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HIV infection among MSM who inject methamphetamine in 8 US cities

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Abstract

Background and Aims: Men who have sex with men (MSM) and inject drugs are at risk for HIV infection. Although research exists on non-injection methamphetamine (meth) use and sexual risk among MSM, less is known about meth injection and its association with HIV infection among MSM who inject drugs.

Methods: We analyzed data from men aged 18 years who reported injecting drugs and male-to-male sexual contact. Men were recruited using respondent-driven sampling, interviewed, and tested for HIV during the 2012 and 2015 cycles of National HIV Behavioral Surveillance among persons who inject drugs. We included data from 8 cities where 10 MSM reported meth as the primary drug injected. We assessed differences in demographic characteristics, past 12 months risk behaviors, and HIV infection between MSM who primarily injected meth and those who primarily injected another drug.

Results: Among 961 MSM, 33.7% reported meth as the drug they injected most often. Compared to MSM who primarily injected other drugs, MSM who primarily injected meth were more likely to have had 5 condomless anal sex partners, have been diagnosed with syphilis, and were less likely to report sharing syringes. In multivariable analysis, injecting meth was associated with being HIV-positive (adjusted prevalence ratio 1.48; 95% confidence interval 1.08–2.03). Including number of condomless anal sex partners in mediation analysis rendered this association no longer significant.

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Contributors

L. Nerlander – original idea, data analysis and interpretation of findings during analysis, and preparation of manuscript. B. Hoots – data analysis, interpretation of findings during analysis, and detailed input on drafts of manuscript. H. Bradley – data analysis, interpretation of findings during analysis, and detailed input on drafts of manuscript. D. Broz – interpretation of findings during analysis, subject matter knowledge on PWID, and detailed input on drafts of manuscript. A. Thorson – interpretation of findings during analysis, overall direction, and detailed input on drafts of manuscript. G. Paz-Bailey – interpretation of findings during analysis, overall direction, and detailed input on drafts of manuscript. All authors have contributed to and approved the final article. The NHBS Group Author contains local PIs and key staff involved in data collection at each National HIV Behavioral Surveillance site in the US.

Conflict of interest

No conflicts declared.

Conclusions: HIV prevalence among MSM who primarily injected meth was almost 50% higher than among MSM who primarily injected other drugs, and this association was mediated by sexual risk.

Keywords

Methamphetamine; MSM; PWID; HIV; Chemsex; Sharing

1. Introduction

Men who have sex with men (MSM) and who inject drugs are at high risk for HIV infection from both sexual and injection-related risk behaviors. MSM who inject methamphetamine (meth) may have additional risk relative to MSM who inject other drugs because of the psychological and physiological effects of meth on sexual behavior and HIV transmission risk. Meth is a highly addictive stimulant drug that can be snorted, smoked, and ingested, as well as injected (Shoptaw and Reback, 2007). Many MSM use meth to enhance sex and to remove feelings of shame and guilt associated with being gay as suggested by Reback (1997). Meth increases libido and is also associated with impulsivity and a reduction in inhibitions, which can lead men to engage in unsafe sex (Fawcett, 2015; Kurtz, 2005; Peck et al., 2005; Prestage et al., 2009; Semple et al., 2002; Shoptaw and Reback, 2007; Shrem and Halkitis, 2008). Men using meth are more likely to have condomless anal sex and sex with multiple partners (Colfax et al., 2001; Halkitis et al., 2001; Scott et al., 2007). There are additional physiological effects of meth that increase the risk for HIV, including mucosal dryness and reduced sexual sensitivity. MSM who use meth are more likely to engage in rougher sex and sex for longer durations of time, which may result in mucosal tears that can increase the risk for HIV transmission (Fawcett, 2015; Shoptaw and Reback, 2007). Meth also restricts blood flow, making it difficult to achieve a full erection; as a result, users are more likely to engage in receptive anal sex, which carries a higher risk for HIV transmission (Baggaley et al., 2010; Mansergh et al., 2006).

A 2015 meta-analysis found a significant association among MSM between meth or amphetamine use by any route versus no use and HIV infection (Vu et al., 2015); however, none of the studies examined the association specifically between meth injection and HIV. One paper found that among MSM who injected drugs, a higher proportion of MSM who were HIV-positive injected amphetamine compared to HIV-negative MSM (86% vs 76%). The association was statistically significant but did not control for potential confounders, and the data are almost two decades old (Kral et al., 2005). More importantly, current research is limited in our understanding of whether HIV acquisition among MSM who inject meth is facilitated by sexual versus injection risk (Drumright et al., 2006). A previous study among women who inject drugs found that those who injected meth were more likely to report both sexual and injection-related risk behaviors (Lorvick et al., 2006). A study in Seattle found higher HIV prevalence among MSM who most commonly injected meth compared to other MSM-IDU (Burt and Thiede, 2014). A better understanding of the contribution of sexual versus injection-related risk behaviors to HIV transmission among MSM injecting meth is required to address the high HIV prevalence among MSM who inject drugs. A Centers for Disease Control and Prevention (CDC) consultation called for more

research on the association of methamphetamine use with sexual risk behavior and incident HIV/STD infections in subpopulations of MSM (Mansergh et al., 2006a).

Meth use by any route of administration is common among US MSM; estimates of past 12 month use from different studies range from 10%–27% (Centers for Disease Control and Prevention, 2016; Forrest et al., 2010; Raymond et al., 2013; Reback et al., 2013; Shrem and Halkitis, 2008; Spindler et al., 2007). However, less is known about the prevalence of meth injection. One study of gay and bisexual HIV-positive men found that 65% of men who had injected drugs in the past 90 days had injected meth (Ibañez et al., 2005). Data from the United Kingdom suggest that meth injection could be increasing among MSM (Kirby and Thornber-Dunwell, 2013; Sullivan, 2015), and there are anecdotal reports of similar trends from organizations working with MSM in the Netherlands (Knoops et al., 2015). It is believed that the use of internet sites to find sex parties and drug ‘dens’ may be one driver of this trend (Kirby and Thornber-Dunwell, 2013), which is concerning, as US MSM increasingly use online resources to meet each other (Groves et al., 2014). While US substance use treatment admission data are not reported separately for MSM, the percentage of meth-related treatment admissions where injection was the primary route of administration increased steadily from 19% in 2008 to 26% in 2014 (Substance Abuse and Mental Health Services Administration Center for Behavioral Health Statistics and Quality, 2016; Substance Abuse and Mental Health Services Administration Office of Applied Studies, 2010). Similarly, a study in Denver, Colorado reported that the proportion of people who inject drugs (PWID) who reported injecting methamphetamine most frequently increased from 2% in 2005 to 30% in 2015 (Al-Tayyib et al., 2017). In Seattle, the proportion of PWID reporting any recent methamphetamine use increased in recent years. While no increase was reported for MSM-PWID, the use of injected methamphetamine remained high (> 70%) since 2009 (Glick et al., 2018).

We used data from the 2012 and 2015 National HIV Behavioral Surveillance (NHBS) cycles among persons who inject drugs and limited the analyses to participants who reported male-to-male sex in the past 12 months. Our main objective was to determine whether MSM who primarily inject meth were more likely to be HIV-infected compared to MSM who primarily injected other drugs. A secondary objective was to explore whether any excess HIV risk was mediated by sexual or injection-related risk behaviors.

2. Methods

NHBS methods are described in detail elsewhere (Gallagher et al., 2007; Lansky et al., 2007). Briefly, data collection was conducted in 20 US metropolitan statistical areas (MSAs) with high AIDS burden (referred to in this report by the principal city name). Formative research was conducted to inform survey implementation (Allen et al., 2009). Participants were then recruited using respondent-driven sampling (RDS) (Heckathorn, 1997; Lansky et al., 2007) beginning with 5–10 ‘seed’ participants per city. Persons were eligible to participate in the survey if they injected drugs in the past 12 months and were aged 18 years, residents of the MSA, able to complete the survey in English or Spanish, and able to provide informed consent. Self-reported drug injection in the past 12 months was confirmed by observation of physical evidence of recent injection and by assessing knowledge of

injection practices. Trained interviewers administered a standardized questionnaire face to face. HIV testing was performed on blood or oral specimens with rapid or laboratory-based testing and confirmed with Western blot or immunofluorescence. Participants could recruit up to five people they knew who injected drugs, who lived in the MSA, and who had not participated before. Participants were offered incentives for completing the survey, taking an HIV test (typically 25 USD for each), and for recruiting others (typically 10 USD per recruit). All NHBS activities are anonymous.

2.1. Measures

A nonreactive rapid test was considered a definitive negative result. Participants were considered to be HIV-positive if they had a reactive rapid test followed by a laboratory-confirmed positive HIV test result. The main independent variable examined is 'primary drug,' defined as the drug the participant reported injecting most often. Participants were asked which drug they injected most often. If participants answered 'Crystal, meth, Tina, crank, ice' in 2012, and 'Methamphetamine, also known as meth, crystal meth, speed, or crank' in 2015 they were categorized as using meth as their primary drug injected. Participants who reported injecting any other drug most frequently constituted the reference category. Other measures have been defined elsewhere (Centers for Disease Control and Prevention, 2015).

2.2. Analysis

Analyses were limited to data from participants who reported male gender, completed the interview, reported at least one male oral or anal sex partner in the past 12 months, and had a valid NHBS HIV test result. Only cities where at least ten individual MSM in either 2012 or 2015 reported injecting meth as their primary drug were included in analyses. As the objective was to examine the potential risk of HIV acquisition associated with primary drug injected, participants who reported being diagnosed with HIV in the same year or prior to the year that they first injected drugs or were missing date of HIV diagnosis were excluded.

Using data from 2012 and 2015 combined, we examined primary drug injected by sociodemographic characteristics and city of interview. We furthermore compared the prevalence of sexual and drug use risk behaviors, HIV infection, and use of prevention and testing services by primary drug injected.

We examined the bivariate association between primary drug and HIV infection. We used previous research and evaluation of directed acyclic graphs, a way to graphically explore relationships between variables (Hernan and Robins, 2010; Robins, 2003), to inform selection of potential confounders of the association between primary drug and HIV infection for multivariable analyses. Variables that were significantly associated with both primary drug and HIV infection were added one by one, starting with the variable with the lowest P -value for the association with HIV infection. Variables with $P < 0.05$ were retained in the model. Race has been shown to be an important factor in HIV risk in the United States and, despite the lack of a significant association with the outcome in this sample, was included in the model. We also retained education in the model for similar reasons. Sexual identity was included as a two-level variable: gay-identified and nongay identified.

We evaluated whether there was an interaction between region (West Coast and Denver vs. East) and primary drug.

To evaluate whether the association between primary drug and HIV infection was mediated by syringe sharing and the number of condomless anal sex partners in the past 12 months, we added these variables to the confounder-adjusted multivariable model. However, our analyses are limited by the cross-sectional nature of NHBS, and we cannot infer causality. In a sensitivity analysis, multivariable analysis was repeated with a sample that excluded men who injected meth in addition to primarily injecting another drug.

Bivariate and multivariable analyses used Poisson models with generalized estimating equations (GEE) clustered on recruitment chain in PROC GENMOD in SAS v. 9.3. To account for the sampling design (Broz et al., 2014), we: 1) clustered the model on recruitment chain (Wagner et al., 2011; Zeger and Liang, 1986) to account for the general dependence among observations linked to one another in population networks and 2) included city as a covariate in the models to account for the multi-site nature of the study.

2.3. Ethics

Verbal informed consent was obtained from all participants. NHBS activities were approved by local institutional review boards (IRB) in participating cities and approved by CDC.

This report has been prepared in accordance with the STROBE guidelines for reporting of observational studies (Von Elm et al., 2014).

3. Results

In 2012 and 2015, 14,617 men who injected drugs had complete interview data and a valid HIV test result. Of 14,617 men, 1679 (11.4%) reported having 1 male oral or anal sex partner in the past 12 months. Eight cities had at least ten MSM who reported injecting meth most frequently (Atlanta, Denver, Houston, Los Angeles, New Orleans, San Diego, San Francisco, Seattle) and contributed data for this analysis from 1032 MSM. We excluded 72 participants who reported receiving their first positive HIV test prior to or in the same year that they first injected any drug ($n = 69$) or had missing date of HIV diagnosis ($n = 3$).

Of 961 MSM included in the final analysis sample, 324 (33.7%) reported injecting meth most often, 429 (44.6%) most often injected heroin, 74 (7.7%) most often injected cocaine, 98 (10.2%) most often injected 'speedball' (heroin and cocaine together), and 36 (3.8%) most often injected some other drug (data not shown in table). City-specific sample estimates of the percentage of MSM who primarily injected meth ranged from 9.7% (Atlanta) to 57.6% (San Francisco) (Fig. 1) across both years.

Background characteristics, sexual and drug use behaviors, and use of prevention services by primary drug injected are described in Table 1. Primary drug differed by age; meth users were more likely to be younger ($P = 0.005$) (Table 1). Primary drug also differed by race: 59.3% of meth users were white compared to 35.3% of those reporting a different primary drug ($P = 0.04$). Participants who primarily injected meth had higher levels of education; 47.8% had some college education or above compared to 35.3% of those who primarily

injected any other drug ($P = 0.02$). Self-reported sexual identity was associated with primary drug, with 44.3% of participants who primarily injected meth identifying as homosexual or gay compared to 15.2% of other participants ($P = 0.0002$).

With regards to sexual risk behaviors, 29.0% of MSM who primarily injected meth reported 5 or more condomless anal sex partners in the past 12 months compared to 9.2% among MSM who primarily injected other drugs ($P = 0.0004$). Those who primarily injected meth were also more likely to report a diagnosis of gonorrhea or chlamydia (12.7% vs. 4.9%, $P = 0.0003$) or syphilis (11.1% vs. 2.4%, $P = 0.0008$) in the past 12 months.

MSM who primarily injected meth were less likely to report receptive syringe sharing compared to those who primarily injected other drugs (25.6% vs. 50.5%, $P = 0.0005$), and they had fewer syringe sharing partners. Meth injection was also associated with less frequent injection of any drug. Only 46.3% of MSM who primarily injected meth injected one or more times per day compared to 65.8% of MSM who primarily injected other drugs ($P < 0.0001$).

MSM who primarily injected meth were more likely to have received an HIV test in the past 12 months (65.1% vs. 54.1% among those who primarily injected other drugs, $P = 0.03$).

3.1. HIV prevalence

Overall HIV prevalence among MSM across all 8 cities was 20.2% (Table 2). HIV prevalence was 29.3% among MSM who primarily injected meth compared to 15.5% among MSM who primarily injected other drugs (PR 2.06, 95% CI 1.52–2.78, adjusted for sampling strategy, not shown in table). HIV prevalence was higher among MSM who were more educated, had health insurance, and who were not homeless (Table 2). HIV infection was associated with sexual identity; of men who identified as ‘homosexual or gay’, 42.1% were HIV-positive compared to 15.0% of bisexual men and 6.4% of MSM who self-identified as ‘heterosexual or straight.’ Higher numbers of condomless anal sex partners were associated with higher HIV prevalence; 39.1% of men with five or more partners in the past 12 months were HIV-positive compared to 17.3% and 16.4% of men with one or no condomless anal sex partners, respectively. MSM who shared syringes were less likely to be HIV-positive (15.5% vs. 23.6% among those who had not shared syringes). Among HIV-positive MSM who reported having tested positive prior to the survey, around three-quarters of MSM, regardless of primary drug, reported being on antiretroviral treatment.

In multivariable analysis, adjusting for age, race, education, and sexual identity, MSM who primarily injected meth remained significantly more likely to be HIV-positive compared to MSM who primarily injected other drugs (aPR 1.48; 95% CI 1.08–2.03) (Table 3). The interaction term between region and primary drug was not significant ($P = 0.42$). In mediation assessment, adding syringe sharing in the past 12 months as a potential mediator did not meaningfully change the association (aPR 1.44; 95% CI 1.07–1.95). Adding the total number of condomless anal sex partners in the past 12 months as a second potential mediator rendered the association not significant (aPR 1.30; 95% CI 0.94–1.79).

In a sensitivity analysis of the confounder-adjusted model (age, race, education, and sexual identity), when men who injected meth in addition to primarily injecting another drug were excluded, the association between meth use and HIV infection retained significance and became slightly stronger (aPR 1.68; 95% CI 1.01–2.78, not shown in table).

4. Discussion

In this analysis of MSM who inject drugs from 8 large US cities, we found that the HIV prevalence among MSM who primarily injected meth was almost 50% higher than the prevalence among those who primarily injected other drugs, including heroin or cocaine. MSM who primarily injected meth were substantially more likely to report sexual risk behaviors, including a higher number of condomless anal sex partners. This group was also more likely to have a diagnosis of sexually transmitted infections (STIs) in the past 12 months. However, they were less likely to report injection-related risk behaviors, such as syringe sharing, number of sharing partners, and frequent injection compared to MSM who primarily injected other drugs. A previous paper using NHBS data from Seattle also found that MSM who most commonly injected meth were more likely to be HIV positive compared to other MSM-PWID. However, that paper used data from a single city and also did not exclude MSM who had received their HIV diagnosis before starting to inject drugs as we did for our analyses (Burt and Thiede, 2014).

We found that the association between meth as primary drug injected and HIV infection was in part explained by the number of condomless anal sex partners. Sexual risk behavior may be contributing to the higher prevalence of HIV among MSM injecting meth not only through increased numbers of partners but also through risky sexual encounters and sexual networks, which we were unable to directly measure. For many MSM who use meth (by any route), sexual activity often occurs in group settings in which meth use is involved and condomless sex is common (Bourne et al., 2015; Fawcett, 2015; Kirby and Thornber-Dunwell, 2013; Knoop et al., 2015). Since NHBS data is cross-sectional, we cannot clearly determine if sexual risk behavior is resulting in increased HIV infection or if HIV positive meth users are more likely to engage in sexual risk, potentially putting other MSM at risk. Regardless, this is an important group to target for HIV prevention interventions.

Syringe sharing did not mediate the association between primary drug injected and HIV infection, and MSM who primarily injected meth were less likely to share needles compared to MSM who primarily injected other drugs. Syringe sharing was also negatively associated with HIV prevalence, further suggesting that HIV prevalence may be driven by sexual risk behaviors in this population of MSM-PWID. Previous work is inconclusive with regards to difference in injection risk behaviors between meth injectors and those who inject other drugs (Lorvick et al., 2006; Richard et al., 2002; Ropelewski et al., 2011; Zule and Desmond, 1999); however, none of these studies were among MSM. Previous analysis of NHBS data from Seattle only found that MSM who injected meth were less likely to share needles (Burt and Thiede, 2014). In our sample, MSM who primarily injected meth injected less frequently compared to others, and it is possible that they are less likely to share, as their syringe supply needs are lower. One previous study of 100 MSM-PWID found that of those who injected meth, 20% injected at least weekly compared to 43% of those

who injected heroin (Bull et al., 2002). We also found that meth injectors were of higher socio-economic status than those primarily injecting other drugs, possibly indicating access to a more sufficient syringe supply and therefore a lower risk of sharing.

MSM who primarily injected meth were more likely to have attained a higher level of education and less likely to be homeless compared to MSM who primarily injected other drugs, but they were more likely to be HIV infected despite this. This is in contrast to findings from other work which show that low socioeconomic status (SES) is associated with HIV infection (Zierler et al., 2000). In this study population, it is possible that the sexual risk behaviors associated with meth use are more important determinants of HIV risk than SES. In general, factors associated with injection initiation among MSM are not well understood (Bluthenthal et al., 2018), and it is not clear whether these differ by type of drug. In our sample, sexual identity was highly associated with primary drug, and it is possible that many MSM who primarily inject meth may have started using meth to enhance sex or to deal with negative emotions associated with being gay (Reback, 1997; Nakamura et al., 2009) and not because of other factors such as socioeconomic deprivation.

Many HIV prevention programs are geared towards either PWID or MSM and may not adequately address the needs of MSM who are at risk for HIV both through sexual and injection risk (Boddiger, 2005; Bull et al., 2002). Even within the subgroup of MSM who inject drugs, different strategies are needed to address HIV risk among those who inject meth compared to those who inject other drugs, particularly heroin. While medication-assisted treatment (MAT) and syringe services programs (SSP) address the needs of many PWID, MAT does not address meth addiction, and no medications are approved for treatment of meth dependence (Ballester et al., 2017; Shoptaw and Reback, 2007). While SSP services are still needed for this group, we found that MSM who inject meth were less likely to share syringes than others and that sexual transmission appears to be more closely linked to their HIV risk. Given the relationship between meth use and sex among MSM (Halkitis et al., 2005; Kirby and Thornber-Dunwell, 2013), sexual and drug harm-reduction services may be best combined (Bourne et al., 2015; Mansergh et al., 2006b; Rose et al., 2006). Recovery may be challenging; some MSM are unable to function sexually without meth, and sex may provide a trigger for drug use (Fawcett, 2015). Some behavioral therapies have been shown to be effective for meth use, although not all are focused among MSM or PWID (Rawson et al., 2004; Reback et al., 2004; Shoptaw and Reback, 2007).

Pre-exposure prophylaxis (PrEP) use may reduce HIV risk in this population. PrEP is recommended for MSM at high risk for HIV infection, including those who have had anal sex without condoms or been diagnosed with an STI in the past 6 months (US Public Health Service, 2014). Based on our findings, many MSM who inject meth would likely be candidates for PrEP. While condom use should also be promoted, condomless sex may be the norm in some meth-using networks of MSM, and the high induced by meth injection may limit the user's ability to practice safer sexual behaviors (Knoops et al., 2015). Post-exposure prophylaxis should also be an option for MSM after a high-risk exposure (Landovitz et al., 2012; Shoptaw and Reback, 2007).

HIV testing and linkage to care and treatment for those who test HIV-positive should also be a priority. The CDC recommends that MSM test for HIV every 12 months, and while we found that MSM who injected meth were more likely to test for HIV than those who inject other drugs, more than a third had not tested in the past 12 months. This group should be a focus for efforts to increase HIV testing. A majority of MSM who were aware of their HIV-positive status reported being on antiretroviral treatment. Linkage to and retention in care, adherence to antiretroviral treatment, and ensuring viral suppression among HIV-positive MSM would likely reduce the risk of onward transmission within networks of MSM who inject meth given the high rates of risk behaviors among those who are HIV-positive. Testing and treatment of STIs in this group may be another way to reduce the risk for HIV acquisition, as STIs have been shown to increase the risk for HIV transmission among MSM (Bernstein et al., 2010; Jin et al., 2010). Providers should screen for meth use among MSM, offer testing for HIV and STIs, link patients to treatment or prevention as appropriate, and provide referrals to drug treatment services (Shoptaw and Reback, 2007). For HIV-positive MSM who inject meth, access to affordable substance use treatment to reduce or cease meth use is also key to improving health and preventing HIV transmission.

4.1. Limitations

The analysis is subject to several limitations. All risk behaviors are self-reported; however, we have no reason to believe that there would be a reporting bias by drug most commonly injected. It is possible that MSM who engage in sexual risk behaviors are also more likely to use meth (Degenhardt et al., 2007). However, previous work, including longitudinal studies and event-level analyses, provides evidence of a causal link between meth use and sexual risk behaviors (Colfax et al., 2005; Hoenigl et al., 2016; Vosburgh et al., 2012). A related consideration is that some men may initiate use of meth after becoming diagnosed with HIV, especially as many who live with HIV are older and struggle with stigma, low energy levels, and challenges with feeling desirable (Fawcett, 2015; Halkitis et al., 2016). However, by excluding men who started injecting after being diagnosed with HIV, we were able to limit this potential bias. We cannot infer causality, as the data are cross-sectional. In particular, we are assuming in our mediation analysis that past 12-month sexual risk behavior is a proxy for past behavior. This may not be correct, as people who are diagnosed with HIV may change their risk behaviors (Marks et al., 2005). However, for this bias to have an effect on our analysis, any such behavior change would have to be different among MSM who inject meth compared to MSM who primarily inject other drugs. A further limitation is that RDS sampling weights were not used in our analyses. However, we account for the potential sampling biases by clustering on recruitment chain in regression models. Finally, as the data were not weighted, all estimates are sample estimates and may not be representative of the underlying population of MSM who inject drugs in the participating cities or elsewhere. NHBS recruitment is conducted in cities with high HIV prevalence, and cities included in this analysis were mainly located in the West and in the South regions of the US; thus, our findings may not reflect HIV risk behaviors in other areas.

4.2. Conclusion

In this study, using data from 8 large US cities, we found that MSM who primarily injected meth were more likely to be HIV-positive compared to MSM who primarily injected other

drugs. Sexual risk behaviors account for the majority of excess HIV risk among MSM who primarily injected meth, and this group was less likely to report injection related risk behaviors. Previous work on meth use among MSM has mainly focused on non-injection meth use, and this paper fills an important gap documenting excess HIV risk associated with injection meth use, vis-à-vis sexual risk behavior, as compared to other injection drugs among MSM specifically. Understanding HIV risk behaviors and effective prevention interventions for MSM who inject drugs is key to effectively addressing the very high prevalence of HIV in this population.

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

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References

- Allen DR, Finlayson T, Abdul-Quader A, Lansky A, 2009. The role of formative research in the National HIV Behavioral Surveillance system. *Public Health Rep.* 124, 26–33.
- Al-Tayyib A, Koester S, Langedger S, Raville L, 2017. Heroin and methamphetamine injection: an emerging drug use pattern. *Subst. Use Misuse* 52, 1051–1058. [PubMed: 28323507]
- Baggaley RF, White RG, Boily M-C, 2010. HIV transmission risk through anal intercourse: systematic review, meta-analysis and implications for HIV prevention. *Int. J. Epidemiol* 39, 1048–1063. [PubMed: 20406794]
- Ballester J, Valentine G, Sofuoglu M, 2017. Pharmacological treatments for methamphetamine addiction: current status and future directions. *Expert Rev. Clin. Pharmacol* 10, 305–314.
- Bernstein KT, Marcus JL, Nieri G, Philip SS, Klausner JD, 2010. Rectal gonorrhea and chlamydia reinfection is associated with increased risk of HIV seroconversion. *J. Acquir. Immune Defic. Syndr* 53, 537–543. [PubMed: 19935075]
- Bluthenthal RN, Chu D, Wenger LD, Bourgois P, Valente T, Kral AH, 2018. Differences in time to injection onset by drug in California: implications for the emerging heroin epidemic. *Drug Alcohol Depend.* 185, 253–259. [PubMed: 29477084]
- Boddiger D, 2005. Metamphetamine use linked to rising HIV transmission. *Lancet* 365, 1217–1218. [PubMed: 15816071]
- Bourne A, Reid D, Hickson F, Torres-Rueda S, Steinberg P, Weatherburn P, 2015. “Chemsex” and harm reduction need among gay men in South London. *Int. J. Drug Policy* 26, 1171–1176. [PubMed: 26298332]
- Broz D, Pham H, Spiller M, Wejnert C, Le B, Neaigus A, Paz-Bailey G, 2014. Prevalence of HIV infection and risk behaviors among younger and older injecting drug users in the United States, 2009. *AIDS Behav.* 18, 284–296. [PubMed: 24242754]
- Bull SS, Piper P, Rietmeijer C, 2002. Men who have sex with men and also inject drugs— profiles of risk related to the synergy of sex and drug injection behaviors. *J. Homosex* 42, 31–51. [PubMed: 12066991]
- Burt RD, Thiede H, 2014. Evidence for risk reduction among amphetamine-injecting men who have sex with men: results from national HIV behavioral surveillance surveys in the Seattle area 2008–2012. *AIDS Behav.* 18, 1998–2008. [PubMed: 24728999]
- Centers for Disease Control and Prevention (CDC), 2016. HIV Infection Risk, Prevention, and Testing Behaviors Among Men Who Have Sex with Men— National HIV Behavioral Surveillance, 20 US Cities, 2014. HIV Surveillance Special Report. Centers for Disease Control and Prevention, Atlanta, pp. 1–32.

- Centers for Disease Control and Prevention (CDC), 2015. HIV Infection, Risk, Prevention, and Testing Behaviors Among Persons Who Inject Drugs—National HIV Behavioral Surveillance: Injection Drug Use, 20 U.S. Cities, 2012, HIV Surveillance Special Report. Centers for Disease Control and Prevention, Atlanta.
- Colfax GN, Mansergh G, Guzman R, Vittinghoff E, Marks G, Rader M, Buchbinder S, 2001. Drug use and sexual risk behavior among gay and bisexual men who attend circuit parties: a venue-based comparison. *J. Acquir. Immune Defic. Syndr* 28, 373–379. [PubMed: 11707675]
- Colfax G, Coates TJ, Husnik MMJ, Huang Y, Buchbinder S, Koblin B, Chesney M, Vittinghoff E, Team ES, 2005. Longitudinal patterns of methamphetamine, popper (amyl nitrite), and cocaine use and high-risk sexual behavior among a cohort of San Francisco men who have sex with men. *J. Urban Health* 82, i62–i70. [PubMed: 15738319]
- Degenhardt L, Mathers B, Guarinieri M, Panda S, Phillips B, Strathdee S, 2007. The Global Epidemiology of Methamphetamine Injection: a Review of the Evidence on Use and Associations With HIV and Other Harm. National Drug and Alcohol Research Centre, University of NSW, Sydney.
- Drumright LN, Patterson TL, Strathdee SA, 2006. Club drugs as causal risk factors for HIV acquisition among men who have sex with men: a review. *Subst. Use Misuse* 41, 1551–1601. [PubMed: 17002993]
- Fawcett D, 2015. *Lust, Men, and Meth: A Gay Man's Guide to Sex and Recovery*. S. FL Center for Counseling and Therapy, Inc., Copper City, pp. 226.
- Forrest DW, Metsch LR, LaLota M, Cardenas G, Beck DW, Jeanty Y, 2010. Crystal methamphetamine use and sexual risk behaviors among HIV-positive and HIV-negative men who have sex with men in South Florida. *J. Urban Health* 87, 480–485. [PubMed: 20101468]
- Gallagher KM, Sullivan PS, Lansky A, Onorato IM, 2007. Behavioral surveillance among people at risk for HIV infection in the U.S.: the national HIV behavioral surveillance system. *Public Health Rep.* 122 (Suppl. (1)), 32–38. [PubMed: 17354525]
- Glick SN, Burt R, Kummer K, Tinsley J, Banta-Green CJ, Golden MR, 2018. Increasing methamphetamine injection among non-MSM who inject drugs in King County, Washington. *Drug Alcohol Depend* 182, 86–92. [PubMed: 29175463]
- Grov C, Breslow AS, Newcomb ME, Rosenberger JG, Bauermeister JA, 2014. Gay and bisexual men's use of the internet: research from the 1990s through 2013. *J. Sex Res* 51, 390–409. [PubMed: 24754360]
- Halkitis PN, Parsons JT, Stirratt MJ, 2001. A double epidemic: crystal methamphetamine drug use in relation to HIV transmission among gay men. *J. Homosex* 41, 17–35. [PubMed: 11482426]
- Halkitis PN, Fischgrund BN, Parsons JT, 2005. Explanations for methamphetamine use among gay and bisexual men in New York City. *Subst. Use Misuse* 40, 1331–1345. [PubMed: 16048820]
- Halkitis PN, Levy MD, Solomon TM, 2016. Temporal relations between methamphetamine use and HIV seroconversion in gay, bisexual, and other men who have sex with men. *J. Health Psychol* 21, 93–99. [PubMed: 24578373]
- Heckathorn DD, 1997. Respondent-driven sampling: a new approach to the study of hidden populations. *Soc. Probl* 44, 174–199.
- Hernan MA, Robins JM, 2010. *Causal Inference*. Chapman and Hall/ CRC, Boca Raton, FL.
- Hoenigl M, Chaillon A, Moore DJ, Morris SR, Smith DM, Little SJ, 2016. Clear links between starting methamphetamine and increasing sexual risk behavior: a cohort study among men who have sex with men. *J. Acquir. Immune Defic. Syndr* 71, 551–557. [PubMed: 26536321]
- Ibañez GE, Purcell DW, Stall R, Parsons JT, Gómez CA, 2005. Sexual risk, substance use, and psychological distress in HIV-positive gay and bisexual men who also inject drugs. *AIDS* 19, S49–S55. [PubMed: 15838194]
- Jin F, Prestage GP, Imrie J, Kippax SC, Donovan B, Templeton DJ, Cunningham A, Mindel A, Cunningham PH, Kaldor JM, Grulich AE, 2010. Anal sexually transmitted infections and risk of HIV infection in homosexual men. *J. Acquir. Immune Defic. Syndr* 53, 144–149. [PubMed: 19734801]
- Kirby T, Thornber-Dunwell M, 2013. High-risk drug practices tighten grip on London gay scene. *Lancet* 381, 101–102. [PubMed: 23320280]

- Knoops L, Bakker I, van Bodegom R, 2015. Tina and Slamming: MSM, Crystal Meth and Intravenous Drug Use in a Sexual Setting. Soa Aids Nederland, Amsterdam.
- Kral AH, Lorvick J, Ciccarone D, Wenger L, Gee L, Martinez A, Edlin BR, 2005. HIV prevalence and risk behaviors among men who have sex with men and inject drugs in San Francisco. *J. Urban Health* 82, i43–i50. [PubMed: 15738321]
- Kurtz SP, 2005. Post-circuit blues: motivations and consequences of crystal meth use among gay men in Miami. *AIDS Behav.* 9, 63–72. [PubMed: 15812614]
- Landovitz RJ, Fletcher JB, Inzhakova G, Lake JE, Shoptaw S, Reback CJ, 2012. A novel combination HIV prevention strategy: post-exposure prophylaxis with contingency management for substance abuse treatment among methamphetamine-using men who have sex with men. *AIDS Patient Care STDS* 26, 320–328. [PubMed: 22680280]
- Lansky A, Abdul-Quader AS, Cribbin M, Hall T, Finlayson TJ, Garfein RS, Lin LS, Sullivan PS, 2007. Developing an HIV behavioral surveillance system for injecting drug users: the national HIV behavioral surveillance system. *Public Health Rep.* 122 (Suppl. (1)), 48–55.
- Lorvick J, Martinez A, Gee L, Kral AH, 2006. Sexual and injection risk among women who inject methamphetamine in San Francisco. *J. Urban Health* 83, 497–505. [PubMed: 16739050]
- Mansergh G, Shouse R, Marks G, Guzman R, Rader M, Buchbinder S, Colfax G, 2006. Methamphetamine and sildenafil (Viagra) use are linked to unprotected receptive and insertive anal sex, respectively, in a sample of men who have sex with men. *Sex. Transm. Infect* 82, 131–134. [PubMed: 16581738]
- Mansergh G, Purcell DW, Stall R, McFarlane M, Semaan S, Valentine J, Valdiserri R, 2006a. CDC consultation on methamphetamine use and sexual risk behavior for HIV/STD infection: summary and suggestions. *Public Health Rep.* 121, 127–132. [PubMed: 16528944]
- Mansergh G, Purcell DW, Stall R, McFarlane M, Semaan S, Valentine J, Valdiserri R, 2006b. CDC consultation on methamphetamine use and sexual risk behavior for HIV/STD infection: summary and suggestions. *Public Health Rep.* 121, 127–132. [PubMed: 16528944]
- Marks G, Crepaz N, Senterfitt JW, Janssen RS, 2005. Meta-analysis of high-risk sexual behavior in persons aware and unaware they are infected with HIV in the United States: implications for HIV prevention programs. *J. Acquir. Immune Defic. Syndr* 39, 446–453. [PubMed: 16010168]
- Nakamura N, Semple SJ, Strathdee SA, Patterson TL, 2009. Methamphetamine initiation among HIV-positive gay and bisexual men. *AIDS Care* 21, 1176–1184. [PubMed: 20024778]
- Peck JA, Reback CJ, Yang MX, Rotheram-Fuller ME, Shoptaw S, 2005. Sustained reductions in drug use and depression symptoms from treatment for drug abuse in methamphetamine-dependent gay and bisexual men. *J. Urban Health* 82, i100–i108. [PubMed: 15738315]
- Prestage G, Grierson J, Bradley J, Hurley M, Hudson J, 2009. The role of drugs during group sex among gay men in Australia. *Sex. Health* 6, 310–317. [PubMed: 19917200]
- Rawson RA, Marinelli-Casey P, Anglin MD, Dickow A, Frazier Y, Gallagher C, Galloway GP, Herrell J, Huber A, McCann MJ, 2004. A multi-site comparison of psychosocial approaches for the treatment of methamphetamine dependence. *Addiction* 99, 708–717. [PubMed: 15139869]
- Raymond HF, Chen Y-H, Ick T, Scheer S, Bernstein K, Liska S, Louie B, Pandori M, McFarland W, 2013. A new trend in the HIV epidemic among men who have sex with men, San Francisco, 2004–2011. *J. Acquir. Immune Defic. Syndr* 62, 584–589. [PubMed: 23334505]
- Reback CJ, 1997. The Social Construction of a Gay Drug: Methamphetamine Use Among Gay and Bisexual Males in Los Angeles, CA. Report for the City of Los Angeles. AIDS Coordinator, Los Angeles.
- Reback CJ, Larkins S, Shoptaw S, 2004. Changes in the meaning of sexual risk behaviors among gay and bisexual male methamphetamine abusers before and after drug treatment. *AIDS Behav.* 8, 87–98. [PubMed: 15146136]
- Reback CJ, Fletcher JB, Shoptaw S, Grella CE, 2013. Methamphetamine and other substance use trends among street-recruited men who have sex with men, from 2008 to 2011. *Drug Alcohol Depend.* 133, 262–265. [PubMed: 23890490]
- Richard AJ, Mosier V, Atkinson JS, 2002. New syringe acquisition and multi-person use of syringes among illegal drug users. *J. Public Health Policy* 23, 324–343. [PubMed: 12325289]

- Robins JM, 2003. Semantics of causal DAG models and the identification of direct and indirect effects. In: Green P, Hjort N, Richardson S (Eds.), *Highly Structured Stochastic Systems*. Oxford University Press, Oxford, pp. 70–81.
- Ropelewski LR, Mancha BE, Hulbert A, Rudolph AE, Martins SS, 2011. Correlates of risky injection practices among past-year injection drug users among the US general population. *Drug Alcohol Depend.* 116, 64–71. [PubMed: 21227602]
- Rose VJ, Raymond HF, Kellogg TA, McFarland W, 2006. Assessing the feasibility of harm reduction services for MSM: the late night breakfast buffet study. *Harm Reduct. J* 3, 29. [PubMed: 17018154]
- Scott JC, Woods SP, Matt GE, Meyer RA, Heaton RK, Atkinson JH, Grant I, 2007. Neurocognitive effects of methamphetamine: a critical review and meta-analysis. *Neuropsychol. Rev* 17, 275–297. [PubMed: 17694436]
- Semple SJ, Patterson TL, Grant I, 2002. Motivations associated with methamphetamine use among HIV men who have sex with men. *J. Subst. Abuse Treat* 22, 149–156. [PubMed: 12039618]
- Shoptaw S, Reback CJ, 2007. Methamphetamine use and infectious disease-related behaviors in men who have sex with men: implications for interventions. *Addiction* 102 (Suppl. (1)), 130–135. [PubMed: 17493062]
- Shrem MT, Halkitis PN, 2008. Methamphetamine abuse in the United States contextual, psychological and sociological considerations. *J. Health Psychol* 13, 669–679. [PubMed: 18519440]
- Spindler HH, Scheer S, Chen SY, Klausner JD, Katz MH, Valleroy LA, Schwarcz SK, 2007. Viagra, methamphetamine, and HIV risk: results from a probability sample of MSM, San Francisco. *Sex. Transm. Dis* 34, 586–591. [PubMed: 17334264]
- Substance Abuse and Mental Health Services Administration (SAMHSA) Center for Behavioral Health Statistics and Quality, 2016. Treatment episode data set (TEDS): 2004–2014. National Admissions to Substance Abuse Treatment Services. BHSIS Series S-84, HHS Publication No. (SMA) 16–4986. Substance Abuse and Mental Health Services Administration, Rockville, MD.
- Substance Abuse and Mental Health Services Administration (SAMHSA) Office of Applied Studies, 2010. Treatment episode data set (TEDS) 1998–2008. National Admissions to Substance Abuse Treatment Services. DASIS Series: S-50, HHS Publication No. (SMA) 09–447. Substance Abuse and Mental Health Services Administration, Rockville, MD.
- Sullivan AK, 2015. Club drugs: what’s happening? *Sex. Transm. Infect* 91, 388.
- US Public Health Service, 2014. Preexposure Prophylaxis for the Prevention of HIV Infection in the United States– 2014. A Clinical Practice Guideline. Centers for Disease Control and Prevention, Atlanta.
- Von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, Initiative S, 2014. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *Int. J. Surg* 12, 1495–1499. [PubMed: 25046131]
- Vosburgh HW, Mansergh G, Sullivan PS, Purcell DW, 2012. A review of the literature on event-level substance use and sexual risk behavior among men who have sex with men. *AIDS Behav.* 16, 1394–1410. [PubMed: 22323004]
- Vu NTT, Maher L, Zablotska I, 2015. Amphetamine-type stimulants and HIV infection among men who have sex with men: implications on HIV research and prevention from a systematic review and meta-analysis. *J. Int. AIDS Soc* 18, 19273. [PubMed: 25609214]
- Wagner KD, Pollini RA, Patterson TL, Lozada R, Ojeda VD, Brouwer KC, Vera A, Volkmann TA, Strathdee SA, 2011. Cross-border drug injection relationships among injection drug users in Tijuana, Mexico. *Drug Alcohol Depend.* 113, 236–241. [PubMed: 20889270]
- Zeger SL, Liang K-Y, 1986. Longitudinal data analysis for discrete and continuous outcomes. *Biometrika* 42, 121–130.
- Zierler S, Krieger N, Tang Y, Coady W, Siegfried E, DeMaria A, Auerbach J, 2000. Economic deprivation and AIDS incidence in Massachusetts. *Am. J. Public Health* 90, 1064–1073. [PubMed: 10897184]
- Zule WA, Desmond DP, 1999. An ethnographic comparison of HIV risk behaviors among heroin and methamphetamine injectors. *Am. J. Drug Alcohol Abuse* 25, 1–23. [PubMed: 10078975]

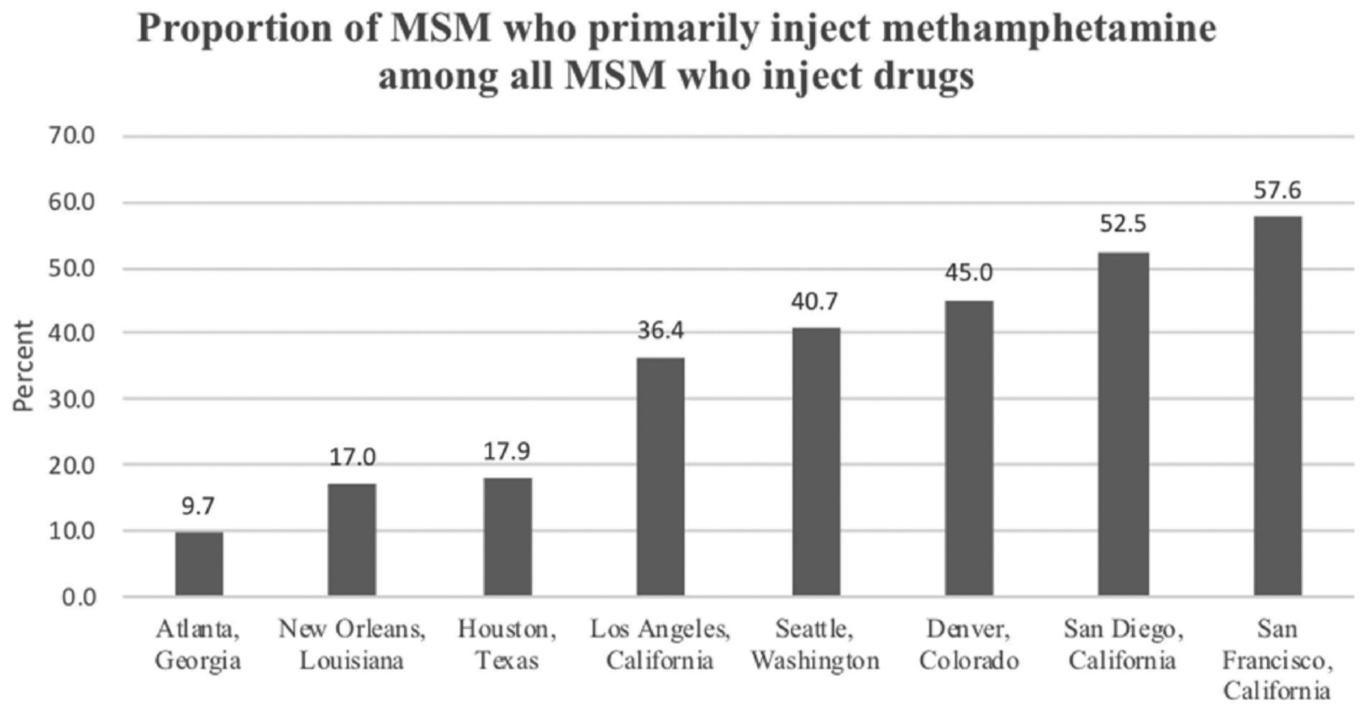


Fig. 1. Percentage of men who have sex with men who also inject drugs who primarily inject methamphetamine, 8 US Cities, National HIV Behavioral Surveillance, 2012 and 2015.

Demographic characteristics, sexual and drug use risk behaviors and use of services by drug injected most frequently, men who have sex with men and who inject drugs, National HIV Behavioral Surveillance, 2012 and 2015.

Table 1

	Drug injected most frequently			Total			p-value ^b
	Meth	Any other drug		Meth	Any other drug		
	n	Col %	n	Col %	N	N	
DEMOGRAPHICS							
Age							
18–34	89	27.5	148	23.2	237	237	0.005
35–44	109	33.6	116	18.2	225	225	
> =45	126	38.9	373	58.6	499	499	
Race							
Black	46	14.3	295	46.5	341	341	0.04
Hispanic/Latino ^a	50	15.5	72	11.4	122	122	
White	191	59.3	224	35.3	415	415	
Other	35	10.9	43	6.8	78	78	
Education							0.02
Less than HSG	51	15.7	173	27.2	224	224	
HS diploma or equiv	118	36.4	239	37.5	357	357	
Some college/tech/postgrad	155	47.8	225	35.3	380	380	
Employment							0.16
Working full or part time	57	17.6	115	18.1	172	172	
Not working	267	82.4	522	82.0	789	789	
Has health insurance							0.32
	230	71.0	334	52.4	564	564	
Homeless ^b							0.02
Not homeless past 12 months	93	28.7	112	17.6	205	205	
Has been homeless past 12 mo or currently	231	71.3	525	82.4	756	756	
Arrested past 12 months ^c							0.12
	277	85.5	578	90.7	855	855	
Poverty ^d							0.52
Above poverty guidelines	95	29.4	151	23.8	246	246	

	Drug injected most frequently				Total	p-value ^b
	Meth		Any other drug			
	n	Col %	n	Col %		
At or below poverty guidelines	228	70.6	484	76.2	712	0.0002
Sexual identity						
Heterosexual or "Straight"	40	12.4	147	23.1	187	
Homosexual or gay	143	44.3	97	15.2	240	
Bisexual	140	43.3	393	61.7	533	
SEXUAL RISK BEHAVIORS						
Total number of anal sex partners past 12 months						
Mean (95%CI)	15.4	(8.5-22.3)	3.6	(2.9-4.2)		< 0.0001
Median (IQR)	2	(1.0-7.0)	1	(0.0-3.0)		0.0002
Total number of unprotected condomless anal sex partners past 12 months						0.0004
0	111	34.6	309	48.9	420	
1-4	117	36.5	265	41.9	382	
5 or more	93	29.0	58	9.2	151	
Mean (95%CI)	13.3	(6.5-20.0)	2.4	(1.8-3.0)		< 0.0001
Median (IQR)	1	(0-5.0)	1	(0-2.0)		< 0.0001
Received money or drugs in exchange for sex, past 12 months	144	44.9	380	59.8	524	0.06
Sex with female past 12 months	160	49.4	493	77.4	653	< 0.0001
Shared needles past 12 months	82	25.6	319	50.5	401	0.0005
DRUG USE						
Number of receptive sharing partners						
Mean (95%CI)	1.5	(0.7-2.3)	3.2	(2.5-4.0)		0.02
Median (IQR)	0	(0-1)	1	(0-3)		< 0.0001
Injection frequency (any drug)						< 0.0001
Once a day or more than once a day	149	46.3	419	65.8	568	
More than once a week	108	33.5	117	18.4	225	
Once a week or less	65	20.2	101	15.9	166	
Non-injection crack use past 12 months	104	32.0	382	60.2	486	0.001
Non-injection meth use past 12 months	262	80.9	277	43.6	539	0.0009
Binged drinking past 30 days	97	30.1	384	60.6	481	0.001

	Drug injected most frequently			Total			
	Meth	Any other drug		n	Col %	N	p-value ^h
TESTING AND USE OF SERVICES							
HIV positive ^e	95	29.3	99	15.5	194	0.0005	
On antiretroviral treatment ^f	36	75.0	56	72.7	125	0.70	
Seen health care provider past 12 months	268	82.7	499	78.3	767	0.31	
Received HIV test past 12 months ^g	164	65.1	318	54.1	482	0.03	
Received HIV intervention past 12 months	112	34.6	181	28.6	293	0.15	
Gonorrhea or Chlamydia diagnosis past 12 months	41	12.7	31	4.9	72	0.0003	
Syphilis diagnosis past 12 mo	36	11.1	15	2.4	51	0.0008	
Total	324	100.0	637	100.0	961		

^aHispanics/Latinos can be of any race.

^bHomeless defined as living on the street, in a shelter, in a single room occupancy hotel, or in a car.

^cIncarcerated defined as having been held in a detention center, jail, or prison, for more than 24 h.

^dPoverty level is based on household income and household size.

^ePWID with a reactive rapid NHBS HIV test result confirmed by supplemental laboratory-based testing, or a positive result by laboratory-based testing without a rapid HIV test.

^fAmong people who reported receiving a positive HIV test result prior to the survey.

^gExcluding long standing HIV-positive participants (diagnosed more than 12 months prior to interview).

^hPoisson regression models with generalized estimating equations (GEE), clustered on recruitment chain and adjusted for city, were used to compare primary drug injected across levels of categorical variables, and to test for differences in means for continuous variables. To test for differences in medians for continuous variables we used the median test.

Table 2

HIV prevalence by demographic characteristics, sexual and drug use risk behaviors and use of services among men who have sex with men and who inject drugs, National HIV Behavioral Surveillance, 2012 and 2015.

	HIV-positive ^a		Row %	p-value ^f
	N	n		
DEMOGRAPHICS				
Age				0.004
18–34	237	30	12.7	
35–44	225	58	25.8	
> = 45	499	106	21.2	0.96
Race				
Black	341	71	20.8	
Hispanic/Latino ^b	122	24	19.7	
White	415	82	19.8	
Other	78	16	20.5	
Education				
Less than HSG	224	31	13.8	0.008
HS diploma or equiv	357	68	19.1	
Some college/tech/postgrad	380	95	25.0	
Employment				0.84
Working full or part time	172	33	19.2	
Not working	789	161	20.4	
Has health insurance				< 0.0001
Yes	564	140	24.8	
No	397	54	13.6	
Homeless^c				0.0002
Not homeless past 12 months	205	70	34.2	
Has been homeless past 12 mo or currently	756	124	16.4	
Arrested past 12 months^d				0.2
No	106	28	26.4	
Yes	855	166	19.4	
Poverty^e				0.91
Above poverty guidelines	246	50	20.3	
At or below poverty guidelines	712	144	20.2	
Sexual identity				< 0.0001
Heterosexual or “Straight”	187	12	6.4	
Homosexual or gay	240	101	42.1	
Bisexual	533	80	15.0	
SEXUAL RISK BEHAVIORS				
Total number of unprotected condomless anal sex partners past 12 months				0.0009
0	420	69	16.4	

	HIV-positive ^a		Row %	p-value ^f
	N	n		
1–4	382	66	17.3	
5 or more	151	59	39.1	
Received money or drugs in exchange for sex, past 12 months				0.25
Yes	524	95	18.1	
No	433	99	22.9	
Sex with female past 12 months				< 0.0001
No	308	119	38.6	
Yes	653	75	11.5	
Drug injected most frequently				< 0.0001
Methamphetamine	324	95	29.3	
Any other drug	637	99	15.5	
Shared needles past 12 months				0.0009
No	552	130	23.6	
Yes	401	62	15.5	
Injection frequency				0.002
One or more times per day	568	90	15.9	
More than once a week	225	62	27.6	
Once a week or less	166	40	24.1	
Non-injection crack use past 12 months				0.0003
No	473	119	25.2	
Yes	486	75	15.4	
Non-injection meth use past 12 months				0.09
No	420	75	17.9	
Yes	539	119	22.1	
Gonorrhea or Chlamydia diagnosis past 12 months				0.02
No	889	168	18.9	
Yes	72	26	36.1	
Syphilis diagnosis past 12 mo				0.005
No	910	167	18.4	
Yes	51	27	52.9	
Total		194	20.2	

^aPWID with a reactive rapid NHBS HIV test result confirmed by supplemental laboratory-based testing, or a positive result by laboratory-based testing without a rapid HIV test.

^bHispanics/Latinos can be of any race.

^cHomeless defined as living on the street, in a shelter, in a single room occupancy hotel, or in a car.

^dIncarcerated defined as having been held in a detention center, jail, or prison, for more than 24 h.

^ePoverty level is based on household income and household size.

^fPoisson regression models with generalized estimating equations (GEE), clustered on recruitment chain and adjusted for city, were used to compare primary drug injected across levels of categorical variables, and to test for differences in means for continuous variables. To test for differences in medians for continuous variables we used the median test.

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Table 3

Multivariable analysis of the association between primary drug injected and HIV prevalence among men who have sex with men and who inject drugs, 8 cities, NHBS 2012 and 2015.

	<u>Model 1^a</u>		<u>Model 2^a</u>		<u>Model 3^a</u>	
	<u>N = 955</u>		<u>N = 947</u>		<u>N = 939</u>	
	<u>aPR</u>	<u>95% CI</u>	<u>aPR</u>	<u>95% CI</u>	<u>aPR</u>	<u>95% CI</u>
Primary drug injected	Ref		Ref		Ref	
Methamphetamine	1.48	1.08–2.03	1.44	1.07–1.95	1.30	0.94–1.79
Any other drug	Ref		Ref		Ref	
Shared needles past 12 months						
Yes			0.81	0.66–0.995	0.79	0.64–0.98
No			Ref		Ref	
Total number of condomless anal sex partners past 12 months						
None					Ref	
1–4					0.95	0.67–1.34
5 or more					1.43	1.06–1.94

^aPoisson regression models with generalized estimating equations (GEE), clustered on recruitment chain and adjusted for city, were used to compare primary drug injected across levels of categorical variables. All models control for age, education, race, self-reported sexual identity.