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Female and Male Differences in AIDS Diagnosis Rates among People who Inject Drugs in Large US Metro Areas from 1993–2007

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Abstract

Purpose—We estimated female and male incident AIDS diagnosis rates (IARs) among people who inject drugs (PWID) in US metropolitan statistical areas (MSAs) over time to assess whether declines in IARs varied by sex after combination antiretroviral therapy (cART) dissemination.

Methods—We compared IARs and 95% confidence intervals (CIs) for female and male PWID in 95 of the most populous MSAs. To stabilize estimates we aggregated data across 3-year periods, selecting a period immediately preceding cART (1993–1995) and the most recent after the introduction of cART for which data were available (2005–2007). We assessed disparities by comparing IAR 95% CIs for overlap, female-to-male risk ratios, and disparity change scores.

Results—IARs declined an average of 58% for female PWID and 67% for male PWID between the pre-cART and cART periods. Among female PWID, IARs were significantly lower in the later period relative to the pre-cART period in 48% of MSAs. Among male PWID, IARs were significantly lower over time in 86% of MSAs.

Conclusions—IARs among female PWID in large US MSAs have declined more slowly than rates among male PWID. This suggests a need for increased targeting of prevention and treatment programs, and for research on MSA level conditions that may drive differences in declining AIDS rates among female and male PWID.

Keywords

Injection drug use; AIDS; gender; health status disparities

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INTRODUCTION

After the introduction of combination antiretroviral therapy (cART), there was a substantial reduction in the number of AIDS diagnoses in the US, particularly among people who inject drugs (PWID) [1]; however, national trajectories of change in AIDS diagnoses have not been the same for female and male PWID [1, 2]. In 1995, PWID represented 7% of persons diagnosed with AIDS among females and 19% among males [2]. In 2011, 20% of new AIDS diagnoses among females were injection-related, while only 10% of AIDS diagnoses among males were from PWID [1]. During this time, we have estimated that PWID prevalence per 10,000 adult population in large US metropolitan statistical areas (MSAs) also fell from 157 in 1993–1995 to 133 in 2005–2007 among males, and from 82 to 75 among females [3]. These data raise questions about changes in epidemiological patterns of AIDS among female PWID and how these patterns may vary across geographic areas.

This paper focuses on differences between female and male PWID in incident AIDS diagnosis rates (IARs) across MSAs. Analysis at the MSA level provides a useful lens through which to understand the historical and social factors that drive HIV burden in different locales. Several papers have found differences in HIV prevalence and AIDS mortality among PWID across MSAs and this variation has been linked to MSA level factors [4–6]. Previous research has also demonstrated that racial/ethnic disparities in AIDS diagnoses among PWID varied significantly across MSAs [7]. While there is ample evidence demonstrating the success of cART in reducing morbidity and mortality in the United States [8, 9], the diffusion of cART and other important services may not have been uniform across MSAs and may have reached male and female injectors at different times. Disparities in the availability of cART and HIV care, as well as its accessibility to female PWID, may have resulted in significant gender differences in AIDS diagnoses across MSAs among injectors. In this paper, we assess changes in IARs among female and male PWID across large MSAs between a pre-cART period (1993–1995) and a period well after cART was available (2005–2007).

METHODS AND MATERIALS

The unit of analysis in this paper is the MSA, which is defined by the US Census Bureau as contiguous counties containing a central city of 50,000 people or more and that form a socioeconomic unity [10]. Studying HIV among PWID at the MSA level [11] is useful since, as noted, each MSA has its own epidemic history and HIV prevalence rate. Analyses were conducted on a cohort of 95 of the largest MSAs in the continental US. Preliminary analysis of trend lines over time from 1992 to 2007 (not shown) demonstrated that rates of AIDS diagnosis fell for both male and female PWID over time, but fell more rapidly beginning in 1996 when cART was first introduced. In this paper, we focus on long-term change between the period before cART and a time when cART was more widely available, treating these two time periods as summary endpoints of linear change. To minimize the potential impact of small numbers of diagnoses in some MSAs we combined data from the 3-years immediately preceding cART dissemination (1993–1995) and compared this to a 3-year period (2005–2007) with the most recent available data.

We estimated metropolitan IARs among adult (aged 15–64) female and male PWID using Centers for Disease Control and Prevention’s National HIV Surveillance System data for 95 MSAs. Female PWID included females who reported injection drug use as a risk factor. Males who reported injecting drugs and males who were both PWID and men who have sex with men were included as male PWID. For each MSA, period and gender, we calculated IARs by dividing the total number of AIDS diagnoses during that period by the estimated number of male or female PWID *without* AIDS. Methods for creating annual estimates of PWID for each MSA for females and males have been reported in detail elsewhere, but involve calculating the number of PWID in the US and then apportioning estimates to MSAs using multiplier methods [3, 11–13]. These estimates were based on data on HIV counseling and testing, drug treatment, AIDS diagnoses, and estimates from published national and MSA-specific research studies [3, 13]. PWID living with AIDS were excluded from the denominators to calculate incidence for the PWID population-at-risk for AIDS. PWID at risk for AIDS could be HIV-infected or HIV-uninfected. These estimates were then scaled (multiplied by 10,000) to provide IARs per 10,000 PWID for both females and males. At the time we conducted these analyses, our estimates of PWID prevalence were only available through 2007. Data on PWID AIDS diagnoses stratified by both gender *and* race were not available due to the suppression of CDC data with small cell sizes.

To facilitate comparisons, we calculated 95% confidence intervals (CIs) for each IAR. CIs were calculated using standard formulas when the number of new diagnoses in an MSA was 100 or more, and using tabled values when the number of diagnoses was smaller [14]. The tabled values formula assumes that AIDS diagnoses are infrequent events relative to the size of the population and so can be viewed as occurring in a Poisson-distributed function [14]. As a result, the size of the CIs reflect both the rates and numbers of diagnoses, so that MSAs with few diagnoses have relatively low rates and wide CIs, and MSAs with many diagnoses have higher rates and more narrow CIs. We also present the dispersion of IARs across MSAs for female and male PWID, using a measure of the Coefficient of Variation (CV).

We employed various methods to assess absolute and relative disparities in IARs for female and male PWID. First, to assess important differences in IARs within a given MSA and time period, we compared the extent to which CIs overlapped for females and males: if the CI overlapped, the difference was considered to be not significant at the 95% level [14, 15]. The CIs are based on standard error estimates that reflect only random error in the numerator. Comparing CIs for overlap is an absolute comparison that accounts for the precision of the IARs, allowing us to utilize all available data without excluding MSAs with small numbers of AIDS diagnoses, and providing a way to assess the frequency and importance of gender differences across MSAs.

Second, we assessed the magnitude of gender differences in IARs among PWID in each period by calculating the rate ratio for female PWID compared to male PWID (female IAR/ male IAR) for each MSA [16]. It is important to note that rate ratios are sensitive to small values so differences may appear to vary greatly within an MSA with small but changing numbers of diagnoses; therefore, we also provide a calculation of relative disparity, the percent difference between groups, which is more appropriate for MSAs with lower diagnosis rates [16].

Third, we present disparity change scores (DCS) for each MSA to track differences in IARs for female and male PWID over time. The DCS indicates the change in the female-to-male rate ratio in each MSA between the early and late period by subtracting the rate of the health outcome at the later time point from the rate of the health outcome at baseline using the following formula: $DCS = |RR_{T1} - 1| - |RR_{T2} - 1|$ [16]. A negative DCS indicates that the gap in IARs between females and males is narrowing, with a larger DCS value indicating a greater change in the disparity [16]. We included the DCS as an additional tool with which to identify possible shrinking or growing disparities and to draw attention to those MSAs where the service needs of female or male PWID may be greater.

The geographic distribution of differences was assessed by comparing IARs across region (Northeast, South, Midwest and West). All analyses were conducted using SPSS version 19 [17].

RESULTS

AIDS diagnosis rates, 95% CIs, and significance of CIs for female and male PWID in each MSA and time period are presented in Table 1. Across all 95 MSAs, in the pre-cART period, IARs among females (per 10,000 female PWID) averaged 103 (SD=124.1). In the later period, after the introduction of cART, the average IAR among females was 43 (SD=44.9). Among males, the average IAR (per 10,000 male PWID) was 163 (SD=138.6) in the pre-cART period and 53 (SD=37.4) in the later period. IARs were more dispersed for female PWID (CV=120%) than male PWID (CV=85%) in the pre-cART period. Similarly, in the cART period, IARs were more dispersed for female PWID (CV=105%) compared to males (CV=71%).

Differences between female and male IARs were present in both the pre-cART and cART periods. As seen in Table 1, in 94 of 95 MSAs, IARs in the pre-cART period were lower among female PWID than male PWID; differences between male and female IARs were significant in 65 of these 94 MSAs, as indicated by non-overlapping CIs. In the cART-era, however, IARs among females were significantly lower than rates among male PWID in only 27 MSAs and significantly higher in 2 MSAs (Houston and New York).

On average, across all 95 MSAs, IARs decreased by 67% for male PWID between the pre-cART and cART era, but only by 58% for female PWID (not shown in table). When we look *within* MSAs, we see that diagnosis rates over time among female PWID were significantly lower in only 48% (n=46) of MSAs and significantly higher in Houston, TX. In the remaining 48 MSAs, there was no significant change in IARs among female PWID over time. Among male PWID, IARs in the cART period were significantly lower in 86% (n=82) of MSAs and showed no significant change in the remaining 13 MSAs.

Disparities between female and male IARs across MSAs and within and across time periods, including female-to-male rate ratios, relative difference in IAR by sex, and disparity change scores, are shown in Table 2. Over time, the female-to-male IAR ratio increased in a number of MSAs: in 1993–1995, on average across all 95 MSAs, the female-to-male PWID rate ratio was 0.5, but this increased to 0.7 in 2005–2007. In other words, in the pre-cART

period, IARs among female PWID were about 47% lower than for male PWID, but in the cART era, they were only about 26% lower than among males.

These results are supported by the Disparity Change Score (DCS) as well. On average, across all 95 MSAs, the DCS was -0.2 , indicating that the gap between female and male PWID IARs narrowed by 21% over time, with the magnitude of dispersion across MSAs being 1.4 times smaller than the mean ($CV=141\%$). In 15 of 95 MSAs, the gap between female and male IARs increased by 10% or more over time as a result of declining female-to-male rate ratios, which suggests that female PWID were faring better relative to male PWID. For 59 MSAs, however, the difference between IARs among female and male PWID narrowed by 10% or more; in 21 of these 59 MSAs, the female-to-male rate ratio in the cART period was 1.00 or greater and in 12 MSAs the disparity narrowed by 50% or more, as indicated by the DCS. This “narrowing” of the female-to-male disparity, indicates that female’s IARs *decreased less over time* and became more similar to rates among males.

As seen in Table 3, regional analysis suggests that gender differences in IARs among PWID may vary by region. In the pre-cART period, IARs for male and female PWID were highest in the Northeast (male=300, female=239), followed by the South (male=179, female=104). These two regions also had the largest female-to-male rate ratios of 0.8 in the Northeast and 0.5 in the South. During the cART era, in the years 2005–2007, IARs among female PWID remained the highest in the Northeast (75) followed by the South (54), but among male PWID, rates were higher in the South (70) than the Northeast (64). While female-to-male rate ratios were greater in all regions in the later period, it is important to note that in the Northeast, where the PWID epidemic started, the sex ratio reversed, such that female IARs were larger relative to male rates (1.12). The DCS over time ranged from about -9% in the West to -36% in the Northeast, which indicates that female and male IARs are becoming more closely aligned.

DISCUSSION

AIDS diagnosis rates among both female and male PWID decreased after the introduction of cART; however, declines were slighter for female PWID relative to male PWID. While average IARs among males declined 67% across the 95 MSAs, they only declined an average of 58% among females. This is evident in our analysis of overlap in CIs, which showed that between the pre-cART and cART periods, IARs among males declined significantly in 86% of MSAs. For female PWID, IARs declined significantly in only 48% of MSAs. Additional measures of disparity, including female-to-male rate ratios and disparity change scores, also demonstrate this trend. This pattern of slower declines in IARs among female PWID is particularly apparent in the Northeast and in some other larger MSAs. For example, in Baltimore, Boston, Chicago, Houston, New York, Newark, Philadelphia, and Washington, DC, IARs among female PWID declined 53% compared to 71% among male PWID. Given that females may be at higher epidemiologic and sociobehavioral risk for HIV [18] and that PWID are less likely than persons in other transmission categories to seek early HIV counseling, testing and treatment [19], to receive CD4 and viral load testing while under care [20], and have a greater risk for HIV-related morbidity and mortality [20, 21], these findings warrant public health attention.

While the results of this study show that IARs among female PWID typically remain lower than those of males, the slighter declines among females may suggest that advances in HIV prevention and care over time might be reaching or benefiting male PWID to a greater extent. At a structural level, poorer outcomes for PWID relative to non-injectors have been linked to barriers to antiretroviral access and adherence that stem from sociocultural issues, like drug policies and stigma, and provider-based barriers, including limited knowledge about substance abuse and physician perceptions [22]. A social determinants of health perspective also points to sex as an important determinant of health: roles, norms, and inequality shape HIV transmission, access to health services, and how health systems respond to the different needs of females and males [18] [23].

At the individual level, studies suggest that a number of factors might be underlying differences in AIDS diagnoses among female and male PWID. In the years soon after cART became widely available, females were less likely than males to receive cART [24–29]. Females infected with HIV were also less likely than males to receive PCP prophylaxis [27]. A study assessing causes of mortality among people living with HIV in care during the cART era (1998–2005) found that the percentage of time receiving cART while in care was lower for females and that female sex was the only factor associated with mortality [30]. Also, progression to AIDS and deaths among females and PWID were greater than for males or non-PWID after the introduction of cART [31].

The combination of being female *and* a drug injector, however, may make female PWID markedly more vulnerable to poor health outcomes. For instance, a recent study in Canada assessing sex differences in virologic responses to ART and mortality among PWID and non-injectors, found that female PWID were the least likely to “virologically suppress, mostly likely to experience rebound, and had a greater risk of mortality” [21]. Other studies have shown that being a female PWID in Vancouver is associated with less CD4 monitoring [32] and, compared to females exposed through heterosexual contact, females in 33 US states who injected had lower three-year survival after HIV diagnosis [19]. Sociopolitical characteristics, stigma, and gender subordination at the MSA level may also serve to exacerbate disparities in AIDS-related outcomes, shaping female PWID’s access to key health interventions, like cART and SEPs; however, research on these factors needs to be conducted.

The studies discussed above would suggest that the disparities we find in AIDS diagnoses between male and female PWID stem from differences in rates of successful access to and use of care. Another possible mechanism, which is not analytically explored in this paper given our lack of sound data on HIV incidence, is that differences in IARs stem from overall changes in the gender distribution of rates of new HIV infections. This could happen if the rate of new HIV infections were declining more slowly for female PWID than for males. Collectively, our results suggest that greater attention should be paid both to gender differences in PWID HIV diagnoses and access to and utilization of services at the MSA-level that may be making female PWID vulnerable to AIDS. More research is needed on the specific factors that may be driving observed gender disparities in AIDS diagnoses across MSAs.

Limitations

Since our data were aggregated at the MSA level and represent an “ecological cohort” of MSAs, our results and the mechanisms underlying observed disparities should not be assumed to be appropriate for interpretation at the individual-level. Because the method of comparing CIs for overlap is a conservative test of significance, some differences may be statistically significant even when the CIs overlapped had other tests been used [15]. We were unable to exclude PWID-MSM, from our analyses as our PWID estimates include PWID who are also MSM, which may skew male results. Also, our PWID estimates, though validated, may include some error. Inaccuracy may also be introduced to the IARs because the time frame for defining someone as a PWID varies between the numerator and the denominator: the denominator is based on drug use in the last year, while the surveillance data on AIDS diagnoses classifies PWID as ever injection drug use. It is also important to note that the CDC’s AIDS definition changed in 1993; however, these changes were implemented rapidly nationwide [33]. To account for potential bias, we aggregated data for 1993–1995 in this early period. We were also unable to obtain data on AIDS diagnoses stratified by gender and race and transmission route simultaneously. Although racial/ethnic disparities may intersect with gender in important ways, previous work by Pouget et al. (2014) demonstrated that racial disparities changed little across the same time period, suggesting that gender disparities grew in a time when racial disparities remained relatively stable. Finally, we are limited by the unavailability of data on ART use and adherence rates among PWIDs in these MSAs, as well as estimates on HIV incidence or prevalence among female and male PWID for these time periods. However, we note that changes in HIV incidence and prevalence take time to get reflected in IARs (due to the time between infection and AIDS), which may somewhat mitigate our lack of data on HIV.

CONCLUSIONS

Geographical analysis of MSA level differences in IARs can illuminate where there have been successes, but also where interventions and services are most necessary and with which populations. In this analysis we found that while there has been substantial progress in reducing IARs among PWID over time, declines among males appear to be greater than declines among females. These findings indicate that female PWID may not be accessing and receiving health services to the same extent as male PWID and therefore suggests that efforts be made to improve their access to and retention in such services. Given potential sociocultural barriers to equality for females in HIV treatment and care, greater efforts are needed in more MSAs to reduce sex differences in AIDS diagnoses; specifically, targeted and comprehensive HIV treatment and prevention programs may be useful for getting female PWID into care more often and sooner. Finally, these results point to a need for research on MSA level epidemiological, socioeconomic, and political conditions that may increase risk of HIV infection and/or progression to AIDS for female PWID.

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List of Abbreviations

(IAR)	AIDS Diagnosis Rate
(PWID)	People who Inject Drugs
(MSA)	Metropolitan Statistical Area

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Table 1

Incident AIDS diagnosis rates per 10,000 people who inject drugs (PWID) and confidence intervals (95% CI) for 1993–1995 and 2005–2007, by metropolitan statistical area in US

	Pre-cART Era (1993 to 1995)				cART Era (2005 to 2007)			
	Female PWID AIDS Diagnosis Rate per 10,000	Male PWID AIDS Diagnosis Rate per 10,000	Sig. of CI ²		Female PWID AIDS Diagnosis Rate per 10,000	Male PWID AIDS Diagnosis Rate per 10,000	Sig. of CI ²	
Mean (SD)	103.5 (124.1)	163.0 (138.6)			42.6 (44.9)	52.8 (37.4)		
Median (Range)	57.0 (3.8, 648.4)	107.4 (19.8, 731.4)			27.0 (2.3, 272.7)	41.0 (6.8, 240.8)		
Coefficient of Variation / %	119.9	85.1			105.2	70.8		
Metropolitan Statistical Area	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI
Akron, OH	18.2	(5.9, 42.5)	36.9	(21.5, 59.1)	14.9	(4.1, 38.2)	25.1	(12.0, 46.1)
Albany--Schenectady--Troy, NY	202.6	(153.9, 261.9)	313.4	(270.1, 356.7)	*	(43.0, 96.5)	63.8	(47.8, 83.4)
Albuquerque, NM	3.8	(1.0, 9.8)	40.0	(31.1, 50.6)	*	(2.2, 12.7)	17.8	(11.8, 26.0)
Allentown--Bethlehem--Easton, PA	65.2	(45.9, 89.9)	70.9	(56.9, 87.2)		(19.2, 51.1)	41.6	(31.4, 54.2)
Ann Arbor, MI	19.0	(3.9, 55.4)	85.0	(51.9, 131.2)		(1.5, 43.4)	30.2	(13.8, 57.4)
Atlanta, GA	149.3	(131.7, 167.0)	298.2	(280.6, 315.7)	*	(71.2, 98.3)	96.3	(85.7, 107.0)
Austin--San Marcos, TX	63.0	(50.4, 77.8)	94.2	(83.3, 105.0)	*	(22.2, 45.8)	54.1	(43.7, 66.3)
Bakersfield, CA	7.3	(3.6, 13.1)	95.7	(81.4, 110.1)	*	(1.1, 7.8)	47.2	(38.2, 56.3)
Baltimore, MD	210.1	(195.7, 224.4)	333.3	(318.8, 347.8)	*	(52.5, 63.9)	70.4	(65.0, 75.7)
Bergen--Passaic, NJ	341.3	(299.8, 382.8)	415.9	(382.3, 449.4)		(64.3, 116.3)	82.1	(66.3, 100.6)
Birmingham, AL	89.3	(58.9, 130.0)	140.5	(110.7, 175.9)		(13.0, 44.1)	57.6	(39.1, 81.7)
Boston, MA--NH	121.8	(111.0, 133.0)	180.2	(170.5, 189.9)	*	(21.2, 28.7)	23.0	(20.6, 25.5)
Buffalo--Niagara Falls, NY	92.5	(68.6, 121.9)	168.7	(145.5, 192.0)	*	(30.0, 66.2)	37.8	(28.1, 49.6)
Charleston--North Charleston, SC	141.1	(89.5, 211.7)	288.4	(236.4, 340.4)	*	(50.7, 128.2)	86.7	(60.7, 120.0)
Charlotte--Gastonia--Rock Hill, NC--SC	64.4	(47.3, 85.7)	182.1	(157.3, 206.8)	*	(49.5, 93.6)	75.6	(60.5, 93.4)
Chicago, IL	211.3	(195.0, 227.5)	299.3	(285.9, 312.7)	*	(57.8, 75.6)	109.5	(100.3, 118.6)
Cincinnati, OH--KY--IN	29.8	(18.7, 45.2)	70.3	(56.7, 86.2)	*	(7.1, 23.9)	21.8	(14.0, 32.5)
Cleveland--Lorain--Elyria, OH	58.3	(44.5, 75.1)	99.3	(85.9, 112.7)	*	(18.6, 40.5)	38.3	(29.4, 48.9)
Columbus, OH	14.5	(7.9, 24.3)	72.0	(58.4, 85.7)	*	(7.7, 24.6)	30.1	(21.5, 41.0)

	Pre-cART Era (1993 to 1995)			cART Era (2005 to 2007)		
	Female PWID AIDS Diagnosis Rate per 10,000	Male PWID AIDS Diagnosis Rate per 10,000		Female PWID AIDS Diagnosis Rate per 10,000	Male PWID AIDS Diagnosis Rate per 10,000	
Dallas, TX	43.4	(35.8, 51.0)	130.6	(119.4, 141.8)	*	*
Dayton--Springfield, OH	30.4	(16.2, 52.0)	66.1	(47.4, 89.6)		
Denver, CO	25.6	(19.1, 33.7)	70.7	(62.2, 79.2)	*	
Detroit, MI	99.3	(86.9, 111.6)	129.3	(118.9, 139.7)	*	
El Paso, TX	8.0	(2.9, 17.4)	19.8	(14.8, 26.0)		*
Fort Lauderdale, FL	372.9	(328.5, 417.2)	414.6	(380.7, 448.5)	165.8	(134.7, 197.0)
Fort Worth--Arlington, TX	40.7	(33.0, 49.6)	77.8	(68.9, 86.6)	*	
Fresno, CA	22.1	(15.5, 30.4)	34.9	(28.1, 41.7)		
Gary, IN	33.7	(18.4, 56.6)	63.7	(48.8, 81.6)	18.1	(9.4, 31.7)
Grand Rapids--Muskegon--Holland, MI	44.8	(23.1, 78.2)	54.7	(37.2, 77.6)		
Greensboro--Winston-Salem--High Point, NC	57.5	(40.3, 79.6)	126.0	(104.4, 147.6)	*	
Greenville--Spartanburg--Anderson, SC	101.2	(63.4, 153.3)	214.4	(173.4, 255.4)	*	
Harrisburg--Lebanon--Carlisle, PA	80.0	(53.6, 114.8)	112.1	(89.2, 139.2)	21.6	(11.2, 37.7)
Hartford, CT	256.8	(222.2, 291.4)	303.1	(281.19, 325.1)	83.3	(64.6, 105.8)
Honolulu, HI	27.4	(14.2, 47.9)	54.0	(40.5, 70.4)		
Houston, TX	53.9	(47.4, 60.4)	105.6	(98.7, 112.4)	*	*
Indianapolis, IN	32.3	(21.3, 47.0)	76.8	(63.8, 89.7)	*	
Jacksonville, FL	92.2	(74.6, 112.8)	178.9	(155.9, 201.9)	*	*
Jersey City, NJ	453.7	(402.3, 505.0)	562.3	(521.6, 603.0)	*	
Kansas City, MO--KS	25.9	(16.2, 39.1)	115.8	(97.9, 133.6)	*	*
Knoxville, TN	13.5	(5.0, 29.5)	39.8	(26.5, 57.6)		
Las Vegas, NV--AZ	46.3	(35.5, 59.4)	103.6	(91.1, 116.2)	*	
Little Rock--North Little Rock, AR	24.3	(11.1, 46.2)	40.7	(30.3, 53.6)		
Los Angeles--Long Beach, CA	32.4	(28.8, 36.0)	82.8	(78.7, 86.8)	*	*
Louisville, KY--IN	18.2	(10.4, 29.6)	65.8	(53.1, 78.6)	*	
Memphis, TN--AR--MS	72.3	(50.6, 100.1)	145.4	(121.1, 169.8)	*	
Miami, FL	393.6	(359.3, 427.9)	482.9	(456.0, 509.9)	*	

	Pre-cART Era (1993 to 1995)			cART Era (2005 to 2007)		
	Female PWID AIDS Diagnosis Rate per 10,000	Male PWID AIDS Diagnosis Rate per 10,000		Female PWID AIDS Diagnosis Rate per 10,000	Male PWID AIDS Diagnosis Rate per 10,000	
Middlesex--Somerset--Hunterdon, NJ	338.9	(289.0, 388.9)	370.1	(331.7, 408.4)	63.5	(47.7, 82.9)
Milwaukee--Waukesha, WI	79.5	(56.3, 109.1)	90.3	(73.3, 110.0)	25.2	(17.7, 34.9)
Minneapolis--St. Paul, MN--WI	38.8	(26.5, 54.7)	89.6	(75.1, 104.0)	30.5	(22.8, 39.8)
Monmouth--Ocean, NJ	239.9	(201.6, 278.1)	350.9	(313.9, 387.8)	58.0	(44.4, 74.3)
Nashville, TN	58.9	(42.1, 80.2)	138.6	(118.4, 158.8)	35.1	(26.6, 45.4)
Nassau--Suffolk, NY	333.8	(294.1, 373.4)	395.0	(366.0, 424.1)	47.3	(38.2, 56.4)
New Haven--Meriden, CT	253.0	(226.1, 279.9)	295.0	(275.9, 314.2)	87.4	(75.8, 99.0)
New Orleans, LA	81.7	(65.7, 97.7)	139.7	(126.3, 153.0)	74.4	(62.1, 86.7)
New York, NY	648.4	(631.1, 665.8)	731.4	(719.1, 743.7)	122.5	(117.6, 127.4)
Newark, NJ	558.3	(522.8, 593.8)	643.5	(616.7, 670.3)	136.2	(121.9, 150.4)
Norfolk--Virginia Beach--Newport News, VA--NC	83.6	(67.0, 103.1)	183.5	(161.4, 205.7)	43.9	(34.0, 55.8)
Oakland, CA	57.0	(48.3, 65.7)	97.1	(88.0, 106.1)	32.5	(26.5, 38.6)
Oklahoma City, OK	24.5	(14.5, 38.8)	74.9	(60.4, 91.7)	64.3	(49.0, 83.0)
Omaha, NE--IA	41.1	(19.7, 75.6)	78.5	(55.8, 107.3)	35.8	(21.5, 55.9)
Orange County, CA	28.4	(22.0, 36.1)	63.0	(55.5, 70.5)	22.7	(17.6, 28.8)
Orlando, FL	131.9	(106.1, 162.2)	285.6	(256.1, 315.0)	131.1	(113.3, 148.9)
Philadelphia, PA--NJ	154.7	(142.3, 167.1)	195.0	(186.4, 203.6)	74.2	(68.5, 79.8)
Phoenix--Mesa, AZ	33.7	(25.6, 43.5)	81.1	(71.9, 90.4)	36.3	(31.5, 41.1)
Pittsburgh, PA	43.7	(32.6, 57.3)	73.2	(61.8, 84.6)	14.9	(10.6, 20.3)
Portland--Vancouver, OR--WA	13.6	(9.4, 18.9)	50.2	(43.1, 57.2)	24.4	(19.8, 29.9)
Providence--Fall River--Warwick, RI--MA	151.1	(120.7, 186.8)	189.6	(163.8, 215.4)	27.1	(19.8, 36.3)
Raleigh--Durham--Chapel Hill, NC	74.1	(54.1, 99.2)	145.4	(122.8, 168.1)	56.2	(42.0, 73.7)
Richmond--Petersburg, VA	74.8	(56.6, 96.9)	155.6	(134.4, 176.9)	48.8	(36.8, 63.6)
Riverside--San Bernardino, CA	28.9	(23.2, 34.5)	96.8	(88.2, 105.5)	36.6	(30.4, 42.8)
Rochester, NY	328.9	(277.3, 380.5)	293.3	(258.6, 328.1)	59.9	(47.5, 74.5)
Sacramento, CA	20.1	(14.5, 27.1)	65.2	(56.3, 74.1)	20.2	(15.0, 26.6)
St. Louis, MO--IL	24.0	(16.4, 33.8)	68.0	(57.5, 78.6)	40.1	(31.2, 50.7)

	Pre-cART Era (1993 to 1995)			cART Era (2005 to 2007)		
	Female PWID AIDS Diagnosis Rate per 10,000	Male PWID AIDS Diagnosis Rate per 10,000		Female PWID AIDS Diagnosis Rate per 10,000	Male PWID AIDS Diagnosis Rate per 10,000	
Salt Lake City--Ogden, UT	29.3	(18.4, 44.4)	52.8	(42.2, 65.2)	4.5	(1.8, 9.3)
San Antonio, TX	16.4	(11.1, 23.4)	57.4	(50.0, 64.9)	*	(34.5, 52.9)
San Diego, CA	33.0	(26.7, 40.3)	107.4	(98.3, 116.5)	*	(35.3, 46.6)
San Francisco, CA	75.6	(65.7, 85.6)	264.2	(250.8, 277.7)	*	(61.9, 75.9)
San Jose, CA	21.2	(14.3, 30.3)	53.5	(44.6, 62.5)	*	(31.3, 56.3)
Sarasota--Bradenton, FL	91.2	(61.1, 130.9)	117.0	(89.9, 149.7)	16.3	(8.4, 28.4)
Scranton--Wilkes-Barre--Hazleton, PA	43.8	(17.6, 90.1)	162.0	(123.6, 208.5)	*	(15.4, 70.2)
Seattle--Bellevue--Everett, WA	15.4	(10.9, 21.2)	76.7	(67.8, 85.6)	*	(5.7, 12.6)
Springfield, MA	171.4	(137.8, 210.7)	208.1	(183.4, 232.8)	46.2	(32.4, 64.0)
Stockton--Lodi, CA	17.8	(10.2, 28.9)	40.5	(30.6, 52.6)	*	(1.6, 9.5)
Syracuse, NY	134.5	(89.3, 194.3)	255.9	(213.2, 298.6)	*	(47.5, 134.8)
Tacoma, WA	24.3	(15.0, 37.1)	53.3	(41.1, 67.9)	*	(1.7, 10.2)
Tampa--St. Petersburg--Clearwater, FL	89.1	(73.8, 104.4)	178.2	(161.5, 194.9)	*	(38.5, 56.5)
Toledo, OH	13.8	(3.8, 35.4)	45.5	(27.4, 71.0)	3.1	(0.1, 17.3)
Tucson, AZ	10.1	(5.0, 18.0)	48.7	(39.5, 57.8)	*	(5.9, 17.3)
Tulsa, OK	19.3	(9.2, 35.4)	62.5	(46.4, 82.4)	*	(7.0, 22.6)
Ventura, CA	16.1	(7.7, 29.5)	34.8	(23.6, 49.3)	2.3	(0.1, 12.8)
Washington, DC--MD--VA--WV	224.0	(206.2, 241.8)	337.9	(321.2, 354.5)	*	(89.1, 109.3)
West Palm Beach--Boca Raton, FL	151.9	(124.7, 179.1)	185.0	(162.7, 207.3)	89.0	(63.9, 120.8)
Wichita, KS	37.3	(15.0, 76.9)	118.1	(84.4, 160.8)	*	(3.3, 30.7)
Wilmington--Newark, DE--MD	217.6	(177.1, 258.1)	340.8	(303.9, 377.7)	*	(37.3, 72.3)
Youngstown--Warren, OH	24.9	(6.8, 63.6)	88.7	(54.9, 135.5)	8.8	(2.4, 22.6)

¹ Absolute value of coefficient of variation

² Significance determined by there not being an overlap of 95% CI for AIDS diagnosis rates among females relative to males;

* $p < 0.05$.

Differences in female-to-male incident AIDS diagnosis rate ratios among people who inject drugs, relative differences, and disparity change score over time for 1993–1995 and 2005–2007, by metropolitan statistical area in US

Table 2

	Pre-cART Era (1993 to 1995)		cART Era (2005 to 2007)		Disparity Change Score Over Time
	Female-to-male Rate Ratio	Relative Difference (%)	Female-to-male Rate Ratio	Relative Difference (%)	
Mean (SD)	0.53 (0.22)	-47.14 (21.64)	0.74 (0.39)	-26.38 (38.95)	-0.21 (0.29)
Median (Range)	0.50 (0.08, 1.12)	-49.98 (-92.38, 12.12)	0.67 (0.07, 2.23)	-33.06 (-92.89, 122.58)	-0.18 (-1.33, 0.26)
Coefficient of Variation ¹ %	40.94	45.91	52.91	147.68	141.49
Metropolitan Statistical Area					
Akron, OH	0.49	-50.68	0.59	-40.58	-0.10
Albany--Schenectady--Troy, NY	0.65	-35.35	1.03	3.27	-0.39
Albuquerque, NM	0.10	-90.42	0.33	-67.17	-0.23
Allentown--Bethlehem--Easton, PA	0.92	-8.01	0.78	-22.27	0.14
Ann Arbor, MI	0.22	-77.70	0.40	-60.22	-0.17
Atlanta, GA	0.50	-49.91	0.88	-12.03	-0.38
Austin--San Marcos, TX	0.67	-33.13	0.60	-40.03	0.07
Bakersfield, CA	0.08	-92.38	0.07	-92.89	0.01
Baltimore, MD	0.63	-36.98	0.83	-17.30	-0.20
Bergen--Passaic, NJ	0.82	-17.93	1.07	6.53	-0.25
Birmingham, AL	0.64	-36.42	0.44	-56.18	0.20
Boston, MA--NH	0.68	-32.38	1.08	8.49	-0.41
Buffalo--Niagara Falls, NY	0.55	-45.19	1.21	20.51	-0.66
Charleston--North Charleston, SC	0.49	-51.08	0.96	-4.27	-0.47
Charlotte--Gastonia--Rock Hill, NC--SC	0.35	-64.62	0.91	-8.74	-0.56
Chicago, IL	0.71	-29.42	0.61	-39.05	0.10
Cincinnati, OH--KY--IN	0.42	-57.57	0.63	-37.34	-0.20
Cleveland--Lorain--Elyria, OH	0.59	-41.27	0.73	-26.71	-0.15
Columbus, OH	0.20	-79.87	0.48	-52.19	-0.28

	Pre-cART Era (1993 to 1995)		cART Era (2005 to 2007)		Disparity Change Score Over Time
	Female-to-male Rate Ratio	Relative Difference (%)	Female-to-male Rate Ratio	Relative Difference (%)	
Dallas, TX	0.33	-66.78	0.58	-41.97	-0.25
Dayton--Springfield, OH	0.46	-54.00	0.27	-73.41	0.19
Denver, CO	0.36	-63.78	0.59	-41.49	-0.22
Detroit, MI	0.77	-23.23	0.84	-15.54	-0.08
El Paso, TX	0.40	-59.72	0.25	-74.84	0.15
Fort Lauderdale, FL	0.90	-10.07	1.00	-0.26	-0.10
Fort Worth--Arlington, TX	0.52	-47.67	0.78	-21.99	-0.26
Fresno, CA	0.63	-36.80	0.96	-3.94	-0.33
Gary, IN	0.53	-47.01	1.01	1.16	-0.48
Grand Rapids--Muskegon--Holland, MI	0.82	-18.11	0.72	-27.97	0.10
Greensboro--Winston-Salem--High Point, NC	0.46	-54.38	0.98	-2.22	-0.52
Greenville--Spartanburg--Anderson, SC	0.47	-52.77	0.74	-25.89	-0.27
Harrisburg--Lebanon--Carlisle, PA	0.71	-28.68	0.61	-39.42	0.11
Hartford, CT	0.85	-15.27	1.30	29.59	-0.45
Honolulu, HI	0.51	-49.22	1.05	5.00	-0.54
Houston, TX	0.51	-48.96	1.61	61.40	-1.10
Indianapolis, IN	0.42	-57.92	0.60	-40.04	-0.18
Jacksonville, FL	0.52	-48.45	0.47	-53.45	0.05
Jersey City, NJ	0.81	-19.32	1.16	15.59	-0.35
Kansas City, MO--KS	0.22	-77.67	0.25	-74.92	-0.03
Knoxville, TN	0.34	-66.04	0.40	-60.15	-0.06
Las Vegas, NV--AZ	0.45	-55.28	0.62	-38.17	-0.17
Little Rock--North Little Rock, AR	0.60	-40.32	0.45	-54.78	0.15
Los Angeles--Long Beach, CA	0.39	-60.81	0.65	-35.38	-0.25
Louisville, KY--IN	0.28	-72.33	1.03	3.35	-0.76
Memphis, TN--AR--MS	0.50	-50.29	0.77	-22.60	-0.28
Miami, FL	0.81	-18.51	0.86	-13.98	-0.05

	Pre-cART Era (1993 to 1995)		cART Era (2005 to 2007)		Disparity Change Score Over Time
	Female-to-male Rate Ratio	Relative Difference (%)	Female-to-male Rate Ratio	Relative Difference (%)	
Middlesex--Somerset--Hunterdon, NJ	0.92	-8.41	1.00	0.22	-0.09
Milwaukee--Waukesha, WI	0.88	-11.94	1.32	32.08	-0.44
Minneapolis--St. Paul, MN--WI	0.43	-56.71	0.89	-11.47	-0.45
Monmouth--Ocean, NJ	0.68	-31.64	0.73	-26.70	-0.05
Nashville, TN	0.42	-57.50	1.03	3.38	-0.61
Nassau--Suffolk, NY	0.84	-15.51	1.28	28.25	-0.44
New Haven--Meriden, CT	0.86	-14.24	0.92	-7.73	-0.07
New Orleans, LA	0.59	-41.49	0.82	-17.95	-0.24
New York, NY	0.89	-11.35	2.23	122.58	-1.34
Newark, NJ	0.87	-13.24	1.14	14.25	-0.27
Norfolk--Virginia Beach--Newport News, VA--NC	0.46	-54.45	0.63	-36.63	-0.18
Oakland, CA	0.59	-41.27	0.58	-41.77	0.01
Oklahoma City, OK	0.33	-67.22	0.20	-79.60	0.12
Omaha, NE--IA	0.52	-47.62	1.07	6.61	-0.54
Orange County, CA	0.45	-54.89	0.64	-36.21	-0.19
Orlando, FL	0.46	-53.79	0.50	-49.94	-0.04
Philadelphia, PA--NJ	0.79	-20.64	0.80	-19.92	-0.01
Phoenix--Mesa, AZ	0.42	-58.49	0.66	-33.89	-0.25
Pittsburgh, PA	0.60	-40.28	0.62	-38.35	-0.02
Portland--Vancouver, OR--WA	0.27	-72.99	0.20	-80.39	0.07
Providence--Fall River--Warwick, RI--MA	0.80	-20.33	1.59	59.23	-0.80
Raleigh--Durham--Chapel Hill, NC	0.51	-49.03	1.31	31.44	-0.80
Richmond--Petersburg, VA	0.48	-51.96	0.64	-35.60	-0.16
Riverside--San Bernardino, CA	0.30	-70.18	0.52	-48.36	-0.22
Rochester, NY	1.12	12.12	1.57	56.75	-0.45
Sacramento, CA	0.31	-69.24	0.46	-54.00	-0.15
St. Louis, MO--IL	0.35	-64.77	0.63	-37.49	-0.27

	Pre-cART Era (1993 to 1995)		cART Era (2005 to 2007)		Disparity Change Score Over Time
	Female-to-male Rate Ratio	Relative Difference (%)	Female-to-male Rate Ratio	Relative Difference (%)	
Salt Lake City--Ogden, UT	0.56	-44.43	0.32	-67.98	0.24
San Antonio, TX	0.29	-71.46	0.39	-61.26	-0.10
San Diego, CA	0.31	-69.29	0.23	-76.54	0.07
San Francisco, CA	0.29	-71.38	0.39	-61.37	-0.10
San Jose, CA	0.40	-60.37	0.23	-76.90	0.17
Sarasota--Bradenton, FL	0.78	-22.06	0.69	-30.72	0.09
Scranton--Wilkes-Barre--Hazleton, PA	0.27	-72.99	0.67	-32.81	-0.40
Seattle--Bellevue--Everett, WA	0.20	-79.86	0.32	-67.71	-0.12
Springfield, MA	0.82	-17.65	1.69	68.58	-0.86
Stockton--Lodi, CA	0.44	-56.12	0.24	-75.97	0.20
Syracuse, NY	0.53	-47.47	0.99	-0.69	-0.47
Tacoma, WA	0.46	-54.44	0.19	-80.62	0.26
Tampa--St. Petersburg--Clearwater, FL	0.50	-49.98	0.67	-33.06	-0.17
Toledo, OH	0.30	-69.60	0.13	-87.40	0.18
Tucson, AZ	0.21	-79.37	0.63	-37.42	-0.42
Tulsa, OK	0.31	-69.16	0.30	-70.00	0.01
Ventura, CA	0.46	-53.82	0.34	-66.00	0.12
Washington, DC--MD--VA--WV	0.66	-33.71	0.93	-6.71	-0.27
West Palm Beach--Boca Raton, FL	0.82	-17.87	1.06	6.00	-0.24
Wichita, KS	0.32	-68.42	0.24	-75.80	0.07
Wilmington--Newark, DE--MD	0.64	-36.15	0.83	-17.37	-0.19
Youngstown--Warren, OH	0.28	-71.98	0.32	-68.36	-0.04

¹ Absolute value of coefficient of variation

Table 3

Regional differences in incident AIDS diagnosis rates per 10,000 people who inject drugs (PWID), by sex, and ratio of female-to-male diagnosis rates for 1993–1995 and 2005–2007 in US

Region	Pre-cART era (1993 to 1995)				cART era (2005 to 2007)			Disparity Change Score Over Time
	Female PWID AIDS Diagnosis Rate per 10,000	Male PWID AIDS Diagnosis Rate per 10,000	Female-to-male Rate Ratio		Female PWID AIDS Diagnosis Rate per 10,000	Male PWID AIDS Diagnosis Rate per 10,000	Mean Female-to-male Rate Ratio	
Northeast (n=21)	238.8	299.5	0.76		74.9	64.1	1.12	-0.36
Midwest (n=20)	44.8	90.7	0.46		22.9	38.3	0.64	-0.18
South (n=32)	104.1	178.6	0.53		54.1	70.5	0.74	-0.21
West (n=22)	26.8	75.8	0.37		13.1	29.3	0.46	-0.09