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Substance-Use and Sexual Harm-Reduction Strategies of Methamphetamine-Using Men Who Have Sex with Men and Inject Drugs

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Abstract

Research indicates that men who have sex with men (MSM), use methamphetamine, and inject drugs are at high risk of HIV infection and they employ multiple harm reduction strategies simultaneously to reduce that risk. In this study, we identified substances most commonly injected and harm reduction strategies most often employed by methamphetamine-using MSM, used latent class analysis (LCA) to identify patterns of harm reduction strategies, and differentiated MSM within each class by individual characteristics. We analyzed data from 284 participants who completed an online cross-sectional survey. Commonly injected substances were methamphetamine (93.70%), gamma-hydroxybutyrate/gamma-butyrolactone (41.55%), flunitrazepam (40.49%), and cocaine (35.56%). The substance-use strategies most often used were avoidance of sharing needles (85.92%) and use of bleach to clean drug paraphernalia (64.08%). The sexual strategy most often used was avoidance of condomless anal intercourse (CAS) while using drugs (77.11%). Using an LCA approach, we identified three classes distinguishable by age, race/ethnicity, and outness. One class (19%) employed *lay* strategies to reduce harm: they avoided sharing drug preparation equipment, serosorted when sharing needles and equipment or having CAS, and practiced withdrawal when having CAS. The largest class (53%) *combined* sexual and substance use strategies: they avoided sharing needles, used bleach to clean needles and equipment, avoided CAS when using drugs, and used extra lubricant when having CAS. The remaining class (28%) employed only *substance-use* rather than sexual strategies. More MSM of color were in the substance-use class, and more young, non-Hispanic White men were in the lay class. The low utilization of sexual strategies by younger, non-Hispanic White men in the lay class is concerning as they are just as likely as older, non-Hispanic White men in the combined class to have CAS with multiple male partners. Interventionists should consider these differences when developing interventions tailored to methamphetamine-using MSM.

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CONFLICT OF INTEREST

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Keywords

HIV prevention; gay men; latent class analysis; injection drug use; methamphetamine

Introduction

Among men who have sex with men (MSM), those who use methamphetamine and inject drugs are at higher risk of HIV infection than those who do not (Centers for Disease Control and Prevention, 2011, 2013). Consequently, this population is encouraged to reduce harms associated with high-risk behaviors (Denning & Little, 2012), by using such strategies as those previously applied to injection drug use and sexual behaviors (Harris & Rhodes, 2011; Marlatt, Blume, & Parks, 2001; Marlatt & Tapert, 1993; Parsons et al., 2005; Springer, 1991; Wilkerson, Smolenski, Morgan, & Rosser, 2012).

Several harm reduction strategies can be used simultaneously. Substance-use strategies include not sharing drug paraphernalia, or rinsing shared syringes and rigs in a bleach–water solution (Abdala, Crowe, Tostov, & Heimer, 2004; Abdala, Gleghorn, Carney, & Heimer, 2001; Cox, Lawless, Cassin, & Geoghegan, 2000; Koester, Glanz, & Baron, 2005; Richard, Mosier, & Atkinson, 2002). Sexual strategies include considering HIV status (serosorting) when deciding whether to share drug paraphernalia or to engage in condomless anal intercourse (CAS; Chen, Vallabhaneni, Raymond, & McFarland, 2012; Eaton, Kalichman, O’Connell, & Karchner, 2009; Philip, Yu, Donnell, Vittinghoff, & Buchbinder, 2010; Yang, Tobin, & Latkin, 2011; Zablotska et al., 2009), or using sexual positioning or withdrawal during CAS (Binson, Pollack, Blair, & Woods, 2010; Dubois-Arber, Jeannin, Locicero, & Balthasar, 2012; Marks et al., 2010; McDaid & Hart, 2012; Parsons et al., 2005; Van de Ven et al., 2002). Biomedical strategies (i.e., pre- and post-exposure prophylaxis, and undetectable viral loads) to reduce HIV risk (Campbell, Herbst, Koppenhaver, & Smith, 2013) are not yet widely used among HIV–negative MSM (Krakower et al., 2012; Mutua et al., 2012), but their acceptability is increasing (Escudero et al., 2014; Holt, 2014; Young, Li, & McDaid, 2013; Young & McDaid, 2014).

Harm reduction can be considered a latent variable consisting of two factors: substance-use strategies and sexual behavior strategies. Variable-centered approaches like regression identify how multiple behaviors are associated with an outcome, but a person-centered approach like latent class analysis (LCA) can illuminate how an individual’s multiple strategies interact to predict successful HIV-risk avoidance. As a statistical modeling technique, LCA reveals unobserved heterogeneity in a population and creates meaningful subgroups (latent classes) from observed indicators (McCutcheon, 1987). Whereas factor analysis groups items into common themes across individuals, LCA groups individuals by items or themes so that individuals *within* classes are more similar than are individuals *between* classes (Muthén & Muthén, 2000). When identified classes represent a range of well-defined distinct characteristics, those classifications can inform class-specific tailored interventions. LCA has shown promise in identifying distinct profiles of alcohol and substance abusers (Argawal, Lynskey, Madden, Bucholz, & Heath, 2007; Green et al., 2010; Kuramoto, Bohnert, & Latkin, 2011; Monga et al., 2007; Noor, Ross, Lai, & Risser, 2014;

Watson et al., 2013), but, to our knowledge, has not been applied to harm reduction strategies among methamphetamine-using MSM.

This study sought to identify harm reduction patterns and differentiate individuals within classes by individual characteristics. The first aim was to identify classes of harm reduction strategies; the second was to examine within classes how demographic, substance use, and sexual behavior characteristics differ among individuals. Results will inform the design and implementation of risk-reduction programs for target populations.

Methods

Study design

Between July and October 2012, we recruited methamphetamine-using MSM ($N=343$) for the online *ParTy Study* using online recruitment (Wilkerson, Shenk, Grey, Rosser, & Noor, 2013). Eligible participants were 18 years or older, resident in the United States or its territories, reported sex with a man or using methamphetamine in the past 30 days. Participants were offered a \$25 e-gift card for survey completion (median time=21 min).

A standard de-duplication, cross-validation, and data cleaning process excluded participants with fraudulent, impossible, or nonsensical data patterns (Konstan, Rosser, Ross, Stanton, & Edwards, 2005; Pequegnat et al., 2007; Wilkerson et al., 2013). Ineligible or duplicate data were removed from the final dataset. For analytical purposes, we restricted our sample to participants who reported injecting drugs in the past 30 days ($N=284$). The institutional review boards of the first and fifth authors' institutions approved all study procedures.

Measures

Participants provided demographic information and responded to items about recent substance use, sexual behavior, and psychosocial measures. All items included a "refuse to answer" option.

Harm reduction latent variable—In this LCA, the latent variable represented categories of strategies that participants employed to prevent HIV infection. With our community advisory board, we developed items to use as indicators of harm reduction latent categories. Each item provided the stem, "In the last 30 days, did you...", with optional responses of yes or no.

We used items relevant only to participants who reported injecting substances and having sex with a man in the past 30 days. Nine items measured latent variables: four substance use-related and five sexual behavior-related. Substance use items asked participants if they had avoided sharing needles or drug preparation equipment, used bleach to rinse rigs, and discussed HIV status before sharing needles or drug preparation equipment. Sexual behavior items asked if participants had avoided CAS when using drugs; used extra lube during CAS; had CAS with people whose HIV status was the same; withdrew prior to ejaculation when they were the insertive partner (termed "pull out before cumming when you topped"); and ensured partner(s) withdrew prior to ejaculation when they were the receptive partner (termed "make sure he pulled out before cumming when you bottomed"). For analytical

purposes, we combined into one item labeled “withdrawal” persons who used withdrawal as either insertive or receptive partner. These eight items are commonly used HIV risk reduction practices (Chen et al., 2012; Parsons et al., 2005; World Health Organization, 2012).

Covariates—Individual-level variables were included as covariates in adjusted latent class regression models. Demographic variables included age, race/ethnicity, and relationship status. We used one Likert-type item to determine how open (“out”) participants were to others as a gay, bisexual, or a man attracted to other men. The item included five response options: (1) *not at all open (out)*; (2) *open (out) to a few people I know*; (3) *open (out) to about half the people I know*; (4) *open (out) to most people I know*; and (5) *open (out) to all or most people I know*. This item was treated as a continuous variable; a higher score indicated greater outness. We used the shortened Drug Abuse Screening Test (DAST-10; Skinner & Center for Addiction and Mental Health, 1982) to identify participants who might be substance-use dependent. This scale was treated as continuous; in our sample, it had an alpha reliability of 0.65. To identify participants engaging in sexual behavior that increased HIV risk, we calculated how many participants reported CAS with a male partner. We created the variable from two items: one asked about the number of male partners; a second asked about the number with whom they had CAS.

Statistical analysis

In this two-step analysis, we first used LCA to identify homogeneous classes based on harm reduction items, and second, multinomial latent regression to identify differences in predictors of class membership among individuals.

Using Mplus 7.1 (Muthén & Muthén, 1998–2012), we estimated preliminary LCA models to identify a model with the optimal number of classes. First, we fit LCA models with increasing numbers of classes without covariates, using the Akaike information criterion (AIC), Bayesian information criterion (BIC), and the Lo-Mendel-Rubin likelihood ratio test (LMR-LRT) to identify the number of classes that best fit the data. BIC is recommended because it relies on both the log likelihood and adjusted sample size (Magidson & Vermunt, 2004; Nylund, Asparouhov, & Muthén, 2007). Lower BIC indicate better fit, thus a model with a low BIC is generally preferable over one with a high BIC. LMR-LRT is useful when comparing LCA models with different classes (Lo, Mendel, & Rubin, 2001). LMR-LRT uses an approximation of the distribution of the difference of the two log likelihoods instead of the χ^2 distribution (Nylund et al., 2007). LMR-LRT provides a *p*-value, which determines whether the *K*-class model fit the data better than the *K*–1 class. A low *p*-value indicates the *K*–1 class model should be rejected in favor of the *K*-class model. In their recent simulation study, Nylund, Aapaouhov, and Muthén (2007) examined BIC and LMR-LRT performance in determining numbers of classes in three mixture models (LCA, factor mixture, and growth mixture models) with three sample sizes (200, 500, and 1,000), and found that LMR-LRT outperforms BIC.

We also used the *entropy* statistic to summarize information about classifications (Ramaswamy, Desarbo, Reibstein, & Robinson, 1993). Entropy value ranges from 0 to 1;

values closer to 1 indicate a better classification. However, no clear cut-point exists for the entropy value to ensure a minimum level of good classification. For the final LCA model, we also considered parsimony and substantive interpretation of latent classes.

After identifying the LCA model with the optimal number of latent classes without covariates, we incorporated posterior probabilities for latent class membership for each participant using Stata 12.1 (StataCorp LP, 2012). We used the χ^2 test, F-test, and Fisher's exact test to examine relationships between individual-level variables and identified latent classes. Because inclusion of covariates sometimes changes classifications (Muthén & Muthén, 1998–2012), we fit the final LCA model with selected covariates for classification. To predict class membership, we adjusted for all other variables in the model. LCA models were estimated using maximum likelihood. We used several starting values to avoid *local maxima* and to ensure all values converged to identical solutions (Muthén & Muthén, 1998–2007). We specified 500 sets of random starting values for the initial stage and 50 optimizations for the final stage of maximum likelihood optimization. All statistical tests were two-tailed. We used a cut-point of a conditional probability greater than or equal to 0.50 as an indication of substantive item endorsement by MSM within a class.

Results

Study participants

Table 1 presents analytic sample ($N=284$) characteristics. Participants were young (mean age of 29.30 ± 4.92 years), racially and ethnically diverse (49.30% racial-ethnic minority), educated (41.55% had at least a bachelor's degree), in a long-term relationship (90+ days) (80.36%), and HIV-negative (97.54%). Participants were out to about half the people they knew (3.05 ± 0.80).

Most participants were more likely to inject stimulants than downers. When heroin was injected, it was more commonly injected in combination with a stimulant than alone. The substances most commonly injected were methamphetamine (93.70%), gamma-hydroxybutyrate/gamma-butyrolactone (41.55%), flunitrazepam (40.49%), and cocaine (35.56%). Participants had substantial substance-use dependence (6.44 ± 1.11 ; range, 3–10) and reported CAS with three or more male partners (3.86 ± 3.39 ; range, 0–45) in the past 30 days.

Model selection

The models were fit with increasing numbers of class sizes until the lowest sample-adjusted BIC (aBIC) was reached. Table 2 summarizes fit indices for preliminary LCA models. The 5-class model had the highest entropy value, but the 4-class model had the lowest AIC and aBIC, indicating a better fit than the 5-class model. However, a larger LMR-LRT p -value for the 4-class model (0.17) indicated the 3-class model should not be rejected in favor of the 4-class model but the smaller LMR-LRT p -value for the 3-class model (< 0.001) indicated that the 2-class model should be rejected in favor of the 3-class model. Also, the lower AIC and aBIC for the 3-class model compared with those for the 2-class model indicated that the 3-

class model was a better fit. Therefore, the 3-class model was selected and used for subsequent analyses.

Latent class probability and class description

Table 3 summarizes frequencies of harm reduction strategies included in the LCA and the conditional probabilities for each item in the final adjusted 3-class model. Overall, participants used more substance-use than sexual strategies. In the past 30 days, most participants avoided sharing needles (85.92%), used bleach to clean needles and equipment (64.08%), serosorted when sharing needles and equipment (51.58%), avoided CAS when using drugs (77.11%), and serosorted when having CAS (50.35%). Although most participants reported withdrawal when having CAS as insertive partner (56.54%) or receptive partner (56.69%), only one-third (35.92%) reported using both withdrawal strategies.

We labeled the three resulting classifications based on the potential risk associated with strategies endorsed by most MSM within a particular class. The smallest class (19% of participants) was distinguished by a reliance on lay strategies, which may be intuitive but are not frequently recommended by health professionals. Men in the *lay class* had a high probability of avoiding sharing drug preparation equipment, serosorting when sharing needles and equipment or having CAS, and practicing withdrawal when having CAS. The largest class (53% of participants) was distinguished by a combined reliance on substance-use and sexual strategies frequently recommended by health professionals. Men in the *combined class* had a high probability of avoiding sharing needles, using bleach to clean needles and equipment, avoiding CAS when using drugs, and using extra lubricant when having CAS. The remaining class (28% of participants) was distinguished by reliance on only substance use strategies frequently recommended by health professionals. Men in the *substance-use class* had a high probability of using substance-use strategies and no sexual strategies.

Latent class membership prediction

Bivariate comparison of covariates identified age, race/ethnicity, educational achievement, relationship status, outness, substance-use dependence, and having CAS with a male partners as being significantly associated with class membership ($p < 0.05$; data not shown). Table 4 presents the results from the final latent class regression model using these covariates to predict class membership. Participants who were younger, Hispanic (compared with non-Hispanic White), in a long-term relationship, substance-use dependent, and had fewer CAS partners had higher odds of being in the lay class than in the combined class. Participants who were more out as gay/bisexual had higher odds of being in the substance-use and in the combined classes than in the lay class. In addition, participants who were single, less educated, and had more CAS partners had higher odds of being in the substance-use class than in the lay class.

Discussion

Methamphetamine-using MSM who inject drugs reported using various harm reduction strategies to reduce HIV risk. When injecting, most reported avoiding shared syringes and nearly two-thirds avoided shared drug preparation equipment. Although CAS was common, three-quarters reported avoiding CAS when using drugs and approximately half reported serosorting and withdrawal. This suggests that these men hear public health messages and integrate them into their behavioral scripts.

Using LCA, we empirically classified study participants into three classes, based on eight substance-use and sexual harm reduction strategies. Latent class regression showed that strategies varied by age, race/ethnicity, and outness. Younger MSM had higher odds of being in the lay or substance-use classes than in the combined class. Hispanic and Asian MSM had higher odds of being in the lay class than in the combined class. MSM who were less out had higher odds of being in the lay class than in the combined class or substance-use class.

Intervention messages should be tailored to each group. MSM in the lay class—men who are likely to be young, Hispanic or Asian, substance-use dependent, less out, and have CAS with fewer partners—need intervention messages that reinforce avoidance of sharing needles and drug preparation equipment while ensuring they know how to use bleach to clean needles. This group also needs reinforcement for CAS avoidance and increased lubricant use. Because men in the lay class are less out, reaching them using communication strategies reliant on gay media could be difficult. Research should thus explore how best to reach young Hispanic and Asian methamphetamine-using MSM.

Because men in the other two classes are equally out, traditional communication strategies that rely on gay media should reach them successfully. MSM in combined strategies class—men who are older, non-Hispanic, in a long-term relationship, and more out—should reinforce existing behaviors while encouraging avoidance of sharing drug preparation equipment. The most attention, however, should be paid to MSM in the substance-only strategies class—men who are young, non-Hispanic, single, and out. These men rarely use sexual strategies, even when having CAS with multiple male partners. Although younger MSM may be using biomedical interventions, this is unlikely to be the dominant explanation for their use of fewer harm reduction strategies in this sample because data were collected in 2012 before biomedical prevention was marketed to young MSM. Thus, research is needed to understand the risk context and motivations for engaging in risk, so that tailored interventions can be developed for this subpopulation of methamphetamine-using MSM.

Our results should be interpreted in light of important study limitations. First, methamphetamine-using MSM in the United States represent a distinct subpopulation and results may not be generalizable to other populations. Second, our recruitment was specific to completing an online cross-sectional survey. Recruitment with other study designs might produce different results. Third, we did not ask participants about the extent to which they used other sexual harm reduction strategies, such as strategic positioning, or biomedical harm reduction strategies. Future research should explore the use of these harm reduction

strategies by methamphetamine-using MSM. Fourth, methamphetamine-using MSM use various harm reduction strategies to minimize HIV risk, resulting in heterogeneous harm reduction patterns that likely vary by context. Our study classifies a small sample of methamphetamine-using MSM by self-reported harm reduction strategies; analysis of larger sample size and consideration of the context and order substance use would produce a more robust solution.

This study describes the prevalence of harm reduction strategies among a sample of methamphetamine-using MSM and highlights LCA in exploring heterogeneity by identifying empirically derived patterns of harm reduction and differentiating individuals within each class by individual characteristics. Our findings indicate that HIV risk varies within this subpopulation per their substance-use and sexual harm reduction patterns. Age, race/ethnicity, and outness can help to explain differences in these patterns; young non-Hispanic methamphetamine-using MSM used the fewest harm reduction strategies. Collectively, our findings inform an empirical basis for designing tailored and targeted prevention and treatment interventions encouraging methamphetamine-using MSM to use both substance-use and sexual harm reduction strategies.

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Table 1Demographic, substance use, and behavioral characteristics of the analytic sample ($N = 284$).

Characteristic	n ^a	%
Race/ethnicity		
White, non-Hispanic	144	50.70
African American	22	7.75
Native American	51	17.96
Asian American	21	7.39
Hispanic	46	16.20
Educational achievement		
High school diploma and some college	166	58.45
Bachelor's degree and above	118	41.55
Relationship status		
Single	54	19.64
In a long-term relationship (90+ days)	221	80.36
HIV status		
HIV-positive	7	2.46
HIV-negative/don't know	277	97.54
Substance injected in past 30 days		
Methamphetamine	282	93.70
Gamma-hydroxybutyrate/gamma-butyrolactone	118	41.55
Flunitrazepam	115	40.49
Cocaine	101	35.56
Methamphetamine + heroin	98	34.51
Cocaine + heroin	65	22.89
Heroin	57	20.07
3,4-methylenedioxymethamphetamine	25	8.80
Ketamine	24	8.45
	Mean $\pm$ SD	
Age	29.30 $\pm$ 4.92	
Outness ^b	3.05 $\pm$ 0.80	
Substance-use dependence ^c	6.44 $\pm$ 1.11	
Number of condomless anal intercourse male partners	3.86 $\pm$ 3.39	

^aDifferences in counts the result of missing items.^bOutness scores ranged from 1 to 5, with a higher score indicating greater outness.^cSubstance-use dependence scores ranged from 1 to 10; a score of 6–8 indicated substantial dependence and a score of 9–10 indicated severe dependence.

Table 2

Model fit indices of latent class analysis with increasing number of classes for the analytic sample ($N = 284$).

Criteria	Class 2	Class 3	Class 4	Class 5
AIC ^a	2783.10	2705.10	2697.03	2697.80
BIC ^b	2845.13	2799.97	2824.74	2858.35
aBIC ^c	2791.22	2717.53	2713.76	2718.83
LMR-LRT ^d	97.53	94.15	25.57	16.90
<i>p</i> -Value for LRT	< 0.001	< 0.001	0.17	0.22
Entropy	0.77	0.73	0.81	0.89

^a Akaike information criterion.

^b Bayesian information criterion.

^c Adjusted bayesian information criterion.

^d Lo-Mendell-Rubin adjusted likelihood ratio test.

Table 3

Sample prevalence, latent class probability, and conditional probability of the 3-class model with covariates for the analytic sample ($N = 284$)

	Overall	Lay Strategies	Combined Strategies	Substance-use Strategies
	N (%)	$n = 53$	$n = 146$	$n = 76$
Unconditional probability of each class		0.19	0.53	0.28
Conditional probability of endorsing each item				
Substance-use behavior:				
Avoid sharing needles	244 (85.92)	0.61	0.94	0.89
Use bleach to clean needles and equipment	182 (64.08)	0.33	0.82	0.55
Serosort when sharing needles and equipment	155 (51.58)	0.64	0.47	0.63
Avoid sharing drug preparation equipment	136 (48.06)	0.95	0.22	0.64
Sexual behavior:				
Avoid CAS ^a when using drugs	219 (77.11)	0.59	0.89	0.66
Serosort when having CAS	143 (50.35)	0.91	0.65	0.00
Use extra lubricant when having CAS	138 (48.59)	0.47	0.72	0.08
Withdrawal when having CAS	102 (35.92)	0.83	0.38	0.00

^aCondomless anal intercourse.

Table 4

Results of latent multinomial regression model: Predictors of class membership for the analytic sample ($N = 284$).^a

	Lay (n=53) vs. Combined (n=146)			Substance-use (n=76) vs. Combined (n=146)			Substance-use (n=76) vs. Lay (n=53)		
	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value
Age (in years)	0.86	[0.76–0.96]	0.009	0.88	[0.81–0.96]	0.005	1.03	[0.90–1.17]	0.66
African American ^b	0.45	[0.07–2.71]	0.38	1.69	[0.50–5.74]	0.39	3.76	[0.55–25.35]	0.17
Native American ^b	2.35	[0.82–6.76]	0.11	1.95	[0.79–4.81]	0.15	0.83	[0.22–3.16]	0.79
Asian American ^b	3.77	[1.01–14.01]	0.05	3.16	[0.54–18.57]	0.20	0.84	[0.17–4.17]	0.83
Hispanic ^b	4.47	[1.41–14.20]	0.001	1.78	[0.52–6.06]	0.36	0.40	[0.11–1.47]	0.17
Educational achievement (Bachelor's degree or above)	1.96	[0.82–4.70]	0.13	0.57	[0.27–1.18]	0.13	0.29	[0.10–0.84]	0.02
Relationship Status (In a long-term relationship)	4.10	[0.82–20.62]	0.09	0.11	[0.04–0.35]	<0.001	0.03	[0.01–0.14]	<0.001
Outness	0.30	[0.16–0.56]	<0.001	1.39	[0.83–2.33]	0.20	4.62	[2.25–9.48]	<0.001
Substance-use dependence	1.87	[1.14–3.07]	0.01	1.54	[0.93–2.54]	0.09	0.82	[0.52–1.29]	0.39
Number of CAS ^c male partners	0.68	[0.53–0.88]	0.003	0.98	[0.67–1.44]	0.92	1.43	[1.00–2.07]	0.05

^aModels were adjusted for age, race/ethnicity, educational achievement, relationship status, outness, substance-use dependence, and CAS with 2+ male partners. Bolded values are statistically significant at $p < 0.05$.

^bNon-Hispanic White (reference).

^cCondomless anal intercourse.