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Prevalence of HIV Infection and Risk Behaviors Among Younger and Older Injecting Drug Users in the United States, 2009

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Abstract

This study compared HIV sero-prevalence and risk behaviors between younger and older injecting drug users (IDUs). IDUs aged ≥18 years were interviewed for the 2009 National HIV Behavioral Surveillance System. Using GEE regression, we assessed characteristics of younger (18–29 years)

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This study was conducted for the NHBS study group

The members of this NHBS study group are listed in appendix

and older (≥30 years) IDUs, and factors associated with past 12-month receptive syringe sharing and unprotected sex (vaginal/anal). Of 10,090 participants, 10 % were younger. HIV seroprevalence was lower among younger than older IDUs (4 vs. 10 %, $p = 0.001$). Younger IDUs were more likely ($p \leq 0.002$) to be non-black race/ethnicity, report higher household income, homelessness, being arrested and to engage in receptive syringe sharing and unprotected sex. In multivariable models, age remained associated ($p < 0.001$) with receptive syringe sharing (aPR = 1.14, 95 % CI1.07–1.22) and unprotected sex (aPR = 1.10, 95 % CI1.06–1.14). Although younger IDUs had lower HIV prevalence, their behaviors place them at increased risk of HIV infection and could lead to a rapid spread in this susceptible population.

Keywords

Injecting drug users; Young; Risk behaviors; HIV; United States

Introduction

Despite significant advances in the prevention of HIV infection, injection drug use continues to contribute to new infections in the United States both directly through the sharing of injection equipment, and indirectly through sexual transmission from injecting drug users (IDUs) to non-injecting sex partners. In 2010, injection drug use accounted for 8 % of the estimated new HIV infections [1] and 16 % of infections among those living with HIV infection at the end of 2009 [2]. Although new HIV infections attributed to drug injection have been declining in the United States since the late 1980s [3], rates continue to be high among specific sub-populations of IDUs, including racial/ethnic minority groups [4–7]. Young, recently initiated IDUs have historically been identified as a group at high risk for HIV [8–12] and hepatitis C [13, 14], though more recent data is sparse. To effectively respond to the evolving challenges of the HIV epidemic among IDUs and their sex partners, it is essential to understand trends in HIV transmission and behaviors among current and emerging sub-groups at greatest risk.

Multiple studies have found that young IDUs are at increased risk for HIV [8, 15, 16] and that they differ in socio-demographic characteristics and risk behaviors from their older counterparts [12, 17, 18]. Prospective studies of young, recently initiated IDUs conducted in the 1990s reported high incidence of HIV infection within the first 3–6 years of starting injection [8, 9, 15, 19]. IDUs in these studies initiated injection around the time that HIV/AIDS prevalence was highest in this population. Other early studies of IDUs exposed to prevention efforts in the late 1980s through the 1990s reported sizeable declines in risk behaviors, particularly unsafe injection practices [20–23], and provided evidence that such changes contributed to reduced HIV transmission [11, 24–26]. Lessons learned by this early generation of IDUs, however, may not have translated to the new generation of IDUs today. More recent studies of young IDUs found high levels of risky injection and sex behaviors, including sharing syringes and other drug preparation equipment, having multiple injection and sexual partners, and exchanging sex for money or drugs [16, 27], though HIV prevalence remains below levels reported in the 1990s [16]. Others, however, documented

high incidence of HCV infection [28] and HCV outbreaks among younger IDUs [29–31], supporting a high potential for the rapid spread of blood-borne infections in this population.

The population size of young IDUs in the United States is increasing [32] and in the presence of high levels of risky behaviors, young IDUs may represent a new generation of an at-risk population that is vulnerable for a widespread resurgence of HIV infection. Many of the more recent studies that examined HIV risk among younger IDUs were restricted to younger or recently initiated IDUs, thus lacking the comparative value of the larger IDU population. Furthermore, in the absence of a nationally representative sample of IDUs, data collected from multiple, geographically diverse areas is imperative to improved understanding of the scope of HIV risk among IDUs. The United States National HIV Behavioral Surveillance System (NHBS) was initiated in 2003 to monitor HIV-associated behaviors in populations at high risk of HIV infection, including IDUs [33]. We used NHBS data to examine HIV sero-prevalence and risk behaviors in younger and older IDUs, while accounting for differences in socio-demographic characteristics and access to HIV prevention.

Methods

Sampling and Eligibility

Data for this analysis were collected in the second cycle of NHBS among IDUs (NHBS-IDU) in 2009. Methods for NHBS-IDU are described in detail elsewhere [33, 34]. Briefly, the second cycle of NHBS-IDU was conducted in 20 large cities within United States metropolitan statistical areas with >500,000 population; approximately 60 % of the nation's AIDS cases had been reported in these cities in 2009 [35]. NHBS-IDU received approval from the Centers for Disease Control and Prevention (CDC) (non-engaged research) and the institutional review boards at each of the participating sites. No personally identifying information was collected during enrollment, interview, or HIV testing.

Formative research was conducted prior to the NHBS-IDU survey to inform implementation [36]. Participants were recruited using respondent-driven sampling (RDS) [34, 37]. Sampling began with a limited number of 'seed' participants who were purposefully chosen through formative research. Eligible participants were offered the opportunity to recruit up to five people they knew personally who inject drugs. Persons were eligible if they injected drugs in the past 12 months and were aged ≥18 years, current residents of the city, able to complete the survey in either English or Spanish, and able to provide informed consent. Drug injection in the past 12 months was confirmed by observing physical evidence of recent injection (e.g., track marks) and by assessing knowledge of injection practices.

Measures

Trained interviewers administered a standardized questionnaire using handheld computers. The main variable of interest for this analysis was age, which was assessed as dichotomous (18–29, ≥30 years) and as a 4-category variable (18–29, 30–39, 40–49, ≥50 years). Younger age was defined a priori based on HIV prevention research that found IDUs<30 years at increased risk [12, 15, 38], and to allow for sufficient power in statistical analyses. In

multivariable analyses, receptive syringe sharing and unprotected sex in the past 12 months were the primary behavioral outcomes. Receptive syringe sharing was defined as injecting with a needle or syringe that someone else had already injected with and unprotected sex as having vaginal or anal sex without a condom with any type of partner (main, casual, or exchange). Independent factors included socio-demographics, and drug use (non-injection, injection), sexual, and prevention behaviors. Household income was dichotomized into at/below vs. above the federal poverty level; poverty level for this variable was based on annual household income, adjusted for family size according to the 2009 poverty guidelines [39]. Binge drinking was defined as drinking ≥5 (males) or ≥4 (females) alcoholic beverages at one sitting ≥1 time in the past 30 days. Time since first injection was calculated based on participant's age at first injection and current age. Exchange sex partners included persons who gave or received things "like money or drugs" in exchange for sex. Finally, cities were categorized into Northeast, South, Midwest and West regions and Puerto Rico based on the United States Census Bureau definition [40].

All participants were offered an anonymous HIV test and for those who consented, testing was performed by collecting blood or oral specimens for either rapid testing in the field or laboratory-based testing. A nonreactive rapid or laboratory-based screening test result was considered HIV-negative; a reactive test result was considered HIV-positive if confirmed by Western blot or indirect immunofluorescence assay.

Data Analysis

Descriptive analysis assessed age distribution in the sample and described participants in terms of socio-demographic characteristics and HIV-related behaviors; crude proportions are reported. Stratified analysis was used to assess the association of age with receptive syringe sharing, unprotected sex, and HIV sero-status by different categories of years since first injection. In this analysis, associations with p-values <0.05 were considered statistically significant.

Bivariate and multivariable analyses accounted for RDS sampling methodology. Multiple approaches for accounting for the RDS design have been suggested [41–43]. Our bivariate and multivariable analyses adjusted for the general dependence among observations linked to one another in recruitment networks by using generalized estimating equations (GEE) with an exchangeable correlation matrix, clustered by recruitment chain [44, 45]. Multivariable estimates adjusted for homophily and the direct dependence among the recruiter and recruit by including the recruiter's value on the outcome in the models [46, 47]. For example, our model of factors associated with unprotected sex included a variable that described unprotected sex practices of the person who recruited the participant. We also adjusted for the differing sample inclusion probabilities by including participants' personal network size, and for the multi-site nature of the study by including indicators for city in the models.

Bivariate analyses using GEE were conducted to examine associations between younger age (18–29 years), other socio-demographic characteristics, and HIV-related behaviors. Associations with Bonferroni-adjusted p-values of <0.002 (0.05/33) were considered statistically significant. Separate bivariate analyses were conducted to select variables for

multivariable models that examined the independent association of younger age with receptive syringe sharing and with unprotected sex. Log-linked Poisson GEE regression was used to estimate prevalence ratios (PR), 95 % confidence intervals (CI), and two-sided *p*-values. PRs have been found to be robust estimates of the strength of associations in cross-sectional studies, particularly when the outcome prevalence is not rare (>10 %) [48]. For each outcome, independent variables significant at *p*-values<0.10 in bivariate analyses were considered for inclusion in multivariable analysis; partial models were first developed within each conceptual group of independent variables (i.e., socio-demographics, and drug use, sexual and prevention behaviors) and those with *p*-values < 0.05 were considered for the final multivariable models. Variables were retained and considered statistically significant in the final models at a Bonferroni-adjusted *p* value of <0.002 for both receptive syringe sharing (0.05/30) and unprotected sex (0.05/32). Modeling decisions were further guided by the QIC goodness-of-fit statistic for GEE, multicollinearity analyses, and by theoretically grounded interaction terms. Gender was included in the model assessing factors associated with unprotected sex, even though it was not significantly related to the outcome. This decision was based on goodness-of-fit analysis and on epidemiologic evidence suggesting female IDUs are at higher risk of HIV through heterosexual transmission than males [49].

Finally, given that some have found recent-onset IDUs at high-risk of HIV infection independently of age [8, 50], we conducted a sensitivity analysis of the independent effects of injection duration, by adding the variable years since first injection to the final models. All analyses were performed using the SAS 9.2 software (SAS Institute Inc., Cary, NC, USA).

Results

Socio-demographic characteristics and HIV status of the total sample of 10,499 eligible participants and comparisons between younger and older IDUs are described in Table 1. Most participants were male (72 %), had obtained high school or higher education (66 %), reported household income at/below the federal poverty level (81 %) and had ever been homeless (62 %). Compared to older IDUs (90 %), younger participants (10 %) were significantly ($p \leq 0.002$) more likely to be non-black, have household income above the federal poverty level, and to have been homeless and to have been arrested in the past 12 months. Most striking racial/ethnic differences by age were observed for black and white participants; within the 18–29, 30–39, 40–49 and ≥50 years age categories, blacks comprised 9, 20, 46 and 60 %, respectively, while whites were 58, 39, 26, 16 %, respectively (data not shown).

The overall HIV sero-prevalence in the sample was 9.0 %; HIV sero-prevalence was more than twice as high among older (9.5 %) compared to younger participants (4.1 %) (Table 1). Only 5.1 % of the total sample self-reported HIV-positive status (1.8 % among younger and 5.5 % among older IDUs).

Analyses of HIV-related behaviors by age are presented in Table 2. The majority of participants injected heroin most frequently and injected at least daily (75 % respectively); this did not differ by age. Compared to older IDUs, younger participants were more likely to

initiate injection at a younger age (≤18 years) and to have more recently initiated injection (≤6 years ago). Younger participants were also more likely to engage in receptive sharing of syringes and other equipment (cooker, filter, water), and less likely to have used crack cocaine through non-injecting methods (i.e., smoking).

The majority of participants (84 %) had vaginal/anal sex in the past 12 months, and younger participants were more likely to report being sexual active compared with older IDUs (Table 2). Younger IDUs were more likely to engage in risky sexual behaviors, including having initiated sex at a younger age (≤17 years), had unprotected sex, ≥2 sex partners and a last sex partner who ever injected drugs. Notably for participants of all ages, of those who reported their last sex partner was a main partner, 54 % of the last main partners ever injected drugs (data not shown). Nearly half of all participants reported receiving free condoms (51 %) and obtaining syringes from syringe exchange programs (SEPs) (47 %) with no differences by age. Younger IDUs were more likely to have purchased sterile needles from pharmacies compared with older IDUs (60 % vs. 39 %) (Table 2). Of note, 51 % of younger IDUs who purchased syringes from pharmacies did not access SEPs during the same time period (data not shown).

Given the high correlation between age and years since first injection (Table 2), we assessed key risk behaviors and HIV sero-status among sub-groups of IDUs who first injected ≤3, 4–6 and ≥7 years ago (Table 3). Younger IDUs were more likely to receptively share syringes and to have unprotected sex compared to older IDUs at every level of years since their first injection. On the other hand, younger IDUs were less likely to test HIV-positive at every level of years since first injection, though the association only reached statistical significance (p-value<0.05) for the ≥7 years category.

In the final multivariable models adjusting for participants' IDU network size, their recruiters' value on the outcome, city of interview and self-reported HIV status (and gender in the model for unprotected sex), younger age remained independently associated (p-value <0.001) with receptive syringe sharing and unprotected sex (Tables 4, 5). Age was also assessed as a 4-level category variable with consistent results for the 18–29 year category and a slight dose–response association across the older age groups (data not shown). Additional independent factors associated with receptive syringe sharing were race/ethnicity, household income at/below the federal poverty level, homelessness, binge drinking, injecting daily, obtaining syringes from unreliable sources, having unprotected sex, having exchange sex partners, and having a last sex partner who ever injected drugs (Table 4). Additional independent factors associated with unprotected sex were being married/cohabitating, binge drinking, receptively sharing syringes, having had ≥2 sex partners, and having a last sex partner who ever injected drugs (Table 5). In a sensitivity analysis assessing independent effects of years since first injection on the behavioral outcomes, the variable was added to both final models (data not shown). Years since first injection was not statistically significant in either model while age remained a significant factor.

Discussion

A key finding in this study of IDUs recruited in geographically diverse cities across the United States, is the significantly higher frequencies of risky injection and sexual behaviors among younger IDUs (18–29 years) compared to their older counterparts. More than one-half of younger IDUs reported receptive syringe sharing in the past year, compared to a third of older IDUs, and younger IDUs were more likely to report other high-risk practices, including receptive sharing of other injection equipment (e.g., cookers) and having unprotected sex, multiple sex partners, and a last sex partner who ever injected drugs. In multivariable analyses, younger age remained independently associated with receptive syringe sharing and unprotected sex, key behaviors that place IDUs at increased risk of HIV infection. These findings support earlier studies that have identified younger IDUs at high risk for HIV [12, 15, 51] and hepatitis C [52], and highlight the need for additional research to examine the potential for a widespread resurgence of HIV among young IDUs in the context of today's HIV epidemic and the state of prevention efforts.

Second, both of our final models of receptive syringe sharing and unprotected sex included other high-risk injection and sex behaviors as independent factors. This suggests a significant overlap in sex- and injection-related behaviors, particularly among younger IDUs who report both in higher proportions. Earlier studies have called for urgent action to address both injection and sex risk among IDUs [49, 53, 54], and to effectively reach younger IDUs [8, 55].

Third, younger IDUs in this study were more likely to engage in risky behaviors irrespective of time since first injection. At every level of years since first injection (≤3, 4–6, and ≥7 years ago), younger IDUs were significantly more likely to report receptive syringe sharing and unprotected sex compared to older IDUs. In the multivariable analyses of factors associated with these two risk behaviors, years since first injection was not significant when included in the final models. Because drug injection is typically initiated in late teens/early twenties [56], many IDUs aged <30 years have recently initiated injection and the risk of HIV acquisition in this population is thought to be particularly high during the first 3–6 years since injection initiation [8, 15, 57]. Others have described injection initiation at older ages [9, 58, 59] and found that older initiates to injection (≥40 years) were less likely to practice risky injection behaviors compared to younger initiates [59]. Together these findings suggest that although, comprehensive prevention programs need to reach IDUs soon after initiating injection, focusing on younger age IDUs may be an effective approach to reach a population most at-risk. In our study, HIV prevalence among younger IDUs was half that of older IDUs at every level of years since first reported injection, suggesting a window of opportunity to intervene even among younger, longer-term IDUs.

Several factors may contribute to the elevated levels of risky behaviors among younger IDUs. Factors associated with young age itself, such as impulsivity, and a lower perception of risk of acquiring HIV may influence decisions regarding risky behaviors [60–62]. Other individual vulnerabilities, such as homelessness and incarceration, have been associated with high-risk behaviors among young IDUs, including sharing injection equipment, engaging in survival sex, and inconsistent condom use [16, 63–65]. In this study and elsewhere [12],

younger IDUs were more likely to have been recently homeless or incarcerated compared with older IDUs, which may introduce other contextual factors (e.g., fewer socio-economic resources, injecting in public spaces) contributing to the higher levels of risky behaviors [63]. Furthermore, differences in generational experiences and first-hand knowledge of the consequences of HIV infection, possibly as a result of age-based homophily in younger IDUs' social/risk networks, may also play a factor. Unlike IDUs who were injecting in the early days of the HIV epidemic or whose family members or neighborhoods were heavily impacted by HIV, younger generations have not witnessed nor have personal knowledge of the devastating social and health consequences of HIV/AIDS prior to the success of antiretroviral therapies. Generational differences in HIV risk perception have been documented among young men who have sex with men, which have been suggested as contributing to the resurgence of sexually transmitted infections and increased HIV incidence in this population, particularly among minority men [66–69].

Generational differences among IDUs may be particularly pronounced by race/ethnicity. African-American communities have historically experienced high rates of both drug injection [70–72] and HIV infection [73], which may have motivated their members to practice risk reduction strategies or avoid drug injection all together [74, 75]. In our analysis, we noted striking differences in the racial/ethnicity composition, with younger IDUs more likely to be white, and older IDUs black. Other studies of IDUs in the United States noted that blacks declined over time as a proportion of participants in studies and were less likely to be recently initiated to injection, while the opposite has been noted for young white IDUs [18, 76, 77]. While HIV risk behaviors are more commonly reported among younger white IDUs [12], they often take place in settings with low background HIV prevalence and result in few infections [56, 78]. Therefore, the future course of the HIV epidemic among IDUs and their sex partners will in part depend upon whether changes in networks of young IDUs lead to higher probabilities of HIV transmission [18, 79].

Finally, although in our assessment of HIV prevention service utilization we found no differences by age in SEP participation, younger IDUs were more likely to purchase syringes from pharmacies. Access to sterile syringes through SEPs and pharmacies has been shown to decrease syringe sharing and the transmission of HIV [80–83], and both are important components of a comprehensive, multilevel HIV prevention strategy for IDUs and their sex partners [84, 85]. Younger, and especially recently initiated IDUs, may not openly identify with drug injection, and thus may avoid services associated with this practice. Furthermore, drug injection by young adults has been increasingly reported in communities where SEPs have not been traditionally located, such as suburban or rural areas [86, 87], thus pharmacies may be a more accessible option for some. Pharmacies, therefore, may be an important entry point for young IDUs for referrals to SEPs, substance abuse treatment, and other HIV and HCV prevention services. CDC recently launched a pilot project to train pharmacists to deliver confidential rapid HIV testing [88]. Together with other efforts to expand HIV testing, pharmacies may also play a critical role in meeting the CDC-recommended annual testing for IDUs [89], particularly among younger IDUs.

Limitations

Several study limitations need to be acknowledged. First, RDS sampling weights were not used in our analyses, however, we account for the potential sampling biases by adjusting for recruitment chains in GEE regression and by adjusting for IDU network size and the recruiters' value on the outcome. Second, without a known sampling frame generalizability to other IDUs, even within the participating cities, is unknown. Furthermore, NHBS recruitment is conducted in cities with high AIDS burden, thus our findings may not reflect risk behaviors in lower prevalence areas. Third, young IDUs may be underrepresented in this study because they may be especially hard to reach and those recruited may be a select group characterized by relatively high risk. However, the use of peer-recruitment and allowing longer recruitment chains should minimize this selection bias. Fourth, because RDS methodology relies on recruitment through social networks, those who inject alone or rarely interact with other IDUs may not be sampled. Fifth, our data are subject to limitations of self-report data, however, studies of drug users show high levels of reliability and validity when reporting sensitive behaviors [90]. Finally, these data are cross-sectional and therefore we do not attempt to infer causal relationships.

Conclusions

This study reinforces that younger IDUs in the United States represent a new generation of an at-risk population who differ from older IDUs in socio-demographic characteristics and report high levels of risky injection and sex behaviors. Highly vulnerable IDU populations with low HIV prevalence, and with high levels of injection and sexual risk behaviors have in other contexts experienced rapid spread of HIV and new epidemics [91]. Although additional factors, not examined here (e.g., risk network characteristics), may be necessary conditions for epidemic increases in HIV transmission, these findings support the need for continued attempts to strengthen HIV prevention efforts for younger IDUs.

At the center of any response to HIV among IDUs is a comprehensive, multi-level prevention strategy, which includes access to sterile injection equipment, substance abuse counseling, medication-assisted therapy, HIV testing and counseling, and sexual and injection risk-reduction education for IDUs and their sex partners [84, 85, 92–94]. Integration with other service programs, such as prevention and treatment services for other sexually transmitted infections and hepatitis B and C infections, could increase the effectiveness of such efforts [94].

Prevention efforts focusing on young IDUs would benefit from increased understanding of the socio-demographic composition of young and newly initiated IDUs, the network structures within which risk behaviors take place, and utilization of prevention services. Furthermore, interventions that place a strong emphasis on strengthening peer norms against risky injection and sex practices and that heighten perception of HIV infection risk from these behaviors may be beneficial. Peer education initiatives have demonstrated some success in influencing the behavior of IDUs [95–97], including young IDUs [98], and should be part of a comprehensive HIV prevention approach. Finally, it is important to recognize that HIV prevention efforts may also be geared toward the subset of non-injecting drug users who are at risk for transition to injection [99]. Injection drug use among adolescents and

young adults in the United States may be increasing [32, 100] and some have suggested that the recent trends in prescription opioid use may signal increasing transitions to injection drug use [101, 102]. Risk behaviors and the injection and sex risk networks of this new generation of IDUs will affect the future course of the HIV epidemic. Preventing new infections among young IDUs is therefore not only important in its own right, but such work also may prevent the re-establishment of a high background rate of HIV infection within this vulnerable population.

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Appendix

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Table 1

Socio-demographic characteristics and HIV infection among younger (18–29 years) and older (≥30 years) injecting drug users: NHBS-IDU 2009

Characteristic	Total[a] (*n* = 10,090), *n* (%)	Younger IDUs (18–29 years) (*n* = 1,010), *n* (%)	Older IDUs (≥30 years) (*n* = 9,080), *n* (%)	*p* value[b]
Gender				0.004
Male	7,298 (72.3)	672 (66.5)	6,626 (73.0)	
Female	2,792 (27.7)	338 (33.5)	2,454 (27.0)	
Race/ethnicity				
Black	4,687 (46.5)	92 (9.2)	4,595 (50.7)	< 0.001
Hispanic/Latino	2,173 (21.6)	275 (27.3)	1,898 (20.9)	
White	2,762 (27.4)	585 (58.1)	2,177 (24.0)	
Other[c]	453 (4.5)	54 (5.4)	399 (4.4)	
Married/cohabiting[d]				0.045
Yes	716 (7.1)	53 (5.3)	663 (7.3)	
No	9,370 (92.9)	957 (94.8)	8,413 (92.7)	
Education				0.930
< High school graduation	3,442 (34.1)	340 (33.7)	3,102 (34.2)	
≥High school graduation (or equivalent)	6,645 (65.9)	670 (66.3)	5,975 (65.8)	
Household Income				< 0.001
At/below federal poverty level	8,071 (80.5)	732 (72.8)	7,339 (81.3)	
Above federal poverty level	1,960(19.5)	274 (27.2)	1,686 (18.7)	
Homeless[e], past 12 months				
Yes	6,209 (61.6)	727 (72.0)	5,482 (60.4)	0.002
No	3,878 (38.5)	283 (28.0)	3,595 (39.6)	
Arrested, past 12 months				< 0.001
Yes	3,626 (36.0)	531 (52.6)	3,095 (34.1)	
No	6,461 (64.0)	479(47.4)	5,982 (65.9)	
Regions and Puerto Rico[f]				0.756
Northeast	2.264 (22.4)	368 (36.4)	1,896 (20.9)	
South	3,856 (38.2)	219 (21.7)	3,637 (40.1)	
Midwest	952 (9.4)	95 (9.4)	857 (9.4)	
West	2,574 (25.5)	271 (26.8)	2,303 (25.4)	
Puerto Rico	444 (4.4)	57 (5.6)	387 (4.3)	
Self-reported HIV status				
Positive	509 (5.1)	20 (2.0)	489 (6.3)	0.001
Negative	7,807 (78.0)	754 (75.0)	7,053 (78.3)	
Tested, but did not obtain results	630 (6.3)	67 (6.7)	563 (6.3)	
Never tested	1,070 (10.7)	164 (16.3)	906 (10.1)	
HIV sero-status				0.001
Positive	906 (9.0)	41 (4.1)	865 (9.5)	
Negative	9,184 (91.0)	969 (95.9)	8,215 (90.5)	

IDUs injecting drug users, *NHBS-IDU* National HIV Behavioral Surveillance System-Injecting Drug Users

[a] Numbers may not add to totals due to missing data

[b] Chi square *p*-values were generated using generalized estimated equations (GEE) clustered on recruitment chains stemmed from initial recruits ('seeds') in respondent-driven sampling

[c] Includes American Indian/Alaska Natives, Asians, Native Hawaiian or other Pacific Islander, and persons of multiple races

[d] Currently married or living with someone as if married

[e] At any time during the past 12 months, lived on the street, in a shelter, a single room occupancy hotel, or temporarily stayed with friends/relatives, or lived in a car

[f] Northeast: Boston, MA; Nassau-Suffolk, NY; New York, NY; Newark, NJ; Philadelphia, PA. South = Atlanta, GA; Baltimore, MD; Dallas, TX; Houston, TX; Miami, FL; New Orleans, LA; Washington, D.C. Midwest = Chicago, IL; Detroit, MI. West = Denver, CO; Los Angeles, CA; San Diego, CA; San Francisco, CA; Seattle, WA. Puerto Rico = San Juan

Table 2

HIV-related behaviors among younger (18–29 years) and older (≥30 years) injecting drug users: NHBS-IDU 2009

Characteristic	Total (*n* = 10,090), *n* (%)	Younger IDUs (18–29 years) (*n* = 1,010), *n* (%)	Older IDUs (≥ 30 years) (*n* = 9,080), *n* (%)	*p* value[a]
Drug use behaviors (past 12 months unless otherwise noted)				
Binge drinking, past 30 days	5,485 (54.4)	635 (62.9)	4,850 (53.5)	0.003
Non-injected crack use	2,611 (25.9)	146 (14.5)	2,465 (27.2)	< 0.001
Age at fist injection ≤18 years	4,125 (40.9)	489 (48.2)	3,636 (40.1)	0.001
Mean (SD)	22.3 (8.1)	19.1 (3.8)	22.7 (8.3)	
Years since first injected ≤6 years	1,318 (13.1)	532 (52.7)	786 (8.7)	< 0.001
Mean (SD)	23.1 (12.9)	6.8 (4.0)	25.0 (12.2)	
Most frequently injected heroin	7,541 (74.8)	773 (76.5)	6,768 (74.6)	0.282
Most frequently injected speedball	1,376 (13.6)	119 (11.8)	1,257 (13.9)	0.129
Injected daily	7,556 (75.0)	797 (78.9)	6,759 (74.6)	0.132
Receptively shared syringes to inject	3,542 (35.6)	527 (52.6)	3,015 (33.7)	< 0.001
Receptively shared syringes to divide drugs (e.g., backloading)	3,488 (34.7)	425 (42.3)	3,063 (33.8)	0.021
Receptively shared cooker, filter or water	5,814 (58.7)	713 (71.7)	5,101 (57.3)	< 0.001
Receptively shared syringes to inject with ≥2 people	2,290 (22.8)	346 (34.4)	1,944 (21.5)	0.014
Obtained syringes from unreliable sources[b]	4,340 (43.0)	402 (39.8)	3,938 (43.4)	0.559
Sexual behaviors (past 12 months unless otherwise noted)				
First had sex at age ≤17 years	8,335 (84.2)	909 (91.8)	7,426 (83.3)	< 0.001
Had sex	8,430 (83.6)	957 (94.8)	7,473 (82.3)	< 0.001
Had unprotected sex	7,184 (71.2)	873 (86.4)	6,311 (69.5)	< 0.001
Had ≥2 sex partners	5,114 (50.8)	654 (64.9)	4,460 (49.2)	< 0.001
Had exchange sex partners	2,565 (25.4)	267 (26.4)	2,298 (25.3)	0.492
Last sex partner ever injected drugs	4,714 (46.7)	574 (56.8)	4,140 (45.6)	0.001
HIV testing and prevention (past 12 months)				
Received HIV testing	4,866 (48.4)	524 (52.1)	4,342 (48.0)	0.003
Participated in alcohol/drug treatment program[c]	3,374 (33.5)	465 (46.0)	2,909 (32.0)	0.005
Received free condoms	5,150 (51.0)	532 (52.7)	4,618 (50.9)	0.222
Obtained syringes from syringe exchange programs	4,764 (47.2)	500 (49.5)	4,264 (47.0)	0.796
Purchased syringes from pharmacies	4,126 (40.9)	603 (59.7)	3,523 (38.8)	0.002

IDUs injecting drug users, *NHBS-IDU* National HIV Behavioral Surveillance System, Injecting Drug Users

[a] Chi square *p*-values were generated using generalized estimated equations (GEE) clustered on recruitment chains stemmed from initial recruits ('seeds') in respondent-driven sampling

[b] Unreliable sources of syringes included needle or drug dealer, shooting gallery, off the street

[c] Includes outpatient, residential, detox, and methadone treatment programs

Table 3

Age and years since first injection among injecting drug users by key risk behaviors and HIV sero-status: NHBS-IDU 2009

	≤3 years since first injection			4–6years since first injection			≥7years since first injection		
	Age 18–29 years (*n* = 297), *n* (%)	**Age ≥30 years (*n* = 435), *n* (%)**	***P* value[a]**	**Age 18–29 years (*n* = 235), *n* (%)**	**Age ≥30 years (*n* = 351), *n* (%)**	***P* value[a]**	**Age 18–29 years (*n* = 478), *n* (%)**	**Age ≥30 years (*n* = 8,282), *n* (%)**	***P* value[a]**
Receptively shared syringes	149 (50.2)	137 (32.2)	0.006	132 (56.7)	105 (30.1)	0.001	246 (52.1)	2769 (33.9)	0.001
Had unprotected sex	256 (86.2)	332 (76.5)	0.009	207 (88.1)	271 (77.2)	0.007	410 (85.8)	5,702 (68.9)	< 0.001
HIV-positive	11 (3.7)	40 (9.2)	0.061	6 (2.6)	27 (7.7)	0.070	24 (5.0)	797 (9.6)	0.002

IDUs injecting drug users, *NHBS-IDU* National HIV Behavioral Surveillance System-Injecting Drug Users

[a]Association between age and behavioral and HIV outcomes within each category of years since first injection. Chi square *p*-values were generated using generalized estimated equations (GEE) clustered on recruitment chains stemmed from initial recruits (‘seeds’) in respondent-driven sampling

Table 4

Factors associated with receptive syringe sharing among injecting drug users: NHBS-IDU 2009

Characteristic	Receptive syringe sharing			
	Bivariate analysis[a]		Final multivariable model[b]	
	PR (95 % CI)	*p* value	aPR (95 % CI)	*p* value
Age 18–29 years (ref: ≥30 years)	1.42 (1.29, 1.56)	< 0.001	1.14 (1.07, 1.22)	< 0.001
Female gender	1.15 (1.05, 1.25)	0.003	–	–
Race/ethnicity (ref: Black)				
Hispanic	1.41 (1.25, 1.58)	< 0.001	1.36 (1.25, 1.48)	< 0.001
White	1.52 (1.35, 1.71)	< 0.001	1.44 (1.33, 1.55)	< 0.001
Other[c]	1.30 (1.15, 1.47)	< 0.001	1.27 (1.14, 1.41)	< 0.001
At/below federal poverty level	1.15 (1.06, 1.24)	< 0.001	1.14 (1.07, 1.22)	< 0.001
Homeless[d], past 12 months	1.66 (1.54, 1.80)	< 0.001	1.35 (1.26, 1.44)	< 0.001
Arrested, past 12 months	1.26 (1.19, 1.34)	< 0.001	–	–
Binge drinking, past 30 days	1.39 (1.30, 1.50)	< 0.001	1.20 (1.12, 1.28)	< 0.001
Age at first injection ≤18 years	1.14 (1.06, 1.22)	< 0.001	–	–
Years since first injected ≤6 years	1.08 (0.98, 1.18)	0.157	–	–
Injected daily	1.26 (1.15, 1.37)	< 0.001	1.15 (1.08, 1.22)	< 0.001
Obtained syringes from unreliable sources[e]	1.99 (1.85, 2.15)	< 0.001	1.70 (1.56, 1.85)	< 0.001
Had unprotected sex, past 12 months	1.70 (1.57, 1.85)	< 0.001	1.36 (1.24, 1.49)	< 0.001
Had ≥2 sex partners	1.58 (1.48, 1.69)	< 0.001	–	–
Had exchange sex partners	1.68 (1.55, 1.81)	< 0.001	1.32 (1.23, 1.42)	< 0.001
Last sex partner ever injected drugs	1.55 (1.45, 1.66)	< 0.001	1.24 (1.16, 1.32)	< 0.001
Participated in alcohol/drug treatment program[f]	1.11 (1.06, 1.17)	< 0.001	–	–
Received counseling about ways to prevent HIV infection[g]	1.09 (1.02, 1.17)	0.012	–	–

NHBS-IDU National HIV Behavioral Surveillance System-Injecting Drug Users, *PR* prevalence ratio, *CI* confidence intervals

[a] Log-linked Poisson Regression using generalized estimating equations (GEE) clustered on recruitment chains stemmed from initial recruits ('seeds') in respondent-driven sampling. Variables presented in the table were selected if statistically significant at $p < 0.05$ in partial multivariable models conducted within each conceptual group of independent variables (i.e., socio-demographic, and drug use, sexual and prevention behaviors); these were then considered in the final multivariable models

[b] Log-linked Poisson Regression using GEE clustered on recruitment chains stemmed from initial recruits ('seeds') in respondent-driven sampling. Prevalence ratios are adjusted (aPR) by recruiter's values on the outcome, IDU network size, city of interview, and self-reported HIV status. Variables were statistically significant in the final models at a Bonferroni-adjusted *p*-value of ≤0.002

[c] Includes American Indian/Alaska Natives, Asians, Native Hawaiian or other Pacific Islander, and persons of multiple races

[d] At any time during the past 12 months, lived on the street, in a shelter, a single room occupancy hotel, or temporarily stayed with friends/relatives, or lived in a car

[e] Unreliable sources of syringes included needle or drug dealer, shooting gallery, off the street

[f] Includes outpatient, residential, detox, and methadone treatment programs

[g] Does not include counseling received as part of HIV testing

Table 5

Factors associated with engaging in unprotected sex among injecting drug users: NHBS-IDU 2009

Characteristic	Unprotected sex			
	Bivariate analysis[a]		Final multivariable model[b]	
	PR (95 % CI)	*p* value	aPR (95 % CI)	*p* value
Age 18–29 years (ref: ≥30 years)	1.22 (1.17, 1.27)	< 0.001	1.10 (1.06, 1.14)	< 0.001
Female gender	1.03 (1.00, 1.06)	0.033	1.02 (1.00, 1.05)	0.039
Race/ethnicity (ref: Black)				
Hispanic	1.05 (0.99, 1.12)	0.099	–	–
White	1.09 (1.04, 1.14)	0.001	–	–
Other[c]	0.96 (0.90, 1.03)	0.237	–	–
Married/cohabiting[d]	1.20 (1.16, 1.24)	< 0.001	1.30 (1.25, 1.34)	< 0.001
Homeless[e], past 12 months	1.08 (1.04, 1.11)	< 0.001	–	–
Arrested, past 12 months	1.11 (1.08, 1.14)	< 0.001	–	–
Binge drinking, past 30 days	1.16 (1.13, 1.19)	< 0.001	1.07 (1.04, 1.10)	< 0.001
Non-injected methamphetamine use	1.14 (1.07, 1.20)	< 0.001	–	–
Years since first injected ≤6 years	1.14 (1.11, 1.18)	< 0.001	–	–
Receptively shared syringes	1.23 (1.19, 1.26)	< 0.001	1.08 (1.05, 1.11)	< 0.001
Obtained syringes from unreliable sources[f]	1.10 (1.07, 1.12)	< 0.001	–	–
First had sex at age ≤17 years	1.12 (1.08, 1.17)	< 0.001	–	–
Had ≥2 sex partners	1.50 (1.45, 1.55)	< 0.001	1.39 (1.34, 1.44)	< 0.001
Last sex partner ever injected drugs	1.48 (1.41, 1.57)	< 0.001	1.36 (1.29, 1.43)	< 0.001

NHBS-IDU National HIV Behavioral Surveillance System-Injecting Drug Users, *PR* prevalence ratio, *CI* confidence intervals

[a] Log-linked Poisson Regression using generalized estimating equations (GEE) clustered on recruitment chains stemmed from initial recruits ('seeds') in respondent-driven sampling. Variables presented in the table were selected if statistically significant at $p < 0.05$ in partial multivariable models conducted within each conceptual group of independent variables (i.e., socio-demographic, and drug use, sexual and prevention behaviors); these were then considered in the final multivariable models

[b] Log-linked Poisson Regression using GEE clustered on recruitment chains stemmed from initial recruits ('seeds') in respondent-driven sampling. Prevalence ratios are adjusted (aPR) by recruiter's values on the outcome, IDU network size, city of interview, and self-reported HIV status. Variables were statistically significant in the final models at a Bonferroni-adjusted *p*-value of ≤0.002

[c] Includes American Indian/Alaska Natives, Asians, Native Hawaiian or other Pacific Islander, and persons of multiple races

[d] Currently married or living with someone as if married

[e] At any time during the past 12 months, lived on the street, in a shelter, a single room occupancy hotel, or temporarily stayed with friends/relatives, or lived in a car

[f] Unreliable sources of syringes included needle or drug dealer, shooting gallery, off the street