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Heterosexual male and female disparities in HIV infection at the end of an epidemic: HIV infection among persons who inject drugs in New York City, 2001–2005 and 2011–2015

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Abstract

Background: We examined whether sex disparities (heterosexual male:female) in HIV infection continue to persist at the “end of the HIV epidemic” among persons who inject drugs (PWID) in New York City (NYC). An “end of the epidemic” was operationally defined as 1) prevalence of untreated HIV infection < 5%, and 2) estimated HIV incidence < 0.5/100 person-years.

Methods: PWID were recruited from persons entering substance use treatment programs at Mount Sinai Beth Israel in 2001–2005 and 2011–2015. A structured interview was administered, and HIV and HSV-2 testing was conducted. Incidence was estimated using newly diagnosed cases of HIV. Disparity analyses compared prevalence of HIV, of untreated HIV, HIV risk behaviors, and estimated HIV incidence.

Results: By 2011–2015, both heterosexual male and female PWID met the two criteria for an “end of the epidemic,” and there were no significant differences in the prevalence of untreated HIV infection. A large sex difference remained in estimated HIV incidence. In 2013–2015, estimated HIV incidence was 2.8/10,000 PY for males and 7.1/10,000 PY for females. Females had greater risk for HIV on several factors.

Conclusion: While NYC has reached an “end of the epidemic” for both heterosexual male and female PWID, sex disparities persist, particularly differences in HIV incidence. Eliminating the sex disparities may require a greater focus on factors associated with sexual transmission.

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Contributors

Don Des Jarlais conceived the study; Courtney McKnight managed data collection; Kamyar Arasteh performed statistical analysis; Jonathan Feelemyer assisted in data analysis and final editing of manuscript; Hannah Cooper, David Perlman, Susan Tross, Aimee Campbell worked with the data and analysis and contributed to the writing and editing of the manuscript. All authors reviewed the full study and results prior to submission to the journal.

Conflict of interest

No conflict of interest declared.

Keywords

Injection drug use; Sex/Gender disparities; HIV; New York city

1. Introduction

Sex differences in HIV infection among persons who inject drugs (PWID) have been observed in many different countries. There are geographic areas without significant differences in HIV prevalence among male and female PWID, but where in the areas in which differences have been observed, the direction has almost always been that of female PWID having higher HIV prevalence than male PWID. In an international systematic review and meta-analysis of female/male differences in HIV prevalence, the weighted summary odds ratio showed a significant difference, with females having an average 18% higher odds of being HIV seropositive (Des Jarlais et al., 2012a).

There are multiple mechanisms that may place female PWID at higher risk for HIV infection compared to male PWID. Female PWID may face greater stigmatization than male PWID and thus have greater difficulties in obtaining sterile injection equipment (UNODC, 2006). Females may have less interpersonal power than male PWID and may not be able to refuse engaging in risk behavior, particularly engaging in unsafe sex (Auerbach and Smith, 2015; Blankenship et al., 2015). Females are also more biologically susceptible than males to sexual transmission of HIV (Boily et al., 2009). The prevalence of herpes simplex virus II (HSV-2) is generally higher among females than males, and HSV-2 infection facilitates HIV acquisition (Barnabas and Celum, 2012). (Additional mechanisms that may generate female/male disparities are considered in more detail in the Discussion below.)

Larger female/male disparities have usually been noted in later stages of HIV epidemics among PWID, after reductions in injecting risk behavior have reduced injecting-related transmission and sexual transmission becomes relatively more important (Des Jarlais et al., 2012b). This would support a prediction that the relative disparities between male and female PWID are likely to persist or even increase over time in a local HIV epidemic.

Reducing HIV transmission among PWID has been one of the notable successes in HIV prevention in many high-income settings (Des Jarlais et al., 2016b). Estimated HIV incidence among PWID in the US fell by approximately 80% from 1996 through 2011 (Hall et al., 2008) and there was an additional 83% reduction in newly diagnosed cases of HIV among PWID between 2005 and 2014 (Prevention, 2016). These reductions are generally attributed to full implementation of “combined prevention and care,” including syringe service programs, medication-assisted treatment for substance use disorders, and antiretroviral treatment for HIV infection (Des Jarlais et al., 2016b). The large reduction in HIV transmission among PWID over the last several decades would support a prediction that male/female disparities in HIV infection among PWID can eventually be greatly reduced or even eliminated.

We thus see two contrasting hypotheses regarding the persistence of sex disparities over time:

1. As injecting-related HIV transmission is reduced over the course of an HIV epidemic among PWID, sexual transmission becomes relatively more important, and sex disparities persist or even become more pronounced.
2. With commitment from public health authorities and community-based organizations, it should be possible to provide equally effective prevention and care services to female and male PWID so that disparities are eliminated over time.

The “end of the epidemic” (New York State Department of Health, 2015) does not mean a total absence of HIV infection among PWID—to our knowledge HIV has not yet been eliminated in any large, diverse population of PWID. Rather an “end of the epidemic” occurs when a stable, “endemic” state of low HIV prevalence with “close to zero” new HIV infections has been achieved. Based on studies of cities where HIV was introduced into the PWID population but HIV prevalence remained at very low levels (Des Jarlais et al., 1995) and studies of large reductions in HIV transmission in high prevalence settings, (Des Jarlais et al., 2016b) we have proposed the following as an operational definition of an “end to an HIV epidemic” among PWID (Des Jarlais et al., 2018 Des Jarlais et al., 2018 in press):

1. The prevalence of untreated HIV infection (HIV seropositives not receiving antiretroviral treatment) is 5% or less.
2. HIV incidence is 0.50/100 (50/10,000) person-years (PY) or less.

In this paper we examine current differences in HIV prevalence by sex (female versus heterosexual male) among PWID in New York City. With over 60,000 cases of AIDS among PWID, New York City has experienced the largest HIV epidemic among PWID of any city in the world. Male/female disparities were noted early as 1984, with prevalence among males at 48% compared to 58% HIV prevalence among females (Marmor et al., 1987). With implementation of full “combined prevention and care,” including treatment as prevention, HIV incidence among PWID in New York City has now fallen to 0.1/100 PY at risk (Des Jarlais et al., 2016a). Given this decrease, we are examining sex disparities in HIV infection at what may be termed the “end of the HIV epidemic” among PWID in New York City. We also explore differences in risk behavior and in HSV-2 infection as possible causal factors in disparities.

2. Materials and methods

The data presented here were collected as part of a long-running research study of persons entering Mount Sinai Beth Israel drug detoxification and methadone maintenance programs in New York City. The methods for this “Risk Factors” study have been previously described (Des Jarlais et al., 2009; Des Jarlais et al., 1989) so only a summary will be presented here. The programs serve New York City as a whole and there were no changes in the requirements for entrance into the program over the study period.

In the detoxification program, research staff visited the general admission wards of the program in a preset order and examined all intake records of a specific ward to construct lists of patients admitted within the prior 3 days. All of the patients on the list for the

specific ward were asked to participate in the study. As there was no relationship between the assignment of patients to wards and the order that the staff rotated through the wards, these procedures should produce an unbiased sample of persons entering the detoxification program. In the methadone program, newly admitted patients (those admitted in the previous month) were asked to participate in the research.

Participants were paid \$20 for their time and effort. In both programs, approximately 95% of those asked agreed to participate. Common reasons for non-participation included medical appointments or other scheduled activities that would not permit completion of study in a single visit.

Written informed consent was obtained and a trained interviewer administered a computer-assisted structured questionnaire covering demographics, drug use, risk behavior, and use of HIV prevention services. Participants were also asked if they had previously been tested for HIV and the results of their most recent test. Over 98% of the participants in these analyses reported that they had been previously tested for HIV. Those who replied that they had tested HIV seropositive were then asked if they had received antiretroviral treatment (ART) in the 6 months prior to the interview. In examining the percentage of HIV seropositive PWID who were/were not receiving ART, we used the numbers of PWID who tested positive for HIV in the study, and not the numbers who self-reported being HIV seropositive. There were a modest (5%) percentage of participants who tested HIV positive but did not report being HIV positive. We believe that the majority of these did not report being seropositive because of concerns over possible stigmatization.

Participants were seen by counselors for HIV pretest counseling and serum collection. HIV testing was conducted at the NYC Department of Health Laboratory using a commercial, enzyme-linked, immunosorbent assays (EIA) test with Western blot confirmation (BioRad Genetic Systems HIV-1-2 + 0 EIA and HIV-1 Western Blot, BioRad Laboratories, Hercules, CA). HSV-2 testing was conducted for all subjects beginning in 2005 and was performed by BioReference Laboratories using the Focus HerpeSelect 1 and 2 ELISA. We used an index value of 1.1 or greater for classifying a subject as HSV-2 seropositive.

For the analyses presented here, only persons who reported having injected drugs in the 6 months prior to program entry are included. Males who reported male-with-male sexual behavior in the previous five years were excluded from these analyses (a separate paper will be prepared for this group). The number of participants who reported “transgender” was too small for statistical analyses, and they are also not included. In this paper, we compare HIV infection and risk behavior among female and heterosexual male PWID from 2001 to 2005 to 2011–2015. These two periods coincide with a marked reduction in HIV incidence among PWID in New York City, from 0.8/100 PY in 1999–2002 (Des Jarlais et al., 2005) to 0.1/100 PY in 2011–2014, (Des Jarlais et al., 2016a) and permit us to assess whether sex disparities changed over these two time periods.

Subjects were permitted to participate on multiple occasions, though only once per calendar year. For trend analyses, we included persons who participated in different years in the data for each year, as these subjects were part of the population of interest (persons entering

Mount Sinai Beth Israel drug treatment programs in each year). The numbers of repeat participants were small—approximately 5%—and results after removing later interviews from repeat subjects were nearly identical (1% difference in absolute values, identical patterns of statistical significance).

We used chi-square tests and Fisher's exact tests for categorical variables and *t*-tests for continuous variables. We used multivariable logistic modeling, controlling for age, sex, recruitment site and race/ ethnicity, to assess whether the sex disparities were statistically significant after controlling for other participant characteristics. (We did not control for recent HIV risk behaviors in these models because of the likelihood that HIV seropositives knew their status and had reduced their risk behaviors to avoid transmitting HIV to partners) (Eaton and Kalichman, 2009).

We also used New York City Department of Health and Mental Hygiene (NYCDOHMH) surveillance data on newly diagnosed cases of HIV among PWID as an estimate of HIV incidence among PWID in New York City (Hygiene, 2014). In New York City cases of newly diagnosed HIV infection among PWID are consistent with other measures of HIV incidence (Des Jarlais et al., 2016a). These newly identified cases are based on exact counts of cases identified by laboratories and are a census rather than a sample, so that statistical testing based on sampling error is not appropriate.

Stata software (STATA Corp, 2012) was used for statistical analyses. The study was approved by the Mount Sinai Beth Israel Institutional Review Board.

3. Results

3.1. Demographic characteristics, drug use and HIV seroprevalence

Tables 1a and 1b present data on the demographic characteristics, injecting drug use behaviors and HIV serostatus by sex for participants in the Risk Factors study during the 2001–2005 and 2011–2015 time periods. In both time periods, a majority of participants were racial/ ethnic minority group members, male, injected heroin, and injected daily or more frequently. In 2001–2005, there was a significant race/ethnicity difference, with males more likely to be Latino/a compared to females, and females more likely to be white compared to males. Males were more likely to be over 40 compared to females and were more likely to inject heroin and cocaine together (“speedball”). HIV prevalence in 2001–2005 was 12.9% among male PWID and 15.3% among female PWID.

Across the two time periods, there was a significant change in the racial/ethnic distributions of male PWID, with a decline in the percentage of males who were White and an increase in the percentage who were Latino. HIV prevalence declined significantly among males (from 12.9% to 5.4%) and females (from 15.3% to 7.6%). In 2011–2015, there again was a significant difference in age, with the males again more likely to be > 40 years of age. The difference in HIV prevalence (5.4% for males and 7.6% for females) in 2011–2015 was not statistically significant.

Table 2 presents results of the multivariable models controlling for age and race/ethnicity. The adjusted odds ratios (AORs) for the likelihood of prevalent HIV infection among female versus male PWID were significant in both time periods. These AORs increased slightly but not significantly from 2001 to 2005 to 2011–2015. The AOR for 2011–2015 versus 2001–2005 was significant in the model combining data from the two time periods AOR = 0.3, 95% CI 0.2–0.4).

3.2. Potential causative factors: risk behaviors and HSV-2 infection

Higher rates of risk behavior are one plausible explanation for differences in HIV infection by sex. Table 3 presents injecting and sexual risk behaviors for acquiring HIV among HIV seronegative subjects in 2001–2005 and 2011–2015. There are a number of statistically significant differences, which suggest higher rates of risk behavior among females. Females reported higher rates of “receptive sharing” (injecting with a needle or syringe that had previously been used by someone else) in both time periods. Males and females reported high rates of unsafe sex with primary partners in both time periods, with females reporting higher rates in both periods. Female PWID showed increases in the percentages reporting unsafe sex with casual partners over the two time periods.

HSV-2 prevalence among HIV negative participants was 31% among males and 64% among females (chi square = 54.4, $p < 0.001$), indicating a greater biological risk for acquiring HIV among females.

3.3. Receipt antiretroviral treatment (ART)

HIV prevalence may no longer be a good measure of sex disparities in an era of high ART coverage. ART reduces death and disability related to HIV infection and may thus extend historical differences in HIV prevalence.

Table 4a presents the percentages of HIV seropositive participants who reported receiving ART in the 6 months prior to interview among those who reported that they had previously tested positive for HIV. There were no significant differences within either time period or across time periods for either sex. There was a significant increase in the percentage of all HIV seropositives on ART, from 53/86 (62%) in 2001–2005 to 31/38 (82%) in 2011–2015 ($p < 0.05$ by Fisher’s exact test).

Table 4b shows the prevalence of untreated HIV infection (HIV seropositive persons not on ART) by sex in the two time periods. There were significant differences in the prevalence of untreated HIV infection among male and female PWID in the 2001–2005 period, significant declines among both male and female PWID over the two time periods, and no significant difference by sex in the 2011–2015 period. The prevalence of untreated HIV infection among both male and female PWID was nearly identical in the 2011–2015 period.

3.4. Estimated HIV incidence

Table 5 presents newly diagnosed cases of HIV among heterosexual male and female PWID in New York City for 2001–2005 and for 2011–2015. These cases do not include males who reported male-with-male sexual behavior in addition to injecting drug use. (Data provided by

Rebekkah Robbins of NYCDOHMH HIV Surveillance Unit, December 14, 2016.) There was a very marked reduction—three quarters or more—in the numbers of newly identified cases of HIV among both the males and the females. The decline in numbers of newly identified cases may be ending, however, as the total cases were 41, 42, and 39 for 2013–2015. There was a modest but statistically significant increase in the percentage of females among the newly identified cases of HIV infection among PWID in the city (Chi-square for trend = 5.4 (df = 1), $p < 0.05$)

To estimate incidence rates, we estimated denominators for the newly identified cases of HIV among male and female PWID based on an estimated 100,000 PWID in New York City and a distribution of 75% heterosexual males and 20% females (Tempalski et al., 2013). This yielded estimated incidence rates of 2.8/10,000 PY (0.028/100 PY) for males and 7.1/10,000 PY (0.078/100 PY) for females for 2013–2015, when an apparent leveling occurred. The estimated incidence rate for females is more than twice that of the estimated incidence for heterosexual males, but both are well under the “ending the epidemic” criterion of 0.5/100 PY (50/10,000 PY).

4. Discussion

First, we should note that the data from this study indicate that both heterosexual male and female PWID in New York City currently meet our criteria for “ending an HIV epidemic” among PWID—prevalence of untreated HIV infection of 5% or less and incidence of HIV of 0.5/100 PY or less. This should be considered a major public health achievement in New York City.

Transitions from opioid analgesic drug use to heroin injecting are occurring in New York City, as in other locations in the US, so that it will be vitally important to continue HIV prevention and care efforts in order to maintain the “end of the HIV epidemic.”

There are mixed results regarding the persistence of sex disparities in HIV infection among PWID in New York City. There is support for the hypothesis that provision of combined prevention and care can reduce or even eliminate some sex disparities. A particularly important reduction in disparities occurred in the prevalence of untreated HIV infection, where the reductions were approximately 75% in each group and there were no statistically significant differences in the 2011–2015 period.

We also found evidence for the hypothesis of persistence of sex disparities. The most important continued sex disparity would be in the estimated HIV incidence between the heterosexual male PWID and the female PWID for 2013–2015, where the estimated incidence for female PWID (7.1/10,000 PY) was more than twice that for heterosexual male PWID (2.8/10,000 PY).

As noted above, there are multiple factors that might create greater vulnerability to HIV infection among female PWID compared to heterosexual male PWID. Table 6 provides examples of potential factors operating at different levels of analysis. These factors are not mutually exclusive; indeed, it is highly likely that multiple factors are operating simultaneously in any epidemiological situation with persistent male:female disparities in

HIV infection. We suspect that over the forty-year history of the HIV epidemic among PWID in New York City, all of these factors have been operating.

While there were sex differences in both injecting and sexual risk behavior in 2011–2015 among our participants, in our assessment, the current sex disparities are most likely the result of differences in sexual transmission of HIV. First, we would note that analyses of HIV, HCV and HSV-2 infection among PWID in New York City (Des Jarlais et al., 2011) and mathematical modeling of HIV among PWID in New York City indicate that approximately two thirds of recent HIV infections are due to sexual transmission. Second, female PWID are biologically more susceptible to HIV and in our studies, were more than twice as likely to have HSV-2 infection than heterosexual male PWID, which greatly increases susceptibility to HIV. Third, hepatitis C virus is transmitted almost exclusively through multi-person use of injection equipment and there is no difference in HCV prevalence in our sample (66% among males, 64% among females, (Des Jarlais et al., 2018, in press). If injection risk behavior was generating the sex difference in HIV incidence, then one would expect to see a very substantial difference in HCV prevalence by gender, with odds ratios similar to those for HIV prevalence.

Potential interventions to reduce the disparities—particularly the disparity in estimated HIV incidence—could include intensification of the New York City Condom distribution program (Des Jarlais et al., 2014), further expansion of ART treatment as prevention—achieving the 90–90–90 goals (Xia et al., 2016), couples HIV counseling (El-Bassel et al., 2011) for sexual partnerships that include one or both persons who inject, and pre-exposure prophylaxis. Utilizing multiple interventions would probably be most effective, but we need to acknowledge that with the present small numbers of newly diagnosed HIV infections among PWID (approximately 40 per year), successfully identifying PWID at highest risk could be difficult. Using HSV-2 seropositive status as an indicator of high risk for sexual transmission might be helpful for focusing interventions.

It is also important to consider a broad perspective on Table 6 factors that may generate female/male disparities in HIV infection among PWID. Factors such as interpersonal violence are likely to be causing many harms to female PWID that are at least as important as the current disparity in HIV infection among PWID in our study. Programs to reduce the factors noted in Table 6 would be fully justifiable from a public health and human rights perspective in the absence of any disparities in HIV infection.

4.1. Limitations

Several limitations of this study should be noted. All of the participants in the study were recruited from a single set of drug treatment programs. Previous comparisons to participants recruited from community sites and other drug treatment programs have, however, shown great consistency in absolute values and in trends between the data from Mount Sinai Beth Israel treatment programs and the data from the other recruitment sites (Des Jarlais et al., 2000a; Des Jarlais et al., 2000b; Des Jarlais et al., 1998) (Shah et al., 2013; Turner et al., 2013). In particular, there has been great consistency in the estimated HIV incidence rates for PWID between the Risk Factors data and New York City and New York State HIV data (Des Jarlais et al., 2016a).

We do not have data on the time of HIV infection or risk behavior at the time of HIV infection for our HIV seropositive participants, so that we cannot identify the risk behaviors that actually led to transmission, but have to infer the likelihood of injecting versus sexual transmission from the patterns in HCV and HSV-2 infection.

The data on risk behavior was obtained from self-reports and is subject to social desirability bias. Multiple reviews of the problem of social desirability bias among PWID, however, indicate that self-report data are suitable for research purposes (Latkin et al., 1993; Needle et al., 1995).

It would seem extremely unlikely that the patterns in the data collected from PWID entering the Mount Sinai Beth Israel drug treatment programs and the data from NYCDOHMH HIV surveillance arose from the limitations of the study, rather it would appear that these patterns reflect existing trends in HIV infection among PWID in the New York City.

5. Conclusions

Ending HIV epidemics in key populations and reducing sex disparities in HIV infection in key populations are two critical public health goals for the US and many other countries. New York City has experienced the largest HIV epidemic among PWID of any city in the world and the epidemic included substantial sex disparities. New York City has also effectively implemented “combined prevention and care for HIV among PWID.” These interventions have led to the “end of the epidemic” among both heterosexual male and female PWID, but have not eliminated the persistent sex disparities, particularly in estimated HIV incidence. Eliminating these disparities may require additional efforts to reduce sexual transmission of HIV among PWID.

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Table 1a

Demographics, drug use characteristics, and HIV infection by gender in the 2001–2005 period among persons who inject drugs entering drug treatment program in New York City.

	Male		Female		Total	
	N	%	N	%	N	%
Total	1438	100.0	360	100.0	1798	100.0
Race/Ethnicity ^{#I *M}						
White	367	25.5	144	40.0	511	28.4
Black	231	16.1	61	16.9	292	16.2
Latino/a	840	58.4	155	43.1	995	55.3
Age ^{#I *M}						
< 40	819	57.0	239	66.4	1058	58.8
> = 40	619	43.0	121	33.6	740	41.2
Injected Heroin ^{#I *M}						
No	127	8.8	13	3.6	140	7.8
Yes	1310	91.2	347	96.4	1657	92.2
Injected Cocaine ^{*M}						
No	933	64.9	238	66.1	1171	65.1
Yes	505	35.1	122	33.9	627	34.9
Injected Speedball ^{#I *M}						
No	783	54.5	223	61.9	1006	56.0
Yes	655	45.5	137	38.1	792	44.0
Daily injection ^{*M}						
No	288	20.0	68	18.9	356	19.8
Yes	1149	80.0	292	81.1	1441	80.2
HIV Serostatus ^{*M *F}						
Negative	1253	87.1	305	84.7	1558	86.7
Positive	185	12.9	55	15.3	240	13.3

^{#I} Within time period 1 (2001–2005): Significant difference ($p < 0.05$) by chi-square test.

^{*M} Across time periods among males: Significant difference ($p < 0.05$) by chi-square test.

^{*F} Across time periods among females: Significant difference ($p < 0.05$) by chi-square test.

Table 1b

Demographics, drug use characteristics, and HIV infection by gender in the 2011–2015 period among persons who inject drugs entering drug treatment program in New York City.

	<u>Male</u>		<u>Female</u>		<u>Total</u>	
	N	%	N	%	N	%
Total	772	100.0	144	100.0	916	100.0
Race/ethnicity						
White	260	33.7	62	43.1	322	35.2
Black	133	17.2	24	16.7	157	17.1
Latino/a	379	49.1	58	40.3	437	47.7
Age ^{#2}						
< 40	338	43.8	84	58.3	422	46.1
> = 40	434	56.2	60	41.7	494	53.9
Injected Heroin						
No	29	3.8	7	4.9	36	3.9
Yes	742	96.2	137	95.1	879	96.1
Injected Cocaine						
No	446	57.8	92	63.9	538	58.8
Yes	325	42.2	52	36.1	377	41.2
Injected Speedball ^{#2}						
No	455	58.9	100	69.4	555	60.6
Yes	317	41.1	44	30.6	361	39.4
Daily Injection						
No	213	27.6	34	23.6	247	27.0
Yes	559	72.4	110	76.4	669	73.0
HIV Serostatus						
Negative	730	94.6	133	92.4	863	94.2
Positive	42	5.4	11	7.6	53	5.8

^{#2} Within time period 2 (2011–2015); Significant difference ($p < 0.05$) by chi-square test.

Logistic regression models for HIV prevalence in 2001–2005 and 2011–2015 time periods and the combined time periods among persons who inject drugs entering drug treatment program in New York City*.

Table 2

Time period	2001–2005			2011–2015			Combined time periods		
	AOR	95% CI	p	AOR	95% CI	p	AOR	95% CI	p
Time period									
2001–2005	–	–	–	–	–	–	1.0	–	–
2011–2015	–	–	–	–	–	–	0.3	0.2–0.4	0.000
Sex									
Male	Ref.			Ref			Ref.		
Female	1.5	1.1–2.1	0.025	2.0	1.0–4.2	0.062	1.6	1.1–2.1	0.005

* Controlling for age, race/ethnicity and recruitment site

Table 3

Risk behaviors for acquiring HIV among HIV seronegative persons who inject drugs entering New York City drug treatment programs, 2001–2005 and 2011–2015.

Time period	2001–2005				2011–2015			
	Male		Female		Male		Female	
	N	%	N	%	N	%	N	%
Total	1437	100.0	360	100.0	772	100.0	144	100.0
Receptive sharing ^{#1#2*M#3}	334	23.2	106	29.4	133	17.2	38	26.4
Unsafe sex w/primary partner ^{#1#2#4}	546	38.0	171	47.5	324	42.0	78	54.2
Unsafe sex w/casual partner ^{#1#2*F#5}	201	14.0	11	3.1	133	17.2	12	8.3

^{#1} Within time period 1 (2001–2005): Significant difference ($p < 0.05$) by chi-square test.

^{#2} Within time period 2 (2011–2015): Significant difference ($p < 0.05$) by chi-square test.

^{*M} Across time periods among males: Significant difference ($p < 0.05$) by chi-square test.

^{*F} Across time periods among females: Significant difference ($p < 0.05$) by chi-square test.

^{#3} Defined as receiving a used needle from another injector.

^{#4} Defined as sex without condom with primary partner.

^{#5} Defined as sex without condom with casual partner.

Table 4a

Receiving Antiretroviral therapy in the prior 6 months in 2001–2005 and 2011–2015 time periods among HIV positive persons who inject drugs entering drug treatment program in New York City.

Time period	2001–2005				2011–2015			
	Male		Female		Male		Female	
	N	%	N	%	N	%	N	%
Total	70	100.0	16	100.0	31	100.0	7	100.0
Received Antiretroviral therapy	42	60.0	11	68.8	25	80.6	6	85.7

Seropositive and not Receiving Antiretroviral therapy in the 6 months prior to the interview among persons who inject drugs entering drug treatment program in New York City.

Table 4b

Time period	2001–2005				2011–2015			
	Men who have sex with men		Female		Heterosexual Male		Female	
	N	%	N	%	N	%	N	%
Total	1439	100	360	100	772	100	144	100
No Antiretroviral therapy ^{*M#F}	143	9.9	44	12.2	17	2.2	5	3.5

^{*M} Across time periods among het-male; Significant difference ($p < 0.05$) by chi-square test.

^{*F} Across time periods among females; Significant difference ($p < 0.05$) by chi-square test.

Table 5

New identified cases of HIV infection among persons with histories of injecting drug use by year for gender, New York City, 2001–2005 and 2011–2015.

Year	Total Cases	Male		Female	
		N	%	N	%
2001	766	525	68.5	241	31.5
2002	507	346	68.2	161	31.8
2003	373	266	71.3	107	28.7
2004	345	218	63.2	127	36.8
2005	283	197	69.6	86	30.4
2011 ^a	75	48	64.0	26	34.7
2012 ^a	70	46	65.7	23	32.9
2013 ^a	41	21	51.2	16	39.0
2014 ^a	42	18	42.9	20	47.6
2015 ^a	39	25	64.1	14	35.9

^aPercentages for males and females may not add up to 100% due to MSM-PWID cases not included in gender total columns for 2011–2015.

Table 6

Factors generating increased vulnerability to HIV infection among females who inject drugs.

Social/Structural Factors	Access to services factors	Interpersonal factors	Biological factors
1. Female gender roles, submissiveness, taking care of others before taking care of self (Blankenship et al., 2015)	1. Institutional sexism in service organizations (Larney et al. (2015); Malinowska-Sempruch, (2015))	1. Greater male power in safe versus unsafe sex decisions (Auerbach and Smith (2015); Blankenship et al. (2015); Malinowska-Sempruch (2015); Wechsberg et al. (2015))	1. General increased susceptibility to sexually transmitted infection (Iversen et al. (2015); Page et al. (2015))
2. Reinforcing multiple stigmatizations of substance use and HIV infection (Deshko (2015)) (Larney et al. (2015))	2. Lack of specialized services for females (Malinowska-Sempruch (2015))	2. Males injecting first, females injecting later in group injection settings (Blankenship et al. (2015))	2. Higher prevalence of herpes simplex virus II, which increases susceptibility to HIV (Freeman et al. (2006))
3. High level of sex work involvement compared to males, elevated risk of sexually transmitted HIV infection (Deshko (2015))	3. Child care responsibilities (Blankenship et al. (2015); Deshko (2015))	3. Violence in relationships (Auerbach and Smith (2015); Blankenship et al. (2015)) (Deshko (2015); Wechsberg et al. (2015))	
	4. Low levels of access to medicated assisted treatment (MAT) and pre-exposure prophylaxis (PrEP) services (Page et al. (2015); Springer et al. (2015))		