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Estimating national rates of HIV infection among men who have sex with men, persons who inject drugs and heterosexuals in the United States

Nicole CREPAZ,

Kristen L. HESS,

David W. PURCELL,

H. Irene HALL

Division of HIV/AIDS Prevention, the U.S. Centers for Disease Control and Prevention, Atlanta, Georgia

Abstract

Background: Calculating national rates of HIV diagnosis, incidence, and prevalence can quantify disease burden and is important for planning and evaluating programs. We calculated HIV rates among men who have sex with men (MSM), persons who inject drugs (PWID), and heterosexuals in 2010 and 2015.

Methods: We used proportion estimates of the United States population classified as MSM, PWID, and heterosexuals along with census data to calculate the population sizes which were used as the denominators for calculating HIV rates. The numerators (HIV diagnosis, incidence, and prevalence) were based on data submitted to the National HIV Surveillance System through June 2017.

Results: The estimated HIV diagnosis and incidence rates in 2015 were 574.7 and 583.6 per 100,000 MSM; 34.3 and 32.7 per 100,000 PWID; and 4.1 and 3.8 per 100,000 heterosexuals. The estimated HIV prevalence in 2015 was 12,372.9 per 100,000 MSM; 1,937.2 per 100,000 PWID; and 126.7 per 100,000 heterosexuals. The HIV diagnosis rates decreased from 2010 to 2015 in all three transmission categories. Blacks had the highest HIV diagnosis rates at both time points. The HIV incidence rates decreased among white MSM, MSM aged 13-24 years, PWID overall, and male and female heterosexuals; however, it increased among MSM aged 25-34 years.

Conclusions: The estimated HIV diagnosis and HIV infection rates decreased for several transmission categories as well as race/ethnicity and age subgroups. MSM continue to be disproportionately affected. Disparities remain and have widened for some groups. Efforts are needed to strengthen prevention, care, and supportive services for all persons with HIV infection.

Corresponding Author: Nicole Crepaz, PhD, Division of HIV/AIDS Prevention, The U.S. Centers for Disease Control and Prevention, 1600 Clifton Rd., Mailstop E-37, Atlanta, Georgia, 30329, USA, Phone: 1-404-639-6149, ncrepaz@cdc.gov.

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.

Keywords

HIV diagnosis rate; HIV incidence rate; HIV prevalence rate; men who have sex with men; persons who inject drugs; heterosexuals; persons with HIV

Introduction

Calculating national rates of HIV infection can quantify the burden of disease and is particularly important for planning and evaluating programs, and guiding resource allocation. HIV incidence measures the number of new infections during a specific time (e.g., year). Estimated HIV incidence rates can be used to assess characteristics of persons most at risk for acquiring HIV infection. HIV diagnoses refer to the number of persons who may have been infected at any time, from years before up to the year when the diagnosis was made. HIV diagnosis rates reflect the trends in HIV incidence and access to HIV testing and can be used to partially monitor HIV testing efforts. HIV prevalence refers to the number of persons living with HIV at a given time regardless of the time of infection or whether the person has received a diagnosis. Estimated HIV prevalence rates can be used to monitor the number of persons in need of care and treatment services for HIV infection.

Currently, census data are not available to determine HIV rates for different groups at risk of HIV infection such as men who have sex with men (MSM), person who inject drugs (PWID), or heterosexuals and such rates are therefore not routinely reported.¹ Using data from national surveys, the Centers for Disease Control and Prevention (CDC) developed an approach to estimate the proportions of the United States population classified as MSM, PWID, and heterosexuals and applied the proportion estimates to census data to produce population sizes for these three transmission categories.²⁻⁴ National HIV infection rates can then be calculated using national HIV surveillance data for the numerators and the population size estimates for the denominators [2-4].

The purpose of this study was to update estimated HIV diagnosis rates [2-4] and, for the first time, to estimate and compare the rates of HIV incidence, for 2010 and 2015 among MSM, PWID, and heterosexuals. The rates of persons living with diagnosed and undiagnosed HIV infection (i.e., HIV prevalence) were also estimated for 2015. These analyses allow for cross-group comparisons at different times to inform progress toward meeting the national goal of reducing health disparities [5].

Methods

We calculated three types of HIV rates for persons aged 13 years or older: (1) diagnosis rates in 2010 and 2015, (2) incidence rates in 2010 and 2015, and (3) prevalence rate in 2015. The MSM, PWID, and heterosexuals classifications were created to best correspond to the HIV transmission categories presented in the national HIV surveillance report [1]. Transmission category summarizes a person's possible HIV risk factors based on the presumed hierarchical order of transmission probability. Persons with > 1 reported risk factor are classified in the category listed first in the hierarchy (for males, male-to-male sexual contact, injection drug use, heterosexual contact; for females, injection drug use and

heterosexual contact) [1]. One exception is MSM who inject drugs; this group makes up a separate transmission category [1].

The Numerators: HIV Diagnosis, Incidence and Prevalence

We used national HIV surveillance system (NHSS) data from all 50 States and the District of Columbia (DC) reported to CDC as of June 2017. All jurisdictions had fully implemented name-based HIV reporting by April 2008. CDC periodically assess the portfolio of NHSS to determine whether methods and efficiencies in data collection and analysis meet the information needs of the nation. Due to the improvement of data quality over the years, in 2016 CDC determined that the adjustments for reporting delays were no longer necessary [6]. We used data reported through June 2017 for year 2015 to allow for reporting of diagnoses and especially deaths, for which 18 months reporting delay is needed to allow time for matching HIV surveillance data with vital statistics data [1]. Some cases of HIV infection were reported to CDC without an identified risk factor [1]. Multiple imputation was used to assign a transmission category [7].

The number of HIV diagnoses in 2010 and 2015 were the cases reported to NHSS (<https://www.cdc.gov/nchhstp/atlas/>). The HIV incidence and prevalence were estimated based on a well-characterized CD4-depletion model [8–10]. Since HIV targets CD4 cells, without treatment HIV reduces the number of CD4 cells. Using the first CD4 count after diagnosis and the estimated depletion of CD4 cells over time, the time between infection and diagnosis can be estimated with the assumption that no treatment has been received [8]. Based on the estimated time from HIV infection to diagnosis, the diagnosis delay distribution can be calculated, which is then used for estimating HIV incidence. Cumulative HIV incidence minus cumulative deaths among persons with HIV yields an estimate of prevalence, the total number of persons with diagnosed and undiagnosed HIV infections [8]. Similar CD4 models have been used in estimating HIV incidence and prevalence in the European Union/ European Economic Area [11,12].

The Denominators – Estimated Population Sizes for MSM, PWID, and Heterosexuals in the United States

We used the previously published estimates of proportions of the United States population classified as MSM [2], PWID [3], and heterosexuals [4] (see Appendix A) to calculate the population sizes for these three transmission categories. The previously published proportion estimates were derived from meta-analyses of national probability surveys across multiple years and were not stratified by year. For our analyses, the proportion estimates were assumed to remain the same for 2010 and 2015. While the proportions of the United States population classified as MSM, PWID, and heterosexuals were estimated based on multiple national surveys, the proportion estimate for MSM who inject drugs was only based on a single national survey, National Health and Nutrition Examination Survey (NHANES) [13]. According to the NHANES data from 1999-2008, 0.35% (CI = 0.18 – 0.52) of males aged 18 years old were MSM who inject drugs [13]. Due to the limitation of a single survey for estimating the proportion of males who were MSM who inject drugs and the small number of HIV cases among this group, they were excluded from the analyses.

To calculate the population sizes, we applied the proportion estimates for MSM, PWID, and heterosexuals to the population data for 2010 and 2015 obtained from the Vintage 2016 postcensal estimates from the U.S. Census Bureau. The estimated population sizes were used as the denominators for calculating the HIV prevalence rates. For HIV diagnosis rates, the denominators for 2010 and 2015 were calculated by subtracting the number of persons who were living with diagnosed HIV infection at year-end 2009 and 2014, respectively, from the population estimates. For HIV incidence rates, the denominators for 2010 and 2015 were calculated by subtracting the number of persons who were living with diagnosed and undiagnosed HIV infection at year-end 2009 and 2014, respectively, from the population estimates.

Analyses for Rates of HIV Diagnosis, Incidence, and Prevalence for MSM, PWID, and Heterosexuals in the United States

We calculated HIV diagnosis rates in 2010 and 2015 stratified by race/ethnicity and age groups for MSM, PWID, and heterosexuals. For the rates of HIV incidence and prevalence, the race/ethnicity and age-specific stratifications were conducted only for MSM. Relative standard errors were greater than 30%, indicating low reliability of estimated HIV incidence and prevalence rates for the race/ethnicity and age-specific stratifications of PWID and heterosexuals. Thus, we only reported the rates of HIV incidence and prevalence by sex and not by race/ethnicity and age for PWID and heterosexuals.

All rates were calculated per 100,000 population. Uncertainties associated with the estimated numerators and denominators were calculated using the delta method to derive the standard error for calculating the 95% confidence intervals for estimated rates [14]. We also calculated rate ratios to directly compare rates by transmission category, sex, race/ethnicity, and age. For rate ratios, males, whites, and the youngest age group (13-24 years) served as the referent groups. Differences in estimated rates for the years 2010 (referent group) and 2015 were assessed by the *z* test. Differences were deemed statistically significant at $P < 0.05$. For transparent reporting, the percentage of increase or decrease and associated *P* value were presented.

Results

Estimated HIV Diagnosis Rates in 2010 and 2015

The estimated HIV diagnosis rates decreased from 2010 to 2015 for all three transmission categories: MSM; 587.8 and 574.7 per 100,000, respectively (-2.2% , $P = 0.012$), PWID; 52.4 and 34.3 per 100,000, respectively (-34.5% , $P < 0.0001$), and heterosexuals; 5.5 and 4.1 per 100,000, respectively (-24.5% , $P < 0.0001$) (Table 1). Rate ratio comparing MSM to PWID was 11 times as high in 2010 and 17 times as high in 2015, while rate ratio comparing MSM to heterosexuals was 107 times as high in 2010 and 140 times as high in 2015.

Among MSM, the highest HIV diagnosis rates were among non-Hispanic blacks/African Americans (hereafter referred to as blacks) at both time points and the rate increased from 2,190.5 in 2010 to 2,269.2 in 2015 ($+3.6\%$, $P = 0.019$). The HIV diagnosis rate among

Hispanic/Latino MSM also increased (944.1 in 2010 and 995.3 in 2015; +5.4%, $P = 0.003$). Comparing black MSM to white MSM, the HIV diagnosis rate was about 8 times as high in 2010 and 9 times as high in 2015. Comparing Hispanic/Latino MSM to white MSM, the HIV diagnosis rate was 3 times as high in 2010 and 4 times as high in 2015. MSM who were 25-34 years old had the highest rates of HIV diagnosis at both time points. The HIV diagnosis rates increased from 2010 to 2015 for MSM aged 13-24 years and aged 25-34 years (+4.5% and +18.1%, both $P < 0.001$), while the HIV diagnosis rates decreased for the older age groups (35-44 years: -22.6%; 45-54 years: -7.2%; 55 years and older: -9.8%, all $P < 0.01$).

Among PWID, the HIV diagnosis rates decreased 35.6% for males (45.0 in 2010 and 28.9 in 2015, $P < 0.0001$) and 33.1% for females (70.0 in 2010 and 46.8 in 2015, $P < 0.0001$). The highest rates in 2010 and 2015 were among black PWID. The HIV diagnosis rates decreased in both sexes among black PWID, Hispanic/Latino PWID and PWID of other races. However, the HIV diagnosis rate increased among white male PWID (+18.7%, $P = 0.015$). For female PWID, HIV diagnosis rates increased (+15.4%), although this was not found to be statistically significant ($P = 0.056$). Comparing black male PWID to white male PWID, the HIV diagnosis rate was 17 times as high in 2010 and 6 times as high in 2015. Comparing black female PWID to white female PWID, the rate was 11 times as high in 2010 and 4 times as high in 2015. The differences in HIV diagnosis rates in 2010 and 2015 were also narrowing when comparing Hispanic/Latino PWID to white PWID for both sexes. Among PWID by age groups, the diagnosis rates decreased among age groups older than 35 years (all $P < 0.001$), but remained stable for persons aged 13-24 and 25-34 years for both males and females.

Among heterosexuals, the HIV diagnosis rates decreased 24.4% for both males (3.8 in 2010 and 2.9 in 2015, $P < 0.0001$) and females (6.9 in 2010 and 5.2 in 2015, $P < 0.0001$). The highest rates in 2010 and 2015 were among black heterosexuals. Comparing black male heterosexuals to white male heterosexuals, the diagnosis rate was 33 times as high in 2010 and 29 times as high in 2015. Comparing black female heterosexuals to white female heterosexuals, the diagnosis rate was 27 times as high in 2010 and 22 times as high in 2015. With regard to age groups, male heterosexuals aged 35-44 years and female heterosexuals aged 25-34 years had the highest HIV diagnosis rates. The HIV diagnosis rates decreased among all racial/ethnic groups and age groups, except heterosexual males aged 13-24 years who had a stable HIV diagnosis rate.

Estimated HIV Incidence Rates in 2010 and 2015

The estimated HIV incidence rates in 2010 and 2015 were 605.0 and 583.6 per 100,000 MSM; 43.0 and 32.7 per 100,000 PWID; and 5.0 and 3.8 per 100,000 heterosexuals (Table 2). The rate ratios indicated substantial disparities between MSM and PWID and MSM and heterosexuals. Comparing MSM to PWID, the HIV incidence rate was 14 times as high in 2010 and 18 times as high in 2015. Rate ratio comparing MSM to heterosexuals was 121 times as high in 2010 and 154 times as high in 2015.

The estimated HIV incidence rate was stable for MSM overall (-3.5%, $P = 0.373$). However, it decreased among white MSM (-14.1%, $P = 0.024$). Blacks had the highest HIV incidence

rates at both time points and the incidence rate remained stable (-2.2% , $P = 0.747$). For Hispanic MSM, the HIV incidence rate increased ($+10.6\%$), although this was not found to be statistically significant ($P = 0.201$). Comparing black MSM to white MSM, the HIV incidence rate was about 9 times as high in 2010 and 10 times as high in 2015. The rate ratio comparing Hispanic/Latino MSM to white MSM was 4 times as high in 2010 and 5 times as high in 2015. MSM 25-34 years old had the highest rates of HIV incidence at both time points, followed by MSM who were 13-24 years old. In contrast to the diagnosis rate, the HIV incidence rate decreased among MSM aged 13-24 years (-21.9% , $P < 0.01$). However, similar to the diagnosis rate, the incidence rate increased among MSM aged 25-34 years ($+27.8\%$, $P < 0.0001$).

Among PWID, the overall estimated HIV incidence rate decreased (-23.9% , $P = 0.03$). Comparing female to male PWID, the HIV incidence rates were approximately 1.5 times as high in 2010 and in 2015.

Among heterosexuals, the estimated HIV incidence also decreased overall (-24.7% , $P < 0.0001$) and for males (-26.5% , $P = 0.026$) and females (-23.8% , $P < 0.0001$). Comparing female to male heterosexuals, the HIV incidence rates were approximately 2 times as high in 2010 and in 2015.

Estimated HIV Prevalence Rates in 2015

The estimated rates of HIV prevalence in 2015 were 12,372.9 per 100,000 MSM; 1,937.2 per 100,000 PWID; and 126.7 per 100,000 heterosexuals (Table 3). The estimated HIV prevalence rate among MSM was 6 times the rate for PWID and 98 times the rate for male heterosexuals.

Among MSM, the HIV prevalence rates were higher for both black and Hispanic/Latino MSM compared with white MSM. Among all age groups, MSM aged 45-54 had the highest HIV prevalence rate. Among PWID, the HIV prevalence rate was higher among females than males (rate ratio: 1.4). Similarly, the HIV prevalence rate was higher among female heterosexuals than male heterosexuals (rate ratio: 1.9).

Discussion

This analysis is the first to comprehensively examine the national rates of HIV diagnosis, incidence, and prevalence among MSM, PWID, and heterosexuals in the United States. These national HIV rates show the disease burden, relative to the sizes of the populations, providing a more refined picture of HIV epidemic for guiding resource allocation. The analyses of HIV rates for each transmission category at two time points (2010 and 2015) and by subgroups allowed for monitoring the progress toward the goal of reducing health disparities. We found that the overall national diagnosis rates decreased between 2010 and 2015 for all three transmission categories and also for several race/ethnicity and age subgroups. The incidence rates decreased among white MSM, MSM aged 13-24 years, PWID overall, and male and female heterosexuals. While the evidence of progress is encouraging, health disparities remain and have widened for some groups.

The estimated rates of HIV diagnosis, incidence, and prevalence presented here quantify the disproportionate HIV disease burden among MSM compared to PWID and heterosexuals. In addition, our data quantify persistent racial/ethnic disparities among MSM. The estimated rates continue to be substantially higher for black and Hispanic/Latino MSM than for white MSM. Only among white MSM did the HIV incidence rate as well as HIV diagnosis rate decrease. The HIV diagnosis rates increased in black MSM and Hispanic/Latino MSM, while the HIV incidence rates remained stable for both groups. The number of new infections among Hispanic/Latino MSM has increased between 2010 and 2015 (the estimated numerator) [9]. However, our analyses could not corroborate an increase in the HIV incidence rate when accounting for the adjusted population size (the estimated denominator). It is possibly due to the uncertainty from the estimated denominator that was added to the HIV incidence rate estimate. The increase in the HIV diagnosis rate and decrease in the HIV incidence rate among MSM aged 13-24 years may reflect targeted testing efforts to identify young MSM with undiagnosed HIV [9]. The result of targeted testing efforts is also reflected in the increased percentage of MSM aged 13-24 living with diagnosed HIV infection [9]. However, MSM aged 25-34 had increased rates of HIV incidence as well as diagnosis, pointing out an important age group for intensifying prevention as well as testing efforts.

Racial/ethnic disparities are also apparent among PWID. Among both male and female PWID, blacks had the highest rates of HIV diagnosis. Even though the HIV diagnosis rates in black male and female PWID decreased, the rates were still 6 and 4 times as high when compared to white male and female PWID in 2015. Among PWID, white males was the only group that showed a significant increased rate of HIV diagnosis. While we found the overall HIV incidence rate among PWID decreased from 2010 to 2015 and was stable when stratified by sex, our analysis did not directly test whether there was a significant increase in the HIV incidence rate among white males due to the relative standard error > 30%, indicating low reliability of the estimated HIV incidence for this subgroup. However, findings from a CDC study conducted in 20 selected metropolitan statistical areas showed a higher percentage of white PWID than Hispanic/Latino and black PWID reported receptive syringe sharing and sharing injection equipment, behaviors that put them at risk for HIV infection [15]. Whites also reported higher rates of misuse of prescribed pain relievers, tranquilizers, stimulants, and sedatives in 2015 than blacks and Hispanics/Latinos [16]. Increased injection of opiates within a network of people who inject drugs might have fueled HIV infections, especially among white male PWID [17].

The magnitude of racial/ethnic disparities in HIV diagnosis rates among heterosexuals is even larger than the disparities observed in MSM and PWID. HIV diagnosis rates were between 22 to 33 times as high among blacks compared with the rates among whites and between 5 to 7 times as high among Hispanics/Latinos compared with rates among whites. Several individual, social and structural factors such as risk behavior, relationship dynamic, stigma, health literacy, health insurance coverage, access to care and HIV treatment, and housing status may have contributed to disparities [18]. Additionally, one recent study showed that blacks had a higher number of HIV infections diagnosed between 2010 and 2015 attributed to heterosexual contact with partners previously known to be HIV infected than other racial/ethnic groups [19]. Many of the infections from partners known to be HIV

infected could have been averted if discordant couples were aware of and were offered effective biomedical and behavioral prevention methods [19]. Continued efforts to promote HIV testing, treatment for HIV-infected partners, and pre-exposure prophylaxis (PrEP) and other prevention services for HIV-negative partners, not only for MSM and PWID, but also for heterosexuals are needed to further reduce health disparities.

There are limitations to our analyses due to assumptions made when calculating HIV rates and rate ratios. First, we used the previously published proportion estimates derived from meta-analyses of national probability surveys and thus our analyses are also subject to general limitations that come with estimating population sizes as described in detail for each population in the previous publications [2–4]. Second, we applied the same proportion estimates of the United States population classified as MSM, PWID, and heterosexuals to 2010 and 2015 census data, thereby assuming that the proportion of each transmission category remained the same over time. Third, HIV incidence and prevalence were estimated based on a CD4 depletion model that relies on a series of assumptions [8]. Due to low reliability of estimated HIV incidence and prevalence rates for the race/ethnicity and age-specific stratifications of PWID and heterosexuals, the rates of HIV incidence and prevalence by race/ethnicity and age were reported for MSM only. These limitations point out the need of re-assessing the HIV rates and rate ratios when more data become available.

Despite these limitations, our estimated rates of HIV diagnosis, incidence, and prevalence quantify the burden of HIV disease and point out the groups that need intensified prevention and care efforts, using the most recent and available data. The national HIV diagnosis rates decreased overall for all three transmission categories and several race/ethnicity and age subgroups. The incidence rates decreased among white MSM, persons aged 13-24 years, PWID overall, and male and female heterosexuals. However, MSM continue to be disproportionately affected and health disparities remain and have widened for some groups. Blacks continued to have the highest rates of HIV diagnosis among all racial/ethnic groups of all three transmission categories. Continued efforts are needed to strengthen interventions that offer HIV testing, PrEP, and other prevention services for at-risk populations and improve access to HIV treatment, promote medication adherence, and address barriers to clinical care and supportive services for all persons with diagnosed HIV infection.

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Appendix A

Estimated proportions of the United States Population Classified as MSM, PWID, and Heterosexuals

For MSM, we used the estimated proportion of persons reporting same-sex behavior in the past 5 years (i.e., 3.9%), which is generally considered more indicative of the gay and bisexual male population that is the target for many HIV prevention activities in the United States [1]. We also used the same overall past-5-year estimate (i.e., 3.9%) to all race/ethnicity and age-specific groups because the race/ethnicity and age-specific proportion estimates of MSM are not available in the literature.

For PWID, we used the estimated proportion of persons who ever injected drugs in their lifetime, excluding MSM who injected drugs [2]. The proportion estimate for lifetime injection drug use for males is 3.6%, for females is 1.6%, and for males and females combined is 2.6% [2]. The estimated proportions of PWID by race/ethnicity and age for each sex are available from Lansky et al, 2014 [2]. Those race/ethnicity and age-specific proportion estimates were used in the analyses of this paper.

For heterosexuals, we used the estimated proportions of males and females who ever had sex with a member of the opposite sex [3]. Following the hierarchy used for transmission category, the proportion heterosexual with no other HIV risk behaviors was calculated by excluding those who reported never having had sex, males who reported sex with another male, males and females who ever injected drugs, and females who only reported sex with female partners.³ The proportion estimate for lifetime heterosexuals for males is 84.1%, for females is 89.4%, and for males and females combined is 86.7% [3]. The estimated proportions of PWID by race/ethnicity and age for each sex are available from Lansky et al, 2015 [3]. Those race/ethnicity and age-specific proportion estimates were used in the analyses of this paper.

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Table 1.

Estimated rates of HIV diagnosis among men who have sex with men (MSM), persons who inject drugs (PWID), and heterosexuals, by selected characteristics and years (2010 and 2015)

	2010						2015						p-value of z-test: Rate2010 = Rate2015
	Reported HIV diagnosis	Estimated Population size	Estimated rate per 100,000 persons in the selected population	Lower 95% Confidence Interval for Estimated Rate	Upper 95% Confidence Interval for Estimated Rate	Rate ratio	Reported HIV diagnosis	Estimated Population size	Estimated rate per 100,000 persons in the selected population	Lower 95% Confidence Interval for Estimated Rate	Upper 95% Confidence Interval for Estimated Rate	Rate ratio	
MSM	26,277	4,470,442	587.8	515.7	661.8		26,459	4,604,040	574.7	503.1	648.5		0.012
<i>Race/Ethnicity</i>													
White	8,550	3,045,320	280.8	247.2	315.0	Referent	7,447	3,063,852	243.1	213.8	272.9	Referent	0.000
Hispanic ^a	6,285	665,698	944.1	824.7	1067.8	3.4	7,265	729,936	995.3	866.7	1,129.2	4.1	0.003
Black	9,780	446,461	2190.5	1886.1	2515.2	7.8	10,129	446,395	2269.2	1,935.4	2,632.3	9.3	0.019
Other ^b	1,662	312,962	531.0	466.7	596.8	1.9	1,618	363,857	444.8	390.6	500.4	1.8	0.000
<i>Age at diagnosis</i>													
13-24	6,932	1,018,299	680.8	602.2	760.1	Referent	7,231	1,016,031	711.7	629.2	795.1	Referent	0.009
25-34	7,748	746,909	1037.3	911.0	1166.7	1.5	9,525	777,711	1224.7	1,071.5	1,382.9	1.7	0.000
35-44	5,844	674,552	866.3	752.5	985.5	1.3	4,566	681,098	670.4	584.0	760.4	0.9	0.000
45-54	4,158	723,203	575.0	498.7	655.2	0.8	3,521	659,871	533.6	459.6	612.5	0.7	0.002
55 & above	1,595	1,307,479	122.0	107.5	136.7	0.2	1,617	1,469,330	110.0	96.6	123.8	0.2	0.006
PWID	3,421	6,532,822	52.4	41.1	76.3		2,347	6,844,304	34.3	26.9	49.9		0.000
Mate PWID	1,987	4,420,771	45.0	33.6	68.1		1,343	4,640,587	28.9	21.6	43.8		0.000
<i>Race/Ethnicity</i>													
White	409	3,129,365	13.1	10.1	18.4	Referent	492	3,173,651	15.5	12.0	21.8	Referent	0.015
Hispanic/Latino ^a	501	421,476	118.7	84.1	201.8	9.1	330	476,541	69.2	49.1	117.0	4.5	0.000
Black	986	449,148	219.5	154.9	376.6	16.8	465	485,733	95.8	67.8	162.9	6.2	0.000
Other ^b	92	194,694	47.4	28.5	141.4	3.6	57	228,890	24.8	14.9	73.4	1.6	0.000
<i>Age at diagnosis</i>													

	2010						2015						p-value of z-test: Rate2010 = Rate2015
	Reported HIV diagnosis	Estimated Population size	Estimated rate per 100,000 persons in the selected population	Lower 95% Confidence Interval for Estimated Rate	Upper 95% Confidence Interval for Estimated Rate	Rate ratio	Reported HIV diagnosis	Estimated Population size	Estimated rate per 100,000 persons in the selected population	Lower 95% Confidence Interval for Estimated Rate	Upper 95% Confidence Interval for Estimated Rate	Rate ratio	
13-24	105	478,086	21.9	15.1	39.4	Referent	119	479,327	24.8	17.1	44.6	Referent	0.420
25-34	337	700,456	48.1	32.0	91.3	2.2	349	753,359	46.4	30.9	87.9	1.9	0.656
35-44	494	820,557	60.2	47.2	82.8	2.8	288	817,119	35.3	27.7	48.4	1.4	0.000
45-54	655	805,285	81.4	63.8	108.1	3.7	327	780,615	41.9	32.9	55.5	1.7	0.000
55 & above	397	1,207,532	32.8	26.0	42.8	1.5	260	1,388,544	18.7	14.8	24.5	0.8	0.000
Female PWID	1,434	2,048,831	70.0	55.7	103.0		1,004	2,142,676	46.8	37.3	68.9		0.000
<i>Race/Ethnicity</i>													
White	409	1,375,357	29.7	26.4	34.0	Referent	475	1,386,005	34.3	30.4	39.2	Referent	0.056
Hispanic/Latino ^a	203	121,433	166.9	114.0	241.7	5.6	139	139,308	99.8	68.4	143.8	2.9	0.000
Black	726	2,17,026	334.7	191.1	1344.6	11.3	339	232,801	145.4	83.5	562.6	4.2	0.000
Other ^b	96	120,991	79.6	60.5	116.4	2.7	51	141,976	35.9	27.3	52.4	1.0	0.000
<i>Age at diagnosis</i>													
13-24	150	252,933	59.1	53.7	73.9	Referent	122	253,492	48.0	43.6	60.0	Referent	0.135
25-34	305	240,862	126.5	108.1	152.4	2.1	294	257,720	114.0	97.5	137.1	2.4	0.273
35-44	356	396,544	89.7	71.2	130.3	1.5	227	396,896	57.2	45.5	82.5	1.2	0.000
45-54	436	343,545	126.9	100.2	190.1	2.1	218	328,994	66.1	52.3	99.0	1.4	0.000
55 & above	188	494,885	38.0	28.4	57.6	0.6	144	556,222	25.9	19.2	39.4	0.5	0.007
Heterosexuals	12,138	222,097,551	5.5	5.3	5.6		9,588	232,249,608	4.1	4.0	4.3		0.000
Male heterosexuals	4,025	105,097,858	3.8	3.7	4.0		3,187	110,119,938	2.9	2.8	3.0		0.000
<i>Race/Ethnicity</i>													
White	477	70,148,872	0.7	0.6	0.7	Referent	407	71,123,727	0.6	0.5	0.6	Referent	0.021
Hispanic/Latino ^a	755	16,446,928	4.6	4.5	4.7	6.8	595	18,471,966	3.2	3.2	3.3	5.6	0.000
Black	2,604	11,573,257	22.5	20.8	24.4	33.1	2,048	12,361,211	16.6	15.3	18.0	28.9	0.000

	2010						2015						p-value of z-test: Rate2010 = Rate2015
	Reported HIV diagnosis	Estimated Population size	Estimated rate per 100,000 persons in the selected population	Lower 95% Confidence Interval for Estimated Rate	Upper 95% Confidence Interval for Estimated Rate	Rate ratio	Reported HIV diagnosis	Estimated Population size	Estimated rate per 100,000 persons in the selected population	Lower 95% Confidence Interval for Estimated Rate	Upper 95% Confidence Interval for Estimated Rate	Rate ratio	
<i>b</i>	189	6,917,611	2.7	2.6	2.9	4.0	138	8,098,828	1.7	1.6	1.8	3.0	0.000
<i>Age at diagnosis</i>													
13-24	284	18,658,588	1.5	1.4	1.6	Referent	260	18,704,146	1.4	1.3	1.5	Referent	0.321
25-34	767	18,408,479	4.2	4.1	4.2	2.7	702	19,765,031	3.6	3.5	3.6	2.6	0.003
35-44	1,105	18,152,989	6.1	5.8	6.4	4.0	770	17,933,380	4.3	4.1	4.5	3.1	0.000
45-54	1,150	19,456,641	5.9	5.7	6.1	3.9	767	18,673,426	4.1	4.0	4.2	3.0	0.000
55 & above	720	31,470,376	2.3	2.2	2.4	1.5	688	36,403,394	1.9	1.8	2.0	1.4	0.001
Female heterosexuals	8,112	117,295,434	6.9	6.7	7.1		6,401	122,425,509	5.2	5.1	5.4		0.000
<i>Race/Ethnicity</i>													
White	1,053	77,852,474	1.4	1.3	1.4	Referent	961	78,451,182	1.2	1.2	1.3	Referent	0.034
Hispanic/Latino ^a	1,315	16,669,886	7.9	7.8	8.0	5.8	1,052	18,917,114	5.6	5.5	5.6	4.5	0.000
Black	5,310	14,498,861	36.6	36.0	37.3	27.1	4,075	15,343,100	26.6	26.1	27.1	21.7	0.000
Other ^b	434	8,208,715	5.3	5.1	5.5	3.9	313	9,583,524	3.3	3.1	3.4	2.7	0.000
<i>Age at diagnosis</i>													
13-24	1,327	18,287,439	7.3	6.9	7.6	Referent	945	18,305,011	5.2	4.9	5.4	Referent	0.000
25-34	2,127	19,385,424	11.0	10.6	11.3	1.5	1,686	20,599,385	8.2	7.9	8.5	1.6	0.000
35-44	2,074	19,576,132	10.6	10.3	10.9	1.5	1,542	19,323,097	8.0	7.7	8.2	1.5	0.000
45-54	1,665	20,937,895	8.0	7.4	8.6	1.1	1,300	19,996,105	6.5	6.0	7.1	1.3	0.000
55 & above	919	39,797,564	2.3	2.2	2.4	0.3	928	45,219,313	2.1	2.0	2.2	0.4	0.016

^aHispanic/Latino can be of any race

^bOther race/ethnicity category includes American Indian/Alaska Native, Asian, Native Hawaiian/other Pacific Islander, and multiple races

MSM = men who have sex with men

PWID = Persons who inject drugs

Table 2.

Estimated rates of HIV incidence among men who have sex with men (MSM), persons who inject drugs (PWID), and heterosexuals, by selected characteristics and years (2010 and 2015)

	2010						2015						p-value of z-test: Rate2010 = Rate2015
	Estimated HIV incidence	Estimated population size	Estimated rate per 100,000 persons in the selected population	Lower 95% Confidence Interval for Estimated Rate	Upper 95% Confidence Interval for Estimated Rate	Rate ratio	Estimated HIV incidence	Estimated population size	Estimated rate per 100,000 persons in the selected population	Lower 95% Confidence Interval for Estimated Rate	Upper 95% Confidence Interval for Estimated Rate	Rate ratio	
MSM	26,400	4,364,386	605.0	524.7	685.3	Referent	26,200	4,497,605	583.6	496.2	671.1	Referent	0.373
<i>Race/Ethnicity</i>													
White	8,200	3,014,113	271.9	235.3	308.5	Referent	7,100	3,034,686	233.6	193.2	274.0	Referent	0.024
Hispanic/Latino ^a	6,500	637,546	1025.0	871.1	1179.0	3.8	7,900	699,952	1133.4	909.3	1357.4	4.9	0.201
Black	10,000	407,036	2459.0	2045.9	2872.1	9.0	9,800	406,347	2405.6	1898.3	2912.8	10.3	0.747
Other ^b	1,700	305,690	544.7	447.6	641.7	2.0	1,400	356,620	407.2	265.7	548.6	1.7	0.100
<i>Age at infection</i>													
13-24	9,700	979,317	989.5	858.0	1120.9	Referent	7,600	986,438	773.0	631.9	914.1	Referent	0.001
25-34	7,600	719,705	1057.1	907.3	1206.9	1.1	10,000	740,265	1351.0	1109.0	1593.1	1.7	0.000
35-44	4,800	652,559	739.6	622.5	856.6	0.7	4,300	661,924	654.8	508.2	801.3	0.8	0.212
45-54	3,200	709,957	456.6	381.2	532.1	0.5	3,000	645,112	462.4	343.2	581.6	0.6	0.914
55 & above	1,000	1,302,850	79.5	63.5	95.5	0.1	1,300	1,463,867	89.3	59.3	119.2	0.1	0.516
PWID	2,800	6,520,671	43.0	29.6	56.3	Referent	2,200	6,835,719	32.7	20.6	44.8	Referent	0.030
Male	1,600	4,413,009	36.8	23.3	50.4	Referent	1,300	4,635,079	28.1	15.1	41.2	Referent	0.124
Female	1,200	2,044,442	57.5	39.1	76.0	1.6	930	2,139,599	43.5	24.9	62.1	1.5	0.112
Heterosexuals	11,200	222,046,788	5.0	4.7	5.3	Referent	8,800	232,204,569	3.8	3.3	4.2	Referent	0.000
Male	3,700	105,078,203	3.5	3.1	3.9	Referent	2,800	110,102,010	2.6	1.9	3.2	Referent	0.026
Female	7,500	117,264,326	6.4	6.0	6.8	1.8	6,000	122,398,400	4.9	4.2	5.5	1.9	0.000

^aHispanic/Latino can be of any race

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MSM = men who have sex with men

PWID = Persons who inject drugs

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Table 3.

Estimated rates of HIV prevalence among men who have sex with men (MSM), persons who inject drugs (PWID), and heterosexuals, by selected characteristics, 2015

	Estimated HIV prevalence	Estimated Population size	Estimated rate per 100,000 persons in the selected population	Lower 95% Confidence Interval for Estimated Rate	Upper 95% Confidence Interval for Estimated Rate	Rate ratio
MSM	632,300	5,110,077	12,372.9	10,910.5	13,835.3	
<i>Race/Ethnicity</i>						
White	240,900	3,271,445	7,363.7	6,472.0	8,255.4	Referent
Hispanic/Latino ^a	151,200	844,249	17,907.0	15,610.9	20,203.2	2.4
Black	201,800	600,384	33,607.6	29,313.2	37,902.1	4.6
Other ^b	38,400	393,999	9,748.5	8,280.0	11,217.0	1.3
<i>Age at end of 2015</i>						
13-24	47,700	1,039,166	4,589.9	4,033.4	5,146.5	Referent
25-34	137,000	867,355	15,789.7	13,942.8	17,636.7	3.4
35-44	123,200	785,621	15,684.0	13,857.8	17,510.3	3.4
45-54	184,700	828,751	22,283.8	19,700.1	24,867.5	4.9
55 & above	139,700	1,589,185	8,791.9	7,769.9	9,813.8	1.9
PWID	135,100	6,972,145	1,937.2	1,371.1	2,503.4	Referent
Male	81,000	4,716,995	1,716.4	1,133.9	2,298.9	Referent
Female	54,100	2,194,109	2,465.9	1,752.5	3,179.3	1.4
Heterosexuals	294,500	232,494,212	126.7	121.1	132.3	Referent
Male	93,600	110,194,234	84.9	78.5	91.3	Referent
Female	201,000	122,595,818	163.9	156.5	171.3	1.9

^aHispanic/Latino can be of any race

^bOther race/ethnicity category includes American Indian/Alaska Native, Asian, Native Hawaiian/other Pacific Islander, and multiple races

MSM = men who have sex with men

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