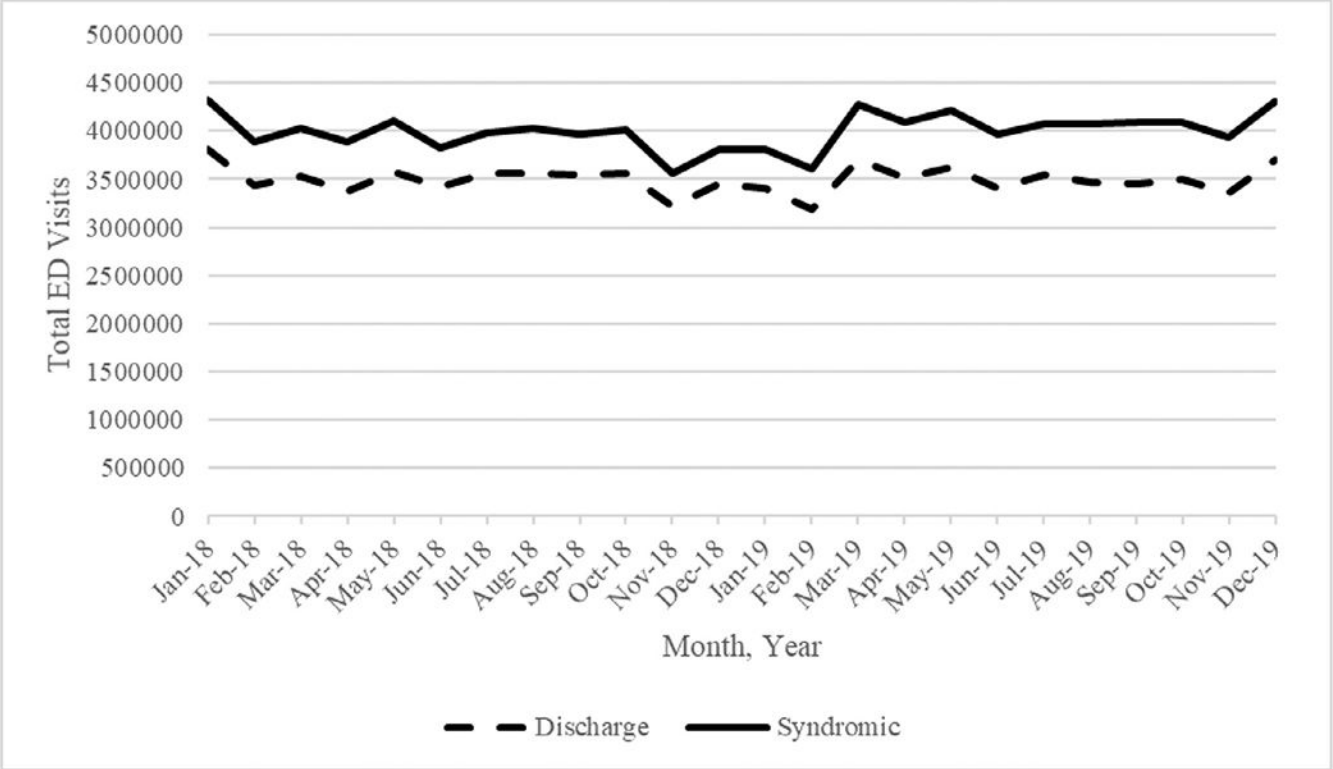
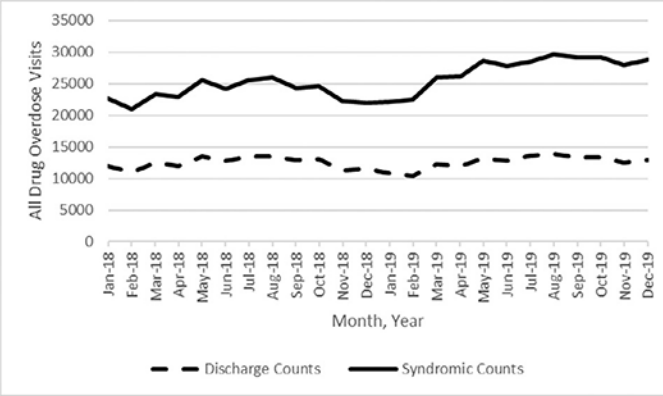


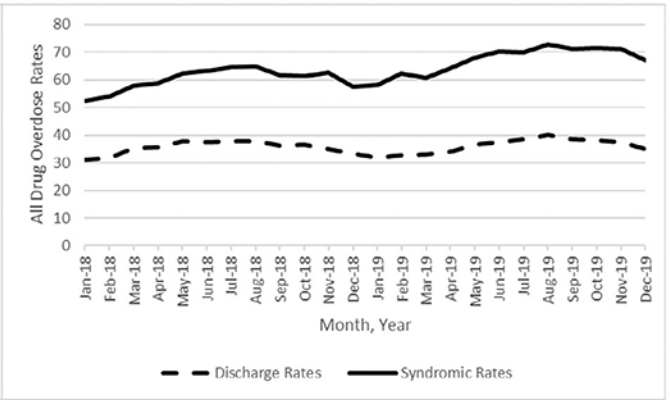
Fig. 1. Monthly total emergency department visits for syndromic and discharge data sources, 14 US states[a], 2018-2019.

(a) Includes the following 14 states: Alaska, Colorado, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Michigan, Missouri, New York, Oregon, Rhode Island, Wisconsin.

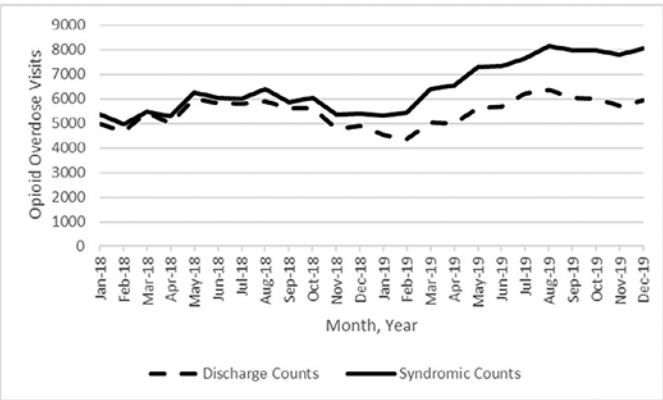
2-1a: All Drug Overdose Counts



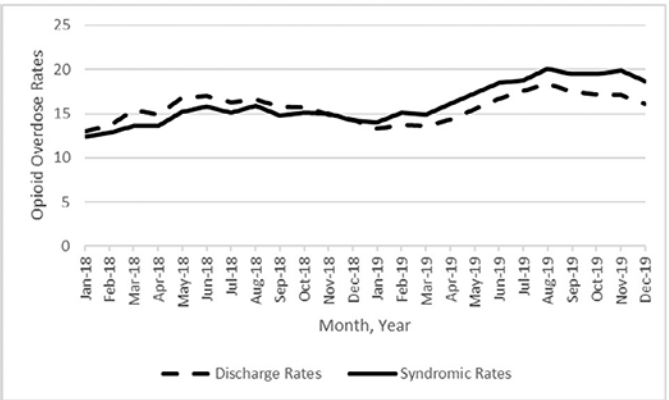
2-1b: All Drug Overdose Rates



2-2a: Opioid Overdose Counts



2-2b: Opioid Overdose Rates



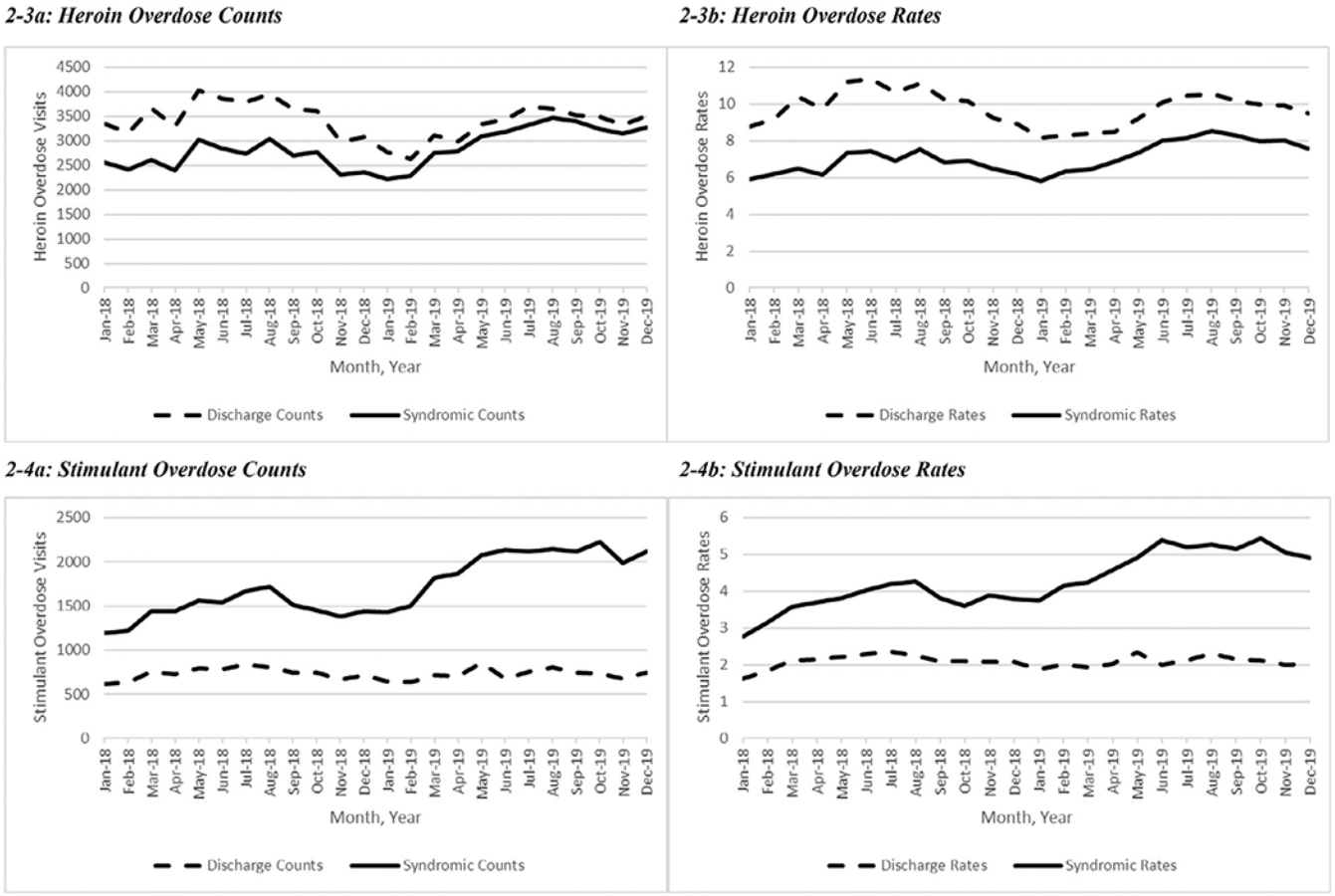


Fig. 2. Monthly emergency department visit counts and rates[a] for drug overdose in for syndromic and discharge data sources, 14 US states[b], 2018-2019.

(a) Crude monthly rates for each drug overdose category were calculated such that drug-involved overdose visit counts were divided by total emergency department visits and then multiplied by 10,000. (b) Includes the following 14 states: Alaska, Colorado, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Michigan, Missouri, New York, Oregon, Rhode Island, Wisconsin.

Table 1

JoinPoint regression analysis [*] on the trends for all drug, opioid, heroin, and stimulant overdose, stratified by data source, 14 US states [†], 2018-2019

Overdose category	Data source	Joins	Segment 1 (MPC: 95% CI)	Segment 2 (MPC: 95% CI)	Segment 3 (MPC: 95% CI)	Segment 4 (MPC: 95% CI)	Segment 5 (MPC: 95% CI)
All drug	SyS	3	Jan 18–Jul 18 (3.6: 2.3,4.9)**	Jul 18–Jan 19 (−1.9: −3.5,−0.3)**	Jan 19–Aug 19 (3.3: 2.1,4.6)**	Aug 19–Dec 19 (−1.8: −3.9,0.3)	–
	DX	4	Jan 18–May 18 (5.1: 2.9,7.4)**	May 18–Oct 18 (−0.7: −2.7,1.4)	Oct 18–Jan 19 (−5.0: −11.4,1.9)	Jan 19–Aug 19 (3.4: 2.3,4.6)**	Aug 19–Dec 19 (−2.6: −4.6,−0.6)**
Opioid	SyS	3	Jan 18–Jun 18 (5.2: 3.1,7.4)**	Jun 18–Jan 19 (−1.6: −3.1,−0.1)**	Jan 19–Aug 19 (5.1: 3.6,6.6)**	Aug 19–Dec 19 (−1.1: −3.5,1.3)	–
	DX	3	Jan 18–Jun 18 (5.8: 3.9,7.8)**	Jun 18–Feb 19 (−3.3: −4.4,−2.2)**	Feb 19–Aug 19 (5.5: 3.6,7.4)**	Aug 19–Dec 19 (−2.9: −5.3,−0.5)**	–
Heroin	SyS	3	Jan 18–Aug 18 (3.2: 1.4,4.9)**	Aug 18–Jan 19 (−4.8: −8.6,−0.8)**	Jan 19–Aug 19 (5.6: 3.5,7.8)**	Aug 19–Dec 19 (−3.1:−6.4,0.4)	–
	DX	3	Jan 18–Jun 18 (5.3: 2.9,7.9)**	Jun 18–Mar 19 (−3.9: −5.1,−2.7)8*	Mar 19–Jul 19 (7.3: 1.5, 13.5)**	Jul 19–Dec 19 (−2.0: −4.3,0.3)	–
Stimulant	SyS	3	Jan 18–Jun 18 (7.4: 4.1,10.8)**	Jun 18–Jan 19 (−1.7: −3.8,0.5)	Jan 19–Jun 19 (7.6: 3.5,11.8)**	Jun 19–Dec 19 (−0.9: −2.8,1.0)	–
	DX	3	Jan 18–May 18 (8.8: 3.7,14.2)**	May 18–Jan 19 (−2.3: −4.2,−0.4)**	Jan 19–Aug 19 (1.9: −0.6,4.6)	Aug 19–Dec 19 (1.9: −7.2,1.7)	–

SyS = syndromic surveillance; DX = discharge; MPC = monthly percentage change.

[*] All line segments are displayed; significant slope coefficients at P <.05 are identified with an "**".

[†] Includes the following 14 states: Alaska, Colorado, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Michigan, Missouri, New York, Oregon, Rhode Island, Wisconsin.