

# Heroin and Healthcare: Patient Characteristics and Healthcare Prior to Overdose

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America's opioid epidemic continues to grow. The negative health outcomes and healthcare costs associated with the epidemic are well documented,<sup>1</sup> with opioid overdose fatalities making up the most acute and reliable measure. In 2014, the CDC reported the highest number of opioid overdose fatalities (28,647) during any previous year on record,<sup>2</sup> only to report that this unprecedented number was surpassed with 47,600 opioid overdose deaths by 2017.<sup>3</sup>

Although the rising number of annual opioid overdose deaths indicates that the opioid epidemic has not yet peaked, the relative contribution of different drug types to the epidemic is changing. In 2015, the CDC reported that the heroin-involved overdose mortality rate was increasing more than overdose deaths involving commonly prescribed opioids (20.6% vs 2.5%).<sup>4</sup> As heroin deaths approach the number of prescription opioid deaths, another challenge has emerged from illicitly manufactured fentanyl (IMF).<sup>5</sup>

The dynamic nature of the opioid overdose epidemic poses continuous challenges to prevention efforts.<sup>6</sup> Despite the problem of polysubstance use among heroin users,<sup>7</sup> demographic changes in opioid use patterns are also well documented. Younger patients have higher prevalence of heroin use disorders,<sup>8</sup> and national reports identify that the largest increases in percentage of individuals with heroin use disorder from 2010 to 2014 are among those aged 18 to 25 years.<sup>9</sup> National death data similarly show high heroin overdose rates among younger age groups.<sup>3,4</sup> Heroin is frequently adulterated with IMF, and deaths involving synthetic opioids, such as fentanyl, are also highest among younger age groups.<sup>3,5</sup>

These studies of recent trends in heroin use and mortality are critically important for identifying at-risk groups. However, they do not provide essential information on the underlying patterns in healthcare utilization preceding an overdose or prior prescription opioid use—an important concern given the association between opioid use disorders involving prescription opioids and heroin.<sup>7</sup> For this study, we aimed to characterize trends in heroin overdoses treated in healthcare settings for an insured population and to describe healthcare encounters before the overdose, including diagnoses and use of prescription opioids, benzodiazepines, and

## ABSTRACT

**OBJECTIVES:** To estimate heroin overdose trends among insured individuals and characterize patients and healthcare utilization preceding overdose to inform scale-up of effective prevention and treatment.

**STUDY DESIGN:** Retrospective descriptive analysis.

**METHODS:** We analyzed 2010 to 2014 IBM MarketScan Databases and calculated annual heroin overdose rates. For a subset of patients, we describe their comorbidities, where they accessed health services, and select prescription histories prior to their first heroin overdose.

**RESULTS:** Heroin overdose rates were much lower, but increased faster, among the commercially insured compared with Medicaid enrollees from 2010 to 2014 (270.0% vs 94.3%). By 2012, rates among the commercially insured aged 15 to 24 years reached the overall rates in the Medicaid population. All patients had healthcare encounters in the 6 months prior to their first heroin overdose; two-thirds of commercially insured patients had outpatient visits, whereas two-thirds of Medicaid patients had emergency department visits. One month prior to overdose, 24.5% of Medicaid and 8.6% of commercially insured patients had opioid prescriptions. Fewer Medicaid patients had buprenorphine prescriptions (17.8% vs 27.3%) despite similar rates of known substance-related disorders. A higher proportion of Medicaid patients had non-substance-related comorbidities.

**CONCLUSIONS:** Heroin overdose rates were persistently higher among the Medicaid population than the commercially insured, with the exception of those aged 15 to 24 years. Our findings on healthcare utilization, comorbidities, and where individuals access services could inform interventions at the point of care prior to a first heroin overdose. Outpatient settings are of particular importance for the growing cohort of young, commercially insured patients with opioid use disorders.

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## TAKEAWAY POINTS

Healthcare utilization patterns among insured patients who experience heroin overdose highlight opportunities for interventions before the first overdose, noting differences in patient characteristics and healthcare access points by insurance type.

- ▶ Medicaid and commercial insurance pay for approximately half of heroin overdoses, and nearly all insured patients access healthcare services in the 6 months prior to overdose.
- ▶ Outpatient interventions are important for the emerging cohort of young, commercially insured patients with opioid use disorder.
- ▶ Many insured patients who experience heroin overdose have multiple comorbidities, emphasizing the importance of coordinated care, including mental health care, judicious opioid and benzodiazepine prescribing, medication-assisted treatment, provision of naloxone, and prevention of infectious disease transmission.

buprenorphine. Patients treated for heroin overdose in healthcare settings include those who survive the overdose, as well as those for whom the overdose was fatal. We used longitudinal patient-level and payer-specific data to explore these characteristics and identify whether opportunities for preoverdose interventions exist, given that interventions are frequently initiated when an overdose occurs but there may be opportunities to intervene further upstream. These aspects provide insight into the diverging trajectory of the heroin epidemic, including patients' risk profiles beyond substance use disorders, and may contribute to a more effective prevention strategy.

## METHODS

## Data Source

Data for Medicaid and commercially insured enrollees were analyzed separately for 2010 to 2014. We analyzed administrative claims data from IBM MarketScan Research Databases, which are derived from a convenience sample of commercially insured and Medicaid enrollees. Approximately half of the US population is covered by employer-sponsored commercial health plans,<sup>10</sup> and the IBM MarketScan Commercial Databases capture data on more than a quarter of these individuals annually from every state in the United States. Approximately 20% of the US population is covered by Medicaid.<sup>11</sup> The IBM MarketScan Multi-State Medicaid Databases are derived from 10 to 13 unidentified geographically dispersed states from each of the 4 Census regions, capturing both fee-for-service and managed care data. The numbers of enrollees in our sample for each study year are provided in [Table 1](#). The IBM MarketScan Databases encompass the full continuum of healthcare, including inpatient, outpatient, and emergency department (ED) services, as well as prescriptions dispensed through retail pharmacies.

Of note, Medicaid and commercial health plans cover approximately half of all ED visits and admissions in the United States for heroin overdose (data not shown). Our analysis focuses on those who overdose on heroin and are insured, and we acknowledge that there may be differences between them and those who are uninsured. Although insured individuals who overdose on heroin are not representative of all who overdose on heroin, they are most likely to be affected by reforms in clinical practice and insurance oversight.

## Sample

IBM MarketScan provides access to data on enrollees who have prescription drug coverage. All analyses were restricted to enrollees aged 15 to 64 years, as there are few heroin overdoses in younger adolescents and children, and the number of enrollees 65 years or older drops off considerably as they transition to Medicare. When calculating annual rates, we included only individuals continuously enrolled throughout a given calendar year. For 2014 Medicaid data, we included only individuals who were continuously enrolled in both 2013 and 2014. This kept

our sample consistent by reducing the impact of a large increase in MarketScan Medicaid enrollees in 2014 due in part to Medicaid expansion under the Affordable Care Act.

## Measures and Analyses

**Overdose rates.** Within each calendar year, we identified enrollees with at least 1 inpatient, outpatient, or ED claim with an *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* diagnosis of 965.01 (poisoning by heroin) or E850.0 (accidental poisoning by heroin). We then stratified our study population by gender and age categories to calculate heroin overdose rates by demographic characteristics. Distinct from the diagnostic codes for heroin overdose, we also calculated opioid (other than heroin) overdose rates ([eAppendix](#) [available at [ajmc.com](#)]) for each year to compare with heroin overdose trends. In 2017, Green et al reported that *ICD-9-CM* codes for opioid-related poisoning had a very high predictive value, suggesting that they can be used to monitor overdose rates.<sup>12</sup>

**Healthcare utilization, prescriptions, and diagnoses prior to overdose.** We next conducted additional analyses on a subset of patients experiencing heroin overdose. We examined diagnoses, healthcare utilization, and select controlled substance prescriptions among patients experiencing heroin overdose who had 18 months of continuous enrollment prior to their first heroin overdose in the study period. Eighteen months provided a retrospective period with no heroin overdose, such that the index heroin overdose event we examined was regarded as the "first heroin overdose" for our study purposes. We had access to data from 2009 but not 2008, so we excluded patients with a heroin overdose occurring in the first 6 months of 2010.

We then assessed the proportion of patients with at least 1 ED visit, inpatient admission, or outpatient visit in the 6 months prior to the impending overdose to highlight opportunities for screening, intervention, or referral during such encounters. Encounters in the 14 days prior to the overdose were not considered to avoid capturing claims that may have been related to the first heroin overdose and to focus on missed opportunities that would have allowed a reasonable amount of time for intervention prior to the index event. We also determined the proportion of patients filling a prescription for

buprenorphine indicated for the treatment of opioid use disorder anytime up to 3 days before the overdose. We next determined the proportion of patients with prescriptions for opioids in the 6 months, 3 months, and 1 month prior to the overdose, and repeated this for benzodiazepines. Lastly, we identified common diagnoses in the 6 months prior to the heroin overdose using categories from the Healthcare Cost and Utilization Project Clinical Classifications Software for ICD-9-CM.<sup>13</sup> Diagnoses included those received in the course of inpatient admissions or during outpatient or ED visits.

## RESULTS

### Overdose Rates

Heroin overdose rates were lower than opioid (other than heroin) overdose rates but increased over time. We observed much higher heroin overdose rates among the Medicaid population compared with the commercially insured population, but rates increased faster among the commercially insured from 2010 to 2014 (Table 1). Heroin overdose rates increased 270.0% among the commercially insured—from 1.9 to 7.1 per 100,000 enrollees—during the study period. Among the Medicaid population, these rates increased 94.3% during the same time period—from 15.7 to 30.5 per 100,000 enrollees. In contrast, opioid (other than heroin) overdose rates remained fairly stable, although much higher than heroin overdose rates.

Heroin overdose rates were consistently higher among male than female enrollees, irrespective of health insurance type. In 2014, the rates of heroin overdose among male and female enrollees were 10.5 and 4.1 per 100,000 commercial enrollees, respectively, and 34.9 and 28.0 per 100,000 Medicaid enrollees, respectively. The highest heroin overdose rates among the commercially insured were in the youngest age group—those aged 15 to 24 years (30.3 per 100,000 in 2014)—whereas among the Medicaid population, this age group had the lowest rates (14.0 per 100,000 in 2014). In 2012, heroin overdose rates among the commercially insured aged 15 to 24 years were similar to the overall rates of heroin overdose in the Medicaid population. Among the commercially insured, heroin overdose rates declined as age category increased, whereas rates remained steady among Medicaid enrollees aged 35 to 64 years.

### Healthcare Utilization, Prescriptions, and Diagnoses Prior to Overdose

Nearly all enrollees with heroin overdose had at least 1 healthcare encounter in the 6 months prior to their first overdose, including approximately 1 in 4 having an inpatient admission (Table 2<sup>13</sup>). A higher proportion of commercially insured (64.7%) than Medicaid (36.6%) patients had outpatient visits, whereas the opposite was true for ED visits (35.5% vs 62.1%). A consistently higher proportion of Medicaid patients were prescribed opioids prior to their heroin overdose. For instance, within 1 month of the overdose, 24.5% of Medicaid patients and 8.6% of commercially insured patients had prescriptions for opioids, which is a nearly 3-fold difference. Additionally, a higher proportion of Medicaid patients were prescribed

benzodiazepines. Specifically, 29.0% of Medicaid and 14.5% of commercially insured patients received benzodiazepine prescriptions within 1 month of the overdose. More enrollees on Medicaid (14.5% vs 3.9%) were also prescribed both benzodiazepines and opioids within 1 month of overdose. Prescriptions for buprenorphine indicated for the treatment of opioid use disorder were prescribed less frequently for Medicaid patients than commercially insured patients (17.8% vs 27.3%) preceding the overdose.

Table 2<sup>13</sup> lists the categories of diagnoses received by patients in the 6 months prior to their heroin overdose. Similar proportions of both Medicaid and commercially insured populations were diagnosed with substance-related disorders other than alcohol and tobacco (approximately 49%) (see eAppendix for codes for opioid overdose and substance-related disorders) and with alcohol-related disorders specifically (approximately 14%). However, for all other diagnoses, the proportion receiving the diagnosis was higher among the Medicaid than commercially insured patients. Notably, there were approximately 3-fold higher proportions of Medicaid patients than commercially insured patients with diagnoses of nonspecific chest pain, other nervous system disorders, and hepatitis (all forms of viral hepatitis and chronic hepatitis associated with liver disease and cirrhosis).

## DISCUSSION

We found increasing trends in heroin overdose rates that reflect previously reported increases in heroin use and heroin-related overdose deaths.<sup>7,14</sup> During the study period of 2010 to 2014, opioid (other than heroin) overdose rates remained stable, whereas heroin overdose rates increased steadily among most demographic groups year to year; however, we acknowledge that these increases were relative to initially small heroin overdose rates. Our findings that men, young adults, and Medicaid enrollees had the highest rates of heroin overdose are consistent with prior research.<sup>3,7-9</sup> Our inclusion of nonfatal overdoses and demographic stratifications by payer type provide additional insight into the trajectory of the heroin epidemic. Among the commercially insured population, the highest heroin overdose rates were among those aged 15 to 24 years. During 2012 to 2014, this is the only age group among the commercially insured whose rates were similar to those of their Medicaid counterparts and the overall rates among the Medicaid population. This may represent an emerging cohort of commercially insured individuals with high prevalence of heroin use. In comparison, the same age group with Medicaid insurance had the lowest heroin overdose rates among all Medicaid age groups in every year. All other Medicaid age groups (ages 25-64 years) had consistently high heroin overdose rates, signaling persistent substance use disorder prevalence.<sup>15,16</sup> Although rates of heroin overdose are currently lower among the commercially insured, their numbers may account for a substantial burden from heroin overdose given that more than half of the US population is covered by employer-sponsored commercial health plans.<sup>10</sup>

## METHODS

**TABLE 1.** Rates<sup>a</sup> of Diagnosed Opioid Overdose (other than heroin) and Heroin Overdose<sup>b</sup> by Year, Age, Gender, and Payer Type

Characteristics	Commercial Insurance					% Change 2010-2014
	2010	2011	2012	2013	2014	
Enrollees aged 15-64 years	24,189,188	26,760,195	27,018,563	21,992,798	20,468,570	
	<b>Rate</b>					
Opioid overdose	17.5	19.6	19.6	18.8	18.9	7.9
Heroin overdose	1.9	3.4	4.8	5.8	7.1	270.0
<b>Age in years</b>						
15-24	9.0	15.7	21.8	25.6	30.3	236.4
25-34	1.8	2.1	3.2	3.6	5.2	186.0
35-44	0.5	0.7	1.1	1.4	1.9	320.0
45-54	0.7	0.8	0.8	1.4	1.7	130.6
55-64	0.4	0.7	0.7	1.1	1.2	221.4
<b>Gender</b>						
Male	2.9	5.1	7.0	8.3	10.5	264.3
<b>Age in years</b>						
15-24	12.3	22.5	30.2	34.3	41.2	234.5
25-34	2.7	3.1	5.0	5.8	8.2	199.5
35-44	0.8	1.0	1.3	1.9	2.8	234.3
45-54	1.1	1.3	1.0	1.6	2.5	115.2
55-64	0.6	1.1	1.3	1.8	1.8	187.4
Female	1.1	1.8	2.7	3.5	4.1	277.4
<b>Age in years</b>						
15-24	5.7	8.9	13.1	16.7	19.1	234.6
25-34	1.0	1.1	1.6	1.6	2.5	143.5
35-44	0.1	0.5	0.9	0.9	1.1	828.1
45-54	0.3	0.3	0.7	1.2	0.9	171.8
55-64	0.2	0.4	0.3	0.5	0.7	334.3

<sup>a</sup>Rates are number of enrollees with at least 1 overdose per 100,000 continuously enrolled per given calendar year. For Medicaid in 2014, rates are per 100,000 population continuously enrolled in 2013 and 2014.

<sup>b</sup>Overdoses diagnosed during inpatient, outpatient, or emergency care. Opioid overdose diagnoses are distinct from heroin overdose diagnoses.

Source: IBM MarketScan Commercial and Multi-State Medicaid Databases—United States, 2010-2014.

Healthcare utilization patterns prior to heroin overdoses indicate that nearly all enrollees had at least 1 healthcare encounter (all diagnoses) in the 6 months prior to their first overdose; the majority of commercially insured patients (64.7%) received healthcare through outpatient visits, whereas most Medicaid patients (62.1%) accessed the ED. This is consistent with what we know about insurance type and healthcare access in general.<sup>17</sup> Healthcare utilization patterns prior to heroin overdoses confirm that these high-risk insured patients are not “lost to follow-up” or absent from healthcare settings. This emphasizes the importance of the healthcare system’s role in preventing overdoses by offering brief interventions, coordinating medical and mental health services, and linking patients to appropriate care, such as substance use disorder treatment. Differences in patient healthcare utilization patterns based on payer type have implications for prevention efforts aimed at those at risk for heroin overdose. This knowledge allows for the development of targeted evidence-based strategies specific

to the healthcare settings where these populations are most likely to access care. Although EDs are frequent sites of interventions related to substance use disorders, outpatient settings could be explored to better target young, commercially insured patients at risk for overdose.

Prescribing patterns prior to overdose show that opioid prescribing was higher among the Medicaid population, which could be related to high rates of comorbidities known to cause pain. A greater proportion of Medicaid patients had diagnoses of mood, anxiety, or nervous system disorders; connective tissue disease; joint disorders; back problems; lower respiratory diseases; and hepatitis. High prevalence of comorbidities in our population is consistent with Medicaid populations in general, but nonetheless underscores the importance of screening to ensure that all underlying conditions are appropriately treated. Given that the highest heroin overdose rate in the commercially insured population was among those aged 15 to 24 years, the finding of a relatively lower proportion of

**TABLE 1.** (Continued) Rates<sup>a</sup> of Diagnosed Opioid Overdose (other than heroin) and Heroin Overdose<sup>b</sup> by Year, Age, Gender, and Payer Type

Characteristics	Medicaid					% Change 2010-2014
	2010	2011	2012	2013	2014	
Enrollees aged 15-64 years	1,394,465	1,367,712	1,446,909	1,520,825	1,314,046	
	<b>Rate</b>					
Opioid overdose	160.0	154.8	148.7	151.2	137.6	-14.0
Heroin overdose	15.7	21.5	21.4	23.6	30.5	94.3
<b>Age in years</b>						
15-24	8.4	12.6	12.0	10.3	14.0	67.8
25-34	23.3	32.5	32.2	41.3	52.2	123.5
35-44	19.5	30.4	26.4	27.5	41.7	113.8
45-54	20.8	27.2	32.1	40.0	40.8	96.8
55-64	26.4	21.8	28.2	26.2	40.7	54.2
<b>Gender</b>						
Male	22.2	30.5	28.5	29.8	34.9	57.2
<b>Age in years</b>						
15-24	7.3	10.9	13.6	8.4	11.6	59.7
25-34	38.4	78.6	49.6	72.2	72.0	87.3
35-44	26.9	55.2	35.7	44.8	54.0	100.8
45-54	41.3	37.6	46.1	57.6	55.9	35.3
55-64	50.7	35.1	52.2	38.5	72.6	43.2
Female	12.4	17.0	17.9	20.3	28.0	126.8
<b>Age in years</b>						
15-24	9.1	13.6	10.9	11.6	15.9	75.1
25-34	19.3	20.9	27.7	32.9	46.8	142.6
35-44	16.6	21.2	22.9	20.8	37.2	124.5
45-54	7.9	20.9	23.5	28.8	31.9	302.8
55-64	9.6	12.1	9.7	16.3	15.0	57.0

<sup>a</sup>Rates are number of enrollees with at least 1 overdose per 100,000 continuously enrolled per given calendar year. For Medicaid in 2014, rates are per 100,000 population continuously enrolled in 2013 and 2014.

<sup>b</sup>Overdoses diagnosed during inpatient, outpatient, or emergency care. Opioid overdose diagnoses are distinct from heroin overdose diagnoses.

Source: IBM MarketScan Commercial and Multi-State Medicaid Databases—United States, 2010-2014.

commercially insured with opioid prescriptions could be due to adolescents and young adults being more likely than other age groups to obtain prescription opioids from a friend or relative.<sup>18</sup> Another explanation could relate to individuals now more frequently reporting heroin as their opioid of initiation.<sup>19</sup> Additionally, a higher proportion of the Medicaid population received both opioid and benzodiazepine prescriptions prior to heroin overdose. We found higher benzodiazepine prescribing than opioid prescribing, which is the opposite of what is true for opioid and benzodiazepine prescribing prevalence in the general population<sup>20,21</sup> and likely reflects more mental health conditions in our study population.

The association between poorer overall health and higher opioid utilization emphasizes the need for clinicians to coordinate care and adopt evidence-based prescribing practices. Judicious opioid prescribing, in accordance with the CDC Guideline for Prescribing Opioids for Chronic Pain,<sup>22</sup> would be warranted among our high-risk study group, many of whom had documented histories of substance

use disorders. In addition to monitoring illicit drug use, clinicians can use prescription drug monitoring data to check if patients have overlapping opioid and/or benzodiazepine prescriptions. The concurrent use of opioids and benzodiazepines should be avoided per the FDA's new warnings.<sup>22-25</sup>

Although nearly half of all patients who overdosed on heroin in this study were previously diagnosed with substance-related disorders, relatively few had prescriptions for buprenorphine, 1 of the 3 medications used in medication-assisted treatment (MAT) for opioid use disorder. These low proportions, especially among Medicaid patients, signal opportunities for improving access to this therapy and potentially preventing overdose. Research has shown that MAT can be effective in the treatment of opioid use disorder and can reduce healthcare utilization.<sup>26</sup>

Screening and treatment for hepatitis C and HIV is of particular importance for all patients using heroin. Many individuals who report heroin use inject the drug,<sup>27</sup> which carries considerable risk

## METHODS

**TABLE 2.** Health Services, Prescriptions, and Diagnoses Prior to First Heroin Overdose by Insurance Coverage Type

	Commercial Insurance (2010-2014)		Medicaid (2010-2014)	
	n	%	n	%
Patients continuously enrolled 18 months prior to heroin overdose	4623	100	1114	100
<b>Health Services 6 Months Prior to Heroin Overdose<sup>a</sup></b>				
Any outpatient visit, ED visit, or inpatient admission	4620	99.9	1101	98.8
≥1 outpatient visit	2991	64.7	408	36.6
≥1 ED visit	1640	35.5	692	62.1
≥1 inpatient admission	1235	26.7	306	27.5
<b>Prescriptions Prior to Heroin Overdose</b>				
Opioids				
≥1 opioid prescription 6 months prior to overdose	1139	24.6	570	51.2
≥1 opioid prescription 3 months prior to overdose	760	16.4	434	39.0
≥1 opioid prescription 1 month prior to overdose	396	8.6	273	24.5
Benzodiazepines				
≥1 benzodiazepine prescription 6 months prior to overdose	1098	23.8	447	40.1
≥1 benzodiazepine prescription 3 months prior to overdose	901	19.5	393	35.3
≥1 benzodiazepine prescription 1 month prior to overdose	671	14.5	323	29.0
Opioid and benzodiazepine prescription 1 month prior to overdose	178	3.9	161	14.5
<b>Medication-Assisted Treatment</b>				
Buprenorphine any time between 18 months and 3 days prior to heroin overdose	1263	27.3	198	17.8
<b>Frequent Diagnoses<sup>b</sup> 6 Months Prior to Heroin Overdose<sup>a</sup></b>				
Abdominal pain	423	9.1	227	20.4
Alcohol-related disorders	618	13.4	165	14.8
Anxiety disorders	1215	26.3	404	36.3
Headache	333	7.2	168	15.1
Hepatitis	281	6.1	187	16.8
Lower respiratory disease	478	10.3	262	23.5
Mood disorders	1391	30.1	491	44.1
Nonspecific chest pain	286	6.2	181	16.2
Other connective tissue disease	644	13.9	285	25.6
Other injuries and conditions due to external causes	437	9.5	227	20.4
Other nervous system disorders	407	8.8	288	25.9
Other nontraumatic joint disorders	461	10.0	241	21.6
Spondylosis; intervertebral disc disorders; other back problems	741	16.0	334	30.0
Substance-related disorders (other than alcohol and tobacco)	2256	48.8	552	49.6

ED indicates emergency department.

<sup>a</sup>Health services and diagnoses do not include those received during the 2 weeks prior to overdose.

<sup>b</sup>Diagnostic categories are from Clinical Classifications Software for *International Classification of Diseases, Ninth Revision, Clinical Modification*.<sup>13</sup> See eAppendix for codes for opioid overdose and substance-related disorders.

Source: IBM MarketScan Commercial and Multi-State Medicaid Databases—United States, 2010-2014.

for the transmission of bloodborne diseases through needle sharing. In accordance with recommendations from the CDC,<sup>28</sup> those who inject drugs should be tested for HIV and hepatitis and vaccinated against viral hepatitis B if not immune. Access to comprehensive syringe services programs is also crucial for individuals who use heroin to mitigate risk of overdose and of bloodborne pathogen transmission. Although a nearly 3-fold greater proportion of the Medicaid population had diagnosed hepatitis (16.8% vs 6.1%), many hepatitis B and C infections remain undiagnosed in the United States. The emerging cohort of young, commercially insured patients with high heroin overdose rates warrants further investigation to determine whether they have hepatitis or other infectious disease rates more similar to the Medicaid population.

### Limitations

There are limitations to consider with regard to our results. First, the study may have yielded different results if the analyses were not restricted to the continuously enrolled population. For example, “churning” is common among Medicaid enrollees, whereby individuals fluctuate between states of eligibility and ineligibility, resulting in sporadic coverage.<sup>29</sup> It is known that continuously enrolled patients are more likely to have chronic conditions.<sup>30-32</sup> A second limitation is the potential effect resulting from Medicaid expansion under the Affordable Care Act. In 2013, rates of substance use disorders among currently uninsured Medicaid-eligible individuals were found to be slightly higher than the rates among current Medicaid enrollees.<sup>33</sup> Because we excluded newly eligible Medicaid enrollees, the rates of heroin overdose in our study are likely conservative. A third limitation is that variability in coding practices means that the opioid overdoses we identified could potentially include some heroin overdoses. However, Green et al found high positive predictive values for opioid and heroin overdose codes.<sup>12</sup> Fourth, results are not nationally representative and should be interpreted with caution. Finally, due to the nature of claims data, heroin overdoses that did not involve transport to a medical facility, including fatal overdoses, may not have been captured.

## CONCLUSIONS

Medicaid and private insurance pay for nearly half of heroin overdoses in the United States. Healthcare encounters for heroin overdose increased significantly from 2010 to 2014 for these groups. Rates among Medicaid enrollees were higher, yet rates increased faster among the commercially insured. Healthcare utilization patterns among insured patients who overdose on heroin suggest that opportunities exist for interventions at the point of care prior to the first overdose. We noted differences in where patients accessed care by insurance coverage type, which can inform targeted and tailored prevention efforts. Outpatient settings are of particular importance for the emerging cohort of young, commercially insured patients aged 15 to 24 years with opioid use disorder. Moreover, many patients in our study had multiple comorbidities in addition to known substance use disorders. This emphasizes the importance of coordinated care for all underlying conditions, judicious prescribing practices in accordance with the CDC's guideline, referral to or induction on MAT, provision of naloxone, and screening and referral to treatment and prevention resources for viral hepatitis and HIV. ■

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**eAppendix.** ICD-9-CM Codes for Opioid Overdose and Substance-Related Disorders per Healthcare Cost and Utilization Project (HCUP) Clinical Classifications Software (CCS) for ICD-9-CM. Agency for Healthcare Research and Quality, Rockville, MD.

Opioid Overdose:

96502 96509 9658 8501 E8501 E8502 E8508

Substance-related Disorders:

2920 29211 29212 2922 29281 29282 29283 29284 29285 29289 2929 30400 30401 30402  
30403 30410 30411 30412 30413 30420 30421 30422 30423 30430 30431 30432 30433 30440  
30441 30442 30443 30450 30451 30452 30453 30460 30461 30462 30463 30470 30471 30472  
30473 30480 30481 30482 30483 30490 30491 30492 30493 30520 30521 30522 30523 30530  
30531 30532 30533 30540 30541 30542 30543 30550 30551 30552 30553 30560 30561 30562  
30563 30570 30571 30572 30573 30580 30581 30582 30583 30590 30591 30592 30593 64830  
64831 64832 64833 64834 65550 65551 65553 76072 76073 76075 7795 96500 96501 96502  
96509 V6542