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Human Immunodeficiency Virus and Hepatitis C Virus Infection Testing Among Commercially Insured Persons Who Inject Drugs, United States, 2010–2017

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Abstract

Background.—We assessed prevalence of testing for human immunodeficiency virus (HIV) and hepatitis C virus (HCV) infection among persons who inject drugs (PWID).

Methods.—Using a nationwide health insurance database for claims paid during 2010–2017, we identified PWID by using codes from the *International Classification of Diseases*, *Current Procedural Terminology*, and *National Drug Codes* directory. We then estimated the percentage of PWIDs tested for HIV or HCV within 1 year of an index encounter, and we used multivariate logistic regression models to assess demographic and clinical factors associated with testing.

Results.—Of 844 242 PWIDs, 71 938 (8.5%) were tested for HIV and 65 188 (7.7%) were tested for HCV infections. Missed opportunities were independently associated with being male (odds ratios [ORs]: HIV, 0.50 [95% confidence interval {CI}, 0.49–0.50], $P < .001$; HCV, 0.66 [95% CI, 0.65–0.72], $P < .001$), rural residence (ORs: HIV, 0.67 [95% CI, 0.65–0.69], $P < .001$; HCV, 0.75 [95% CI, 0.73–0.77], $P < .001$), and receiving services for skin infections or endocarditis (adjusted ORs: HIV, 0.91 [95% CI, 0.87–0.95], $P < .001$; HCV, 0.90 [95% CI, 0.86–0.95], $P < .001$).

Conclusions.—Approximately 90% of presumed PWIDs missed opportunities for HIV or HCV testing, especially male rural residents with claims for skin infections or endocarditis, commonly associated with injection drug use.

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Supplementary Data

Supplementary materials are available at *The Journal of Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

Disclaimer. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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Keywords

drug users; hepatitis C; HIV seropositivity; insurance coverage/statistics and numerical data; substance-related disorders

In 2015, an estimated 1 in 7 human immunodeficiency virus (HIV)-infected persons in the United States were unaware of their status, and approximately 30% of new HIV infections were identified among persons who were living with HIV but who did not know their status [1]. Only 55.6% of persons infected with hepatitis C virus (HCV) were aware of their infection status during 2013–2016 [2]. Increasing HIV and HCV testing at clinical encounters for persons at risk is a high-impact public health opportunity that can decrease incidence [3].

In the United States, reports estimate that 2.4 million persons have a substance use disorder related to prescription opioid pain relievers [4]. Treating HIV and HCV infections among this population can help prevent transmission and result in a reduction in incidence [5]. Missing opportunities for testing delays diagnosis and treatment and allows for further transmission, whereas early diagnosis and treatment improve both clinical outcomes and quality of life [6]. Studies have reported low uptake of testing in emergency departments and other clinical venues where encounters by persons who inject drugs (PWID) are most likely to occur [7].

Since 2006, the Centers for Disease Control and Prevention (CDC) has recommended that all adults and adolescents be tested for HIV at least once and annually or more frequently if at high risk (eg, PWID, sexually active men who have sex with men [MSM], sex workers, or others) [8]. Human immunodeficiency virus testing has received an A grade from the US Preventive Services Task Force [9]. Similarly, since 1998, the CDC has recommended HCV testing for persons at increased risk for HCV transmission, including persons who have ever injected drugs [10–12].

Identifying missed opportunities at clinical encounters by PWID can guide development of interventions to increase HIV and HCV testing, but identifying PWID by using claims data or other health services databases is complex. The *International Classification of Diseases, Ninth Revision, Clinical Modifications* (ICD-9-CM) [13] or *Tenth Revision* (ICD-10-CM) [14] codes do not include a specific diagnostic code for injection drug use (IDU). However, encounters with a diagnosis or procedure indicating IDU might be effective for identifying patients who need HIV and HCV testing and linkage to treatment and care [7, 15]. In a recent study designed to test the sensitivity and specificity of developed algorithms to identify potential PWIDs in claims data, researchers reported that codes for injection-related infections or drug misuse codes (excluding drugs not typically injected) were suitable for surveillance use, with resulting sensitivity of 91% but less specificity (43%) [16]. Our study estimates the frequency of HIV or HCV testing among persons with diagnoses and procedures indicative of IDU.

METHODS

We analyzed data from the 2010–2017 IBM Watson Health MarketScan (IBM Corporation, Ann Arbor, MI) Commercial Research Database. At the time of this study, the database included health services claims data for 230 million persons who were enrolled in approximately 350 large company and 21 commercial health insurance plans in the United States [17, 18]. The database included diagnosis and procedure codes for all healthcare services provided during inpatient and outpatient encounters and for dispensed prescriptions, as well as patient demographics and enrollment information. Patient-level data were deidentified and in compliance with the Health Insurance Portability and Accountability Act regulations [19]. The study was not subject to institutional review board review because no personally identifiable information was used, collected, or transmitted in the course of this study.

Our study population included patients aged 15–49 years who had ≥1 medical diagnosis, procedure, or medication dispensed indicative of IDU during 2010–2016. For each patient, the first date of the suspected IDU-related encounter was defined as their index date. The study sample was then restricted to those continuously enrolled for ≥3 months before and 12 months after the index date (which included 2017 dates). We next examined all available patient data in the Truven Health Analytics MarketScan (IBM, Incorporated, Armonk, NY) Commercial Claims and Encounters database, which spans 2003–2017 for medical and prescription records. We excluded patient records if they had a documented HIV diagnosis or HCV diagnosis (Supplementary Table 2) or a prescription of antiretroviral therapy before the index date (Supplementary Figure).

We selected the following 4 risk groups: (1) substance use or dependence group: persons with codes nonmedical drug use or dependence; (2) overdose group: persons with a claim related to drug poisoning, overdose, or suicide attempt by drug misuse; (3) medication-assisted therapy (MAT) group: persons who received MAT or overdose (eg, methadone, naloxone, or naltrexone); and (4) skin or soft-tissue infection or endocarditis group: persons with a diagnosis consistent with IDU, including abscess, cellulitis, acute osteomyelitis, or endocarditis (Supplementary Table 1). We used codes identified for IDU from the literature [16, 20–23]. Of note, patients might have been included in multiple risk groups.

The study outcomes were HIV and HCV testing within 12 months of first clinical counter related to IDU (ie, index encounter). We measured the proportion of patients tested for HIV and HCV by examining the occurrence of testing-related *Current Procedural Terminology* (CPT) [24] codes during the month before and 12 months after the index date (–1 to 12 months of the index date) (Supplementary Table 3). For HCV, this included any test related to the screening (HCV anti-body) or diagnostic follow-up to a positive HCV antibody test, including HCV ribonucleic acid testing and HCV genotyping. Patients were excluded from the HIV testing eligible group if they had pregnancy-related diagnostic and procedural codes during the study period, because these patients were likely to have been screened for HIV for reasons unrelated to drug use (Supplementary Table 4).

We analyzed the number of patients tested over the total number of patients with a risk ICD code by year and described associated characteristics, including patient sex, age group (15–19, 20–29, 30–39, and 40–49 years), US Census region (Northeast, Midwest, South, and West), and urban versus rural location (determined by whether the primary beneficiary resided in a US Census Bureau-designated rural or urban area). We also examined place of service of the first clinical encounter related to IDU. The place-of-service variable was categorized into the 4 following types: (1) general health clinic visit, (2) emergency or urgent care center, (3) hospital, and (4) other, including rehabilitation inpatient treatment program, sexually transmitted disease (STD) clinics or reproductive health centers, public health outreach units (eg, mobile clinics), and all other clinic types. The place of service for the testing procedure was not examined. We also calculated annual number of inpatient and outpatient visits and categorized those into 1–3 visits, 4–12 visits, and ≥13 visits per year.

Descriptive statistics were used to summarize the study population. The χ^2 test was used to examine independent variables and the likelihood of HIV testing (yes, no) or HCV testing (yes, no). Using a multivariate model, we adjusted for age, sex, US region, urban versus rural location, clinic place of care, and risk group types. The association between the independent variables and the testing variables was estimated and presented using odds ratios (ORs) and 95% confidence intervals (CIs). Statistically significant difference was defined as a 2-tailed probability of 0.05 or less for all analysis. All analyses were performed by using SAS 9.4 (SAS Institute, Inc., Cary, NC).

RESULTS

We identified 844 242 persons who had clinical encounters indicative of IDU during 2010–2016. Patients were more often identified through infections related to IDU (547 780; 64.9%), including abscess, cellulitis, acute osteomyelitis, or endocarditis, and 269 628 (31.9%) had a diagnosis of drug abuse or dependence. The majority of the patients were from the South (371 198; 44.0%) and resided in urban areas (723 881; 85.7%). The majority of the study population received care from a general clinic (389 869; 46.2%) or a hospital (277 414; 32.9%); 116 667 (13.8%) were identified through care at an emergency department or an urgent care center (Table 1).

Human Immunodeficiency Virus Testing

The overall HIV testing rate among persons with diagnoses indicating IDU during 2010–2016 was 8.6%, with an increase during 2010–2013. The rate was stable during 2014 and 2015, but it decreased during 2016. Men were less likely to have had an HIV test, compared with women (6.5% and 10.8%, respectively; adjusted OR [aOR] = 0.50; 95% CI, 0.49–0.50; $P < .001$). Patients who were aged 20–29 years had a higher HIV testing rate (13.7%), compared with other age groups; only 4.6% of those aged 40–49 years had been tested. Persons who resided in the Northeast (10.5%) and in urban areas (9.0%) had higher HIV testing rates, compared with other regions and rural areas, respectively. The more frequently a patient used healthcare services, the more likely they were to have been tested for HIV. The most frequently examined patients were twice as likely to have been tested for HIV,

compared with patients examined only 1–3 times per year (aOR = 2.02; 95% CI, 1.97–2.08; $P < .001$) (Table 2).

Patients were more likely to receive an HIV test if their first clinical encounter was in a rehabilitation inpatient treatment program, STD clinic or reproductive health center, or public health outreach unit (eg, mobile clinic) than if their index encounter was in a general practice clinic (aOR = 1.32; 95% CI, 1.28–1.35; $P < .001$). Patients who had a diagnosis of drug misuse were more likely to have been tested for HIV, compared with those who did not (aOR = 1.35; 95% CI, 1.29–1.41; $P < .001$). Patients with an infection indicative of IDU were less likely to have been tested, compared with patients without an infection (aOR = 0.91; 95% CI, 0.87–0.95; $P < .001$) (Table 2).

Hepatitis C Virus Testing

Among persons with a diagnosis or procedure indicative of IDU, the overall HCV testing rate was 7.7%. It increased during 2010–2014, leveled off during 2015, but then decreased in 2016 (Table 2). Men were less likely to have had an HCV test, compared with women (6.7% and 8.7%, respectively; aOR = 0.66; 95% CI, 0.65–0.67; $P < .001$). Patients aged 20–29 years had a higher HCV testing rate (10.9%), compared with other age groups. Persons who resided in the Northeast (9.7%) and in urban areas (8.0%) had higher testing rates. Similar to HIV testing, more frequent healthcare service users were more likely to have been tested for HCV, compared with less frequent users (≥13 visits versus 1–3 visits; aOR = 2.81; 95% CI, 2.73–2.89; $P < .001$).

Patients were more likely to have received an HCV test if their first clinical encounter was in a rehabilitation inpatient treatment program, an STD clinic or reproductive health center, a public health outreach unit (aOR = 1.32; 95% CI, 1.28–1.35; $P < .001$), or in a hospital (aOR = 1.20; 95% CI, 1.18–1.22; $P < .001$), compared with a general practice clinic. Patients who had a diagnosis of substance use or dependence had 1.5 times the odds of having been tested for HCV, compared with patients without the diagnosis (aOR = 1.52; 95% CI, 1.44–1.59; $P < .001$). Patients who had a diagnosis of drug poisoning, overdose, or suicide attempt by drug misuse (aOR = 1.21; 95% CI, 1.15–1.28; $P < .001$) or CPT code for MAT (aOR = 1.09; 95% CI, 1.01–1.17; $P < .021$) were more likely to have been tested for HCV, compared with patients without those conditions. Patients with an infection indicative of IDU were less likely to have been tested for HCV (aOR = 0.90; 95% CI, 0.86–0.95; $P < .001$) (Table 2).

DISCUSSION

In our study, we used ICD-9-CM, ICD-10-CM, and CPT codes to identify persons who had clinical indications of IDU and who might be at increased risk for HIV or HCV infections and therefore candidates for testing, according to CDC guidelines [8, 10, 12]. Among this insured patient population, being male, living in the US Midwest, living in a rural area, and having an infection commonly found among persons with IDU exposure decreased the likelihood for testing for either HIV or HCV, compared with all other patients. Persons were more likely to be tested if they had multiple visits in a calendar year, had higher risk diagnoses in a hospital or other clinic setting (eg, rehabilitation inpatient treatment

program, STD clinics or reproductive health centers, or public health outreach unit), or had a diagnostic code for nonmedical drug use or dependence.

Despite the greater access to medical care and thereby greater access to HIV and HCV testing provided by health insurance, rates for HIV and HCV are low among commercially insured populations. We determined that, among persons with indicative risk, only 7.7% were tested for HCV and 8.6% for HIV. Other studies have reported that, in the United States, routine HIV testing rates among commercially insured populations ranged from 23% to 33%, even among patients at high risk (eg, those with diagnosed STDs) [25, 26], and providers reported routine testing among patients at 13%–20% [27, 28]. In the 2009 National Hospital Ambulatory Medical Care Survey, HIV testing in US emergency departments was 2.3% among populations with sexual risk behaviors [29].

Multiple provider-level barriers to testing might result in low HIV and HCV test coverage of persons at high risk. These include time constraints, competing health priorities during patient visits, discomfort discussing IDU to prevent disruption of the patient-provider relationship or causing stigma, or cultural or language differences with patients [28, 30]. Providers' perceptions that their patients are at low risk for infection or concern that patients might lack the ability to follow up on the test, or a providers' inadequate awareness of resources for linkage to care, might also present barriers to testing [31]. Our study determined that age and sex were substantial predictors for testing for HIV and HCV both. Our data reveal that HIV and HCV testing was lower for men than women. Although the frequency of encounters during a year was controlled for in our study, women might be tested more frequently because they seek healthcare services more often than men [32]. However, published literature demonstrates that women who inject drugs have similar motivation for testing as men [33]. The CDC recommends opt-out HIV testing that does not require consent or special counseling in which testing is performed unless the patient declines [34].

Persons who inject drugs are at increased risk for localized skin and soft-tissue infections, bacteremia, endocarditis, and osteomyelitis because of nonsterile injection practices [20, 35]. In our study, patients were less likely to be tested if they had an ICD-9-CM or ICD-10-CM code for endocarditis or for a skin or soft-tissue or infection associated with IDU. Along with increased hospitalizations for opioid use disorder and overdoses, increases have occurred in the number of hospitalizations for endocarditis and soft-tissue infections associated with IDU [36]. A recent study reported substantial gaps in the evaluation of patients for HIV and HCV infection who were admitted to hospitals with other severe infections related to substance use disorders [37]. Clinical encounters for treatment of these acute infections might provide an opportunity for diagnosing HIV and HCV and for linking persons to care to reduce negative sequela and prevent transmission. Although competing priorities during clinical encounters might be a barrier to HIV and HCV testing, persons with substance use disorders can be successfully engaged and entered into care [38]. Algorithms can be developed that use diagnoses, procedures, tests, and medications in a patient's electronic health record (EHR) as indicators of IDU, and these algorithms can be used to generate EHR prompts for healthcare providers to perform HIV testing. Such

prompts in electronic medical records might be effective in increasing HIV and HCV testing [39].

United States Census region and urban versus rural area were also statistically significant predictors of testing in our study and were consistent with other studies [40]. The majority of persons living with HIV live in urban or metropolitan areas [41], and, therefore, HIV prevention efforts, including testing opportunities, have been focused in those communities [42]. Similarly, the incidence of acute HCV infection is increasing in rural areas, most critically among younger persons, but the majority of acute cases are still in urban areas. One study estimated 67% of the acute HCV cases were in urban counties, compared with 31% residing in rural counties [43]. Although rural populations have lower rates of infection, populations at high risk because of IDU also are at risk for acquiring HIV and HCV. Rural MSM are more likely to face intolerance and are less likely to use basic HIV prevention services, compared with urban MSM [44]. In the United States, PWID or persons who have substance use disorders might be linked to care later than other patient populations [45], but linkage to care can be especially problematic in rural communities. This underscores the importance of opportunities for HIV and HCV testing at clinical encounters.

Limitations

Our study has limitations that should be considered when interpreting the results. Our study population was commercially insured persons; therefore, our findings might not be generalizable to other populations (eg, those who are uninsured or have Medicaid). However, the suboptimal testing findings remain relevant because they represent testing rates among a population with fewer barriers to follow-up care. We also required patients to be enrolled for 16 months, which might have resulted in a selection bias that included persons with stable health insurance coverage. Human immunodeficiency virus or HCV testing that was performed but not billed to a person’s health insurance are not included in our analysis, which under-estimates the testing prevalence. We excluded persons previously prescribed any antiretroviral medication and might have excluded persons at higher risk who had been prescribed preexposure prophylaxis or postexposure prophylaxis. More fundamentally, identifying patients by using diagnostic codes might result in misclassification and likely underestimates the overall prevalence of substance use disorders among commercially insured populations because of billing practices, stigma, and patients failing to acknowledge IDU or physicians not diagnosing drug use. There is no standard method for identifying at-risk PWID populations, and assessing IDU is dependent on the patients’ healthcare access and utilization. In care settings that have restricted access to care, or do not have complete healthcare records, depending on claims-based algorithms use may not be ideal. Miller et al [46] estimated that soft-tissue infections were the most common infection where IDU was unrecorded and approximately half of all IDU-related infections might be unrecorded in hospitals and emergency department’s claims data. Janjua et al [16] reported that their claims-based algorithm, which is similar to the one used in this study, had a low specificity for injection-related infections (43%). This type of misclassification bias among a study population, including injection-drug users with false-positive results, can bias the HIV and HCV testing rates so that the reported testing rate might be underestimated. Of note, the current algorithm limited the population to a younger age (14–50 years);

younger age groups receive a diagnosis of ventricular endocarditis less than older age groups [47]. The algorithm also restricted the soft-tissue injections to the limbs to better mitigate the effect of false-positives on the testing results. Skin and soft-tissue infections at injection sites are commonly reported, with lifetime prevalence of ≤69% among PWID [48]. A specificity and sensitivity analysis was not possible using the MarketScan database; nevertheless, identifying true-positives (injection-drug users) and having a protocol in place to test for HIV and HCV for a patient potentially at high risk might be of higher public health consequence than including false positives or overtesting patients at low risk. The MarketScan database does not include a variable for race and/or ethnicity; therefore, we were unable to estimate HIV and HCV testing among specific racial and/or ethnic groups.

Our study demonstrates the need for increasing HIV and HCV testing of persons with clinical indications of IDU or substance use disorder. We demonstrated that persons who might benefit from HIV and HCV testing were tested too infrequently during clinical encounters; improved testing rates can also improve linkage to care for PWID with HIV or HCV diagnoses. In particular, men in rural communities or in the US Midwest or West can be of high public health priority for testing when presenting with clinical indications of IDU or substance use disorder.

CONCLUSIONS

Human immunodeficiency virus and HCV testing of commercially insured persons with clinical indicators of IDU or substance use disorder was performed infrequently at clinical encounters. To decrease HIV and HCV infection incidence and to support persons with HIV and HCV in attaining optimal health, prevention programs, and initiatives should focus on those at highest risk for acquiring infection. Persons who inject drugs or persons with a substance use disorder are a priority population for HIV and HCV testing. Identifying persons during a clinical encounter who might be at risk and performing HIV and HCV testing provides an opportunity for increased public health impact. Data from this study shows that even in the context of growing concern for injecting drug use with the national opioid epidemic, there are missed opportunities for testing and measures could be incorporated to improve testing for these infections.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Characteristics of Persons With a Clinical Diagnosis (ICD-9-CM,[a] ICD-10-CM,[b] and Procedural[c] Codes) Indicating Injection Drug Use, United States, 2010–2017

Characteristic	Persons Enrolled No. (%)
Total	844 242 (100.0)
Year	
2010	126 470 (15.0)
2011	141 673 (16.8)
2012	113 750 (13.5)
2013	117 772 (14.0)
2014	92 438 (10.9)
2015	107 905 (12.8)
2016	144 234 (17.1)
Sex	
Female	413 415 (49.0)
Male	430 827 (51.0)
Age Group (Years)	
15–19	133 223 (15.8)
20–29	213 220 (25.3)
30–39	211 664 (25.1)
40–49	286 135 (33.9)
US Census Geographic Region	
Northeast	162 111 (19.2)
Midwest	172 549 (20.4)
South	371 198 (44.0)
West	138 384 (16.4)
Urban or Rural Location[d]	
Urban	723 881 (85.7)
Rural	120 361 (14.3)
Type of Healthcare Visit	
General health maintenance clinic visit	389 869 (46.2)
Emergency department/urgent care center	116 667 (13.8)
Other	60 292 (7.1)
Hospital	277 414 (32.9)
Substance Use or Dependence	
Yes	269 628 (31.9)
No	574 614 (68.1)
Drug Overdose	
Yes	30 891 (3.7)
No	813 351 (96.3)
Medication-Assisted Therapy	
Yes	14 548 (1.7)

Characteristic	Persons Enrolled No. (%)
No	829 694 (98.3)
Skin infection or Endocarditis	
Yes	547 780 (64.9)
No	296 462 (35.1)
Number of Visits Per Year	
1–3	678 603 (80.4)
4–12	123 641 (14.6)
≥13	41 998 (5.0)

Abbreviations: ICD-9-CM, *International Classification of Diseases, Ninth Revision, Clinical Modifications*; ICD-10-CM, *International Classification of Diseases, Tenth Revision, Clinical Modifications*.

Note: Source: IBM Watson Health MarketScan (IBM, Incorporated, Armonk, NY) Commercial Claims and Encounters database, 2009–2017.

[a] Diagnosis codes are based on the ICD-9-CM billing claim codes.

[b] Diagnosis codes are based on the ICD-10-CM billing claim codes.

[c] Diagnosis codes are based on *Current Procedural Terminology*.

[d] Urban or rural designation is based on the US Census Bureau designation of the point of the beneficiary's clinical diagnosis.

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Table 2.

Characteristics and Adjusted Odds Ratios Among Persons Tested for HIV or Hepatitis C Virus Infection Within 1 Year of a Clinical Diagnosis (ICD-9-CM,[a] ICD-10-CM,[b] or Procedural,[c] Code) Indicating Injection Drug Use, United States, 2010–2017

Test	**HIV**[d]				**Hepatitis C Virus**[e]			
	Tested				**Tested**			
Overall	**(*n* = 71 938; 8.6%)**				**(n = 65 188; 7.6%)**			
Characteristic	**No. (%)**	**aOR**	**95% CI**	***P* Value**	**No. (%)**	**aOR**	**95% CI**	***P* Value**
Year								
2010	9589 (7.6)	0.93	(0.90–0.95)	<.001	8284 (6.6)	0.89	(0.86–0.92)	<.001
2011	11 558 (8.2)	1.00	—	—	10 098 (7.1)	1.00	—	—
2012	9695 (8.6)	1.02	(0.99–1.05)	.309	8622 (7.6)	1.04	(1.01–1.07)	.009
2013	10 995 (9.4)	1.10	(1.07–1.13)	<.001	9956 (8.5)	1.15	(1.11–1.18)	<.001
2014	8559 (9.4)	1.08	(1.05–1.11)	<.001	8016 (8.7)	1.17	(1.13–1.21)	<.001
2015	9946 (9.3)	1.15	(1.12–1.18)	<.001	9379 (8.7)	1.29	(1.25–1.33)	<.001
2016	11 596 (8.1)	1.08	(1.05–1.11)	<.001	10 833 (7.5)	1.24	(1.2–1.28)	<.001
Sex								
Female	43 901 (10.8)	1.00	—	—	36 149 (8.7)	1.00	—	—
Male	28 037 (6.5)	0.50	(0.49–0.5)	<.001	29 039 (6.7)	0.66	(0.65–0.67)	<.001
Age Group (Years)								
15–19	11 309 (8.5)	1.00	—	—	8617 (6.5)	1.00	—	—
20–29	28 732 (13.7)	1.63	(1.59–1.66)	<.001	23 165 (10.9)	1.62	(1.58–1.67)	<.001
30–39	18 721 (9.0)	1.07	(1.05–1.1)	<.001	16 344 (7.7)	1.27	(1.24–1.31)	<.001
40–49	13 176 (4.6)	0.53	(0.51–0.54)	<.001	17 062 (6.0)	0.99	(0.96–1.02)	.496
US Census Geographic Region								
Northeast	16 840 (10.5)	1.00	—	—	15 751 (9.7)	1.00	—	—
Midwest	11 872 (6.9)	0.67	(0.66–0.69)	<.001	10 526 (6.1)	0.65	(0.63–0.66)	<.001
South	30 753 (8.4)	0.85	(0.83–0.87)	<.001	27 672 (7.5)	0.82	(0.80–0.84)	<.001
West	12 473 (9.1)	0.85	(0.83–0.87)	<.001	11 239 (8.1)	0.84	(0.82–0.86)	<.001
Urban or Rural Location[f]								

Test	HIV[d]				Hepatitis C Virus[e]			
	Tested				Tested			
Overall	(*n* = 71 938; 8.6%)				(n = 65 188; 7.6%)			
Characteristic	No. (%)	aOR	95% CI	*P* Value	No. (%)	aOR	95% CI	*P* Value
Urban	64 856 (9.0)	1.00	—	—	58 225 (8.0)	1.00	—	—
Rural	7082 (5.9)	0.67	(0.65–0.69)	<.001	6963 (5.8)	0.75	(0.73–0.77)	<.001
Type of Visit								
General healthcare clinic	28 839 (7.4)	1.00	—	—	25 558 (6.6)	1.00	—	—
Emergency department/urgent care center	9800 (8.0)	1.08	(1.06–1.11)	<.001	7753 (6.6)	1.03	(1.01–1.06)	.024
Other	7347 (12.0)	1.32	(1.28–1.36)	<.001	7112 (11.8)	1.32	(1.28–1.36)	<.001
Hospital	25 952 (9.0)	1.15	(1.13–1.17)	<.001	24 765 (8.9)	1.20	(1.18–1.23)	<.001
Substance Use or Dependence								
Yes	31 759 (11.9)	1.35	(1.29–1.41)	<.001	31 448 (11.7)	1.52	(1.44–1.59)	—
No	40 179 (7.1)	1.00	—	—	33 740 (5.9)	1.00	—	—
Overdose								
Yes	3352 (10.9)	1.17	(1.11–1.23)	<.001	2800 (9.1)	1.21	(1.15–1.28)	—
No	68 586 (8.5)	1.00	—	—	62 388 (7.7)	1.00	—	—
Medication-Assisted Therapy								
Yes	1134 (8.1)	—	—	—	1128 (7.8)	1.09	(1.01–1.17)	.021
No	70 804 (8.6)	—	—	—	64 060 (7.7)	1.00	—	—
Skin Infection or Endocarditis								
Yes	37 798 (7.0)	0.91	(0.87–0.95)	<.001	31 798 (5.8)	0.90	(0.86–0.95)	<.001
No	34 140 (11.6)	1.00	—	—	33 390 (11.3)	1.00	—	—
Number of Visits Per Year								
1–3	51 688 (7.7)	1.00	—	—	43 457 (6.4)	1.00	—	—
4–12	12 475 (10.2)	1.22	(1.19–1.24)	<.001	12 787 (10.3)	1.44	(1.40–1.47)	<.001
≥13	7775 (18.6)	2.02	(1.97–2.08)	<.001	8944 (21.3)	2.81	(2.73–2.89)	<.001

Abbreviations: aORs, adjusted odds ratios; CI, confidence interval; HIV, human immunodeficiency virus; ICD-9-CM, *International Classification of Diseases, Ninth Revision, Clinical Modifications*; ICD-10-CM, *International Classification of Diseases, Tenth Revision, Clinical Modifications*.

NOTE: Source: IBM Watson Health MarketScan (IBM, Incorporated, Armonk, NY) Commercial Claims and Encounters database, 2009–2017.

[a] Diagnosis codes were based on the ICD-9-CM billing claim codes.

[b] Diagnosis codes were based on the ICD-10-CM billing claim codes.

[c] Diagnosis codes based on *Current Procedural Terminology* (CPT).

[d] Human immunodeficiency virus testing CPT codes (G0432, G0433, G0435, 86689, 8670, 87389, 87534–87391, 8790).

[e] Hepatitis C testing CPT codes (G0472, 80074, 86803, 86804, 87520–87522, 87902, 3266F).

[f] Urban or rural designation is based on the US Census Bureau designation of the point of the beneficiary's clinical diagnosis.