Preintervention Profiles of Information, Motivational, and Behavioral Self-Efficacy for Methamphetamine Use and HIV Medication Adherence Among Gay and Bisexual Men

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Abstract

Although rates of crystal methamphetamine use in the United States have fallen from their peak in the mid-2000s, use remains a major public health concern, which disproportionately affects gay and bisexual men (GBM). It poses a particular challenge for HIV-positive men, for whom it has been linked to medication adherence problems as well as compromised immune function. Although the information, motivation, and behavioral skills (IMB) model has been widely used to conceptualize health behavior, little is known about GBM's initial levels of information, motivation, and behavioral self-efficacy to improve HIV medication adherence and to reduce crystal methamphetamine use at the outset of treatment. The present study identified profiles of IMB factors related to HIV medication adherence and crystal methamphetamine use in a sample of 210 HIV-positive GBM who consented to participate in an intervention study. Results indicated three distinct patterns of IMB factors. The largest group was ready to change both adherence and methamphetamine use ($n = 104$). This group also had depression scores that were significantly lower than other groups. A second group appeared ready to change medication adherence, but was ambivalent about changing methamphetamine use ($n = 60$). This group reported significantly more symptoms of methamphetamine dependence than the other groups. A third group was characterized by global IMB barriers to change ($n = 46$). Results are discussed in the context of tailoring psychoeducation, motivational interviewing, and cognitive behavioral interventions to match these preintervention patterns of IMB factors.

Keywords: HIV, crystal methamphetamine, gay and bisexual men, drug use, IMB model

Introduction

IN THE UNITED STATES, methamphetamine use among gay and bisexual men (GBM) has fluctuated over time. It rose significantly in the early 2000s,¹⁻³ fell from 2004 to 2011, and began to rise again thereafter.⁴ Though presently lower than peak levels, methamphetamine use among GBM continues to be elevated⁵⁻⁷ compared with use among heterosexuals. GBM differ in their methamphetamine use by HIV serostatus, with HIV-positive GBM having higher rates of use than their HIV-negative counterparts.⁸⁻¹⁰

Methamphetamine use is of particular concern because of its association with HIV infection and related complications. Men who use methamphetamines are more likely to engage in sexual behaviors that put them at risk of contracting or transmitting HIV. Specifically, GBM who use methamphetamines are more likely to have sex without condoms, have group sex, participate in sexual marathons, have multiple partners, be high while having sex, have sex with serodiscordant partners, and have sex with injection drug users.¹¹⁻¹³

Methamphetamine use is also associated with negative health consequences, particularly for HIV-positive GBM.

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Use of crystal methamphetamine has been linked to poor HIV medication adherence^{14,15} due to difficulties in maintaining a medication schedule, eating regularly, and having consistent sleep patterns.⁶ Methamphetamine users are also less likely to receive HIV care after being diagnosed with HIV.¹³ These factors contribute to worse HIV disease outcomes¹⁶ such as more rapid HIV progression,^{16–18} increased viral loads,¹ and increased resistance to highly active antiretroviral therapy (HAART).^{19,20}

In addition to HIV-related health consequences, the use of crystal methamphetamine has been associated with negative mental health consequences, particularly among HIV-positive GBM. Methamphetamine use has been associated with several mood, anxiety, and personality disorders, including major depressive disorder,^{21,22} bipolar disorder, post-traumatic stress disorder, and cluster B personality disorders (e.g., borderline personality disorder).²³ In some cases, methamphetamine use contributes to mental health problems (e.g., substance-induced mood disorder) and is sometimes used to self-medicate a pre-existing mental health condition such as depression. Regardless of this, mental health impairments are often associated with sexual risk taking,²⁴ poor immunosuppression,²⁵ and overall worse HIV-related health.

Mental health problems have also been found to be associated with methamphetamine use both directly and indirectly through substance use coping (i.e., using substances to cope with stressful events²⁶). Existing literature suggests that depression symptoms, in particular, are relevant to methamphetamine use for GBM. Evidence from studies of GBM specifically suggests that depression symptoms are commonly reported by those who use methamphetamines^{22,27}; further, depression symptoms tend to remit after reductions in methamphetamine use after intervention.^{21,22} The ongoing threat of methamphetamine use to the health of GBM necessitates a theoretically informed examination of factors associated with use to inform intervention development. Further, because of the strong association with HIV medication adherence, mental health, and related immune functioning among HIV-positive men, special attention to factors that influence methamphetamine use and medication adherence among HIV-positive GBM is warranted.

The Information, Motivation, and Behavioral Skills (IMB) model, widely used in health psychology, may provide a useful framework for understanding critical factors among HIV-positive GBM who have problems with medication adherence and methamphetamine use. The model was initially developed to promote AIDS risk behavior change.²⁸ It was later adapted to help providers and researchers better understand, predict, and promote HAART adherence.²⁹ The model posits that, for behavior change to happen, three things are needed: information, motivation, and behavioral skills.^{28,30} Information refers to behavior-related information and heuristics, motivation refers to personal and social motivation, and behavioral skills, such as self-efficacy, are those that are essential to performing a specific health behavior.³¹ The IMB model contends that behavior change can be achieved by increasing someone's knowledge about a particular topic (i.e., sex risk or drug use), fostering motivation to change, and developing skills needed to change behavior.²⁹

There is some evidence to suggest that pretreatment levels of motivation moderate response to intervention^{32,33}; however, this research has generally treated the construct of motivation in a

manner that is conceptually distinct from the IMB framework. In contrast, research within the IMB framework has generally examined IMB factors (including motivation to change the target behavior) as mediators of the effect of treatment.^{34,35} The existing research on motivation as a moderator of treatment outcome suggests the innovative hypothesis that the IMB model has the potential to moderate response to treatment and/or account for outcome differences above and beyond treatment condition.

To date, no research has examined the potential for IMB factors to inform the tailoring of drug use intervention among HIV-positive GBM. A critical first step in this research is to first identify whether meaningful subgroups or patterns of IMB factors are present within the population of HIV-positive GBM who might seek treatment for methamphetamine use. Given links between methamphetamine use and medication adherence problems within this population, identification of these initial patterns of IMB factors related to medication adherence and methamphetamine use may help providers better understand their HIV-positive GBM patients. An examination of preintervention levels of IMB factors may assist clinicians in tailoring treatment for HIV-positive GBM in a way that maximizes the men's internal strengths, helps inform treatment expectations and needs, and facilitates more focused positive health outcomes. Considering these implications, this study aimed at identifying preintervention patterns of IMB factors related to medication adherence and methamphetamine use before intervention in a sample of HIV-positive methamphetamine-using GBM. Although no specific hypotheses were made about class composition, it was hypothesized that participants could be classified into discrete groups on the basis of IMB responses. Post-hoc analyses examined between-pattern differences in demographic factors as well as missed medication, viral load, amount of methamphetamine use, and level of comorbid depression were also examined.

Method

Participants and procedure

Participants were recruited from the New York City area, and they completed a baseline survey and a face-to-face interview before participating in a randomized clinical trial that was aimed at reducing methamphetamine use and addressing medication adherence. Eligible participants were biologically male, at least 18 years of age, HIV positive (confirmed with documentation), currently prescribed an HAART medication regimen, and English speaking. In addition, screening criteria required that participants report at least 3 days of methamphetamine use during the previous 90 days and 1 day in the past 30 days, as well as having missed a minimum of 3 days of HIV medication in the past 30 days. Those eligible and interested in participating were scheduled for a baseline appointment at our research center. Participants were compensated \$40 for the 2-h baseline assessment. All procedures were approved by the Institutional Review Board of the investigators' institution.

Measures

Demographic characteristics. Participants reported their age, race and ethnicity, sexual orientation, income, education level, relationship status, and year of HIV diagnosis, using audio-assisted computer administered self-interviews (ACASI).

Information—methamphetamine knowledge. Knowledge related to methamphetamine was assessed by using the Methamphetamine Information Scale, which was developed specifically for use in this study, based on previous qualitative work in this area.^{36,37} The scale contained 11 items assessing knowledge of methamphetamine's interaction with HIV (e.g., "Methamphetamine can interact with some HIV meds leading to an increase in side effects") as well as the effects of methamphetamine use on general health (e.g., "Methamphetamine use can damage the liver"). Participants indicated their agreement or disagreement with each statement on a five-point scale ranging from *Strongly Disagree* to *Strongly Agree*. The scale showed good internal consistency, $\alpha = 0.74$.

Motivation—pros and cons of methamphetamine use. Motivation regarding methamphetamine use was measured by utilizing an adapted methamphetamine-specific Decisional Balance Scale.³⁸ This 26-item scale measured participants' perceived pros (e.g., "Using meth helps me to have fun and socialize") and cons (e.g., "I seem to get myself into trouble when using meth") of methamphetamine use. Participants indicated the importance of each statement for their decision making on a scale of 1 (*Not At All*) to 5 (*Extremely*), generating a pros score and a cons score, where higher scores indicate stronger perceptions of pros and cons. The two subscales showed high internal consistency, $\alpha = 0.91$ and $\alpha = 0.86$, respectively.

Behavioral skills—self-efficacy for reducing methamphetamine use. Self-efficacy for reducing or avoiding methamphetamine use was measured by an adapted 15-item Drug-Taking Confidence Questionnaire.³⁹ We used three subscales measuring confidence in being able to refrain from drug use despite: urges and temptations to use (e.g., "I would be able to resist the urge to use meth if I began to think about how good a high had felt"); social pressure to use (e.g., "I would be able to resist the urge to use meth if I were pressured to use meth and felt that I couldn't refuse"); and pleasant times with others (e.g., "I would be able to resist the urge to use meth if I wanted to celebrate with a friend"). Participants rated their confidence on a scale from 1 (*Not at all confident*) to 6 (*Completely confident*), with higher scores indicating greater perceived self-efficacy in resisting methamphetamine use. The three subscales showed strong internal consistency, $\alpha = 0.85$, $\alpha = 0.92$, and $\alpha = 0.91$, respectively.

Information—adherence knowledge. Level of knowledge about HIV medication adherence was measured by using the HAART Knowledge Questionnaire. The six-item measure assessed general adherence-related knowledge (regardless of the specific prescribed regimen), including the effects of adherence on viral load and general health. Participants indicated their agreement or disagreement with each statement (e.g., "If I take my HIV medications, my viral load will go down") on a five-point scale, ranging from *Strongly Disagree* to *Strongly Agree*. This measure demonstrated strong internal consistency, $\alpha = 0.84$.

Motivation—pros and cons for adherence. Motivation for medication adherence was measured by utilizing an adapted adherence-specific 12-item Decisional Balance

Scale.^{40,41} Sample items include "My HIV medications will be able to control my HIV illness if I take them the way my doctor told me" and "Being adherent all the time interferes with my social life." Participants indicated the importance of each statement for their decision making on a scale of 1 (*Not At All*) to 5 (*Extremely*), generating a pros score and a cons score, where higher scores indicate stronger perceptions of pros and cons. The two subscales showed good internal consistency, $\alpha = 0.82$ and $\alpha = 0.78$, respectively.

Behavioral skills—adherence self-efficacy. Participants' perceived self-efficacy for achieving and maintaining adherence was assessed by using a 17-item instrument specifically developed for HIV medication adherence self-efficacy, based on previous pilot work.^{41,42} Participants rated how confident they felt that they could take their HIV medications as required under several circumstances (e.g., being on vacation; when socializing at night) on a five-point scale, ranging from *Strongly Disagree* to *Strongly Agree*. This scale demonstrated strong internal consistency, $\alpha = 0.90$.

Depression. Participants completed the Center for Epidemiological Studies Depression Scale (CESD⁴³), which consists of 20 items measuring how often symptoms of depression have been experienced in the past 3 months (modified from the original CESD's 7-day period). Response options range from 0 (*rarely or none of the time*) to 3 (*most or all of the time*). The scale showed strong internal consistency, $\alpha = 0.88$.

Recent medication adherence and methamphetamine use. Drug use and HIV medication adherence data were collected by using a 14-day timeline follow-back (TLFB) interview.^{15,44} A trained interviewer asked participants to recall the past 14 days, and to mark memorable events (e.g., vacations, birthdays, paycheck days, parties) on the calendar as anchor points. Participants then reported whether or not they had used methamphetamine on each day, as well as whether they had used any other drug and whether they had missed any doses of their HIV medications. To diminish any incentive to under-report methamphetamine use, participants also completed a urine drug-screen. Although the sensitivity period for the urine drug-screen was shorter than the TLFB assessment window, concordance between urine screen results and self-report was high (90.1%) providing support for the validity of TLFB responses.

Biological indicators of immune functioning. Viral load and CD4 counts were obtained through an onsite blood draw by a certified phlebotomist. CD4 levels were reported as the absolute number of CD4 T-lymphocytes per cubic millimeter. HIV selectively infects CD4 T-cells, killing these cells. Viral load is a measure of HIV RNA in peripheral blood. Viral load numbers can reach into the millions, so to adjust for skew, viral load was log transformed.

Data analysis

Statistical analyses were conducted in two phases by using Mplus v7.2.⁴⁵ First, latent class analysis (LCA) was utilized to identify patterns of IMB factors in the absence of any covariates. LCA solutions with 1 to 4 profiles were tested.

The fit of the various models was then compared by using five criteria: Lo-Mendel Ruben likelihood ratio tests (LMR-LRT), the Akaike information criterion (AIC), Bayesian information criterion (BIC), entropy values, and class size. Significant values on the LMR-LRT tests were used to identify the appropriate number of classes by comparing the comparison model ($k-1$) with the k class model the data.⁴⁶ However, smaller AIC and BIC values suggested the goodness of fit relative to the amount of information that is lost when imposing the tested model to the data. Finally, entropy values, which range from 0 to 1, were used to assess the quality of class assignment.⁴⁷ In addition, class size was considered, as classes of very small size have limited predictive utility. Following current recommendations for best practices, once the number of classes was established by identifying the best-fitting model, we calculated an additional model in which class membership was predicted by demographic variables of interest, including: age, race and ethnicity, education, income, and relationship status. This approach allows covariates to exert some influence on class assignment.

Finally, associations between IMB classes that were identified in LCA and preintervention functioning were examined by using regression analyses conducted in SPSS version 24. Linear regressions were specified for continuous outcomes (depression, log viral load, and CD4 count); whereas negative binomial regressions were specified for count outcomes (number of days on which medications were missed and number of days on which methamphetamine was used). Between-class differences for each outcome were evaluated by using estimated-marginal means with a Least Significant Difference (LSD) post-hoc adjustment for multiple comparisons. All regression models controlled for age, race and ethnicity, and education.

It is possible to evaluate the association between class membership and outcome variables in the context of the LCA solution itself. The regression approach utilized here was used to accommodate a collection of outcomes that have diverse distributions. As the primary goals were exploratory, we, therefore, sought to examine links between class membership and a collection of outcome variables, some of which have count distributions. Calculation of an LCA on a group of variables that are heterogeneous with regard to distribution is problematic. The analytic approach utilized here permitted a consistent examination across outcome variables of interest.

Results

Recruitment efforts resulted in 210 men who successfully completed both baseline assessments to be counted in the final analytic sample reported here. The 210 included participants were mostly non-white (66.7%), gay (89.5%), and single (66.7%), with a mean age of 41 years ($SD=8.8$) and relatively low educational and income levels, as displayed in Table 1. On average, participants had been HIV positive for 13.9 years ($SD=7.6$), and 37.6% had a detectable viral load (defined as more than 200 copies per ML). The average number of days of methamphetamine use in the past 14 days was 5.8 ($SD=5.9$), and the average number of days that participants took all their HAART medication in the past 14 days was 9.3 ($SD=4.3$).

Latent class analysis

LCA solutions with one through four classes were specified, and model fit was determined. Model fit statistics are in Table 2. All fit indicators favored the two-class model over the single-class model, and the three-class model over the two-class model. Although AIC, BIC, and entropy improved with the inclusion of a fourth class, the LMR-LRT statistic was not significant. In addition, the four-class solution was characterized by the emergence of a small class ($n=15$). Therefore, the three-class solution was retained in subsequent analyses. Subsequently, a model was run in which class membership was predicted by age, race and ethnicity, education, income, and relationship status. Covariates exerted a minimal influence on the class solution. Class assignments changed for six (1%) participants. Only education level significantly predicted IMB class. Those participants who reported a 4-year degree or more were significantly more likely to be in either Class 1 ($B=0.01$; $SE=0.002$; $\exp B=1.01$; $p<0.01$) or Class 2 ($B=0.01$; $SE=0.002$; $\exp B=1.01$; $p<0.01$), classes relative to Class 3.

We examined between-class differences on variables involved in classification to derive class labels. ANOVA results testing the significance of between-class differences are provided in Table 3.

Class 1 was characterized by a general pattern of IMB factors that are not conducive to change for either behavior. Levels of adherence knowledge and self-efficacy among these men were significantly lower than those of the other classes. In addition, these men perceived significantly fewer advantages and more drawbacks to HIV medication adherence than both other groups. With regard to methamphetamine use, this group also reported significantly lower levels of methamphetamine knowledge, and levels of self-efficacy for reducing methamphetamine use that were significantly lower than Class 2. They perceived more benefits to methamphetamine use compared with Class 2 and significantly fewer cons than Class 3. Consistent with a pattern of IMB factors that generally promotes the status quo, this group was labeled *Change Resistant*.

In contrast, Class 2 was characterized by a general pattern of IMB factors that might be viewed as conducive to change. This group had significantly higher adherence knowledge and self-efficacy compared with the Change-Resistant class. These men perceived significantly more benefits and fewer drawbacks to medication adherence than the Change-Resistant class. With regard to methamphetamine, this group had significantly higher self-efficacy for reducing methamphetamine use than both other classes. Although this group was similar to Class 1 with respect to perceived drawbacks of methamphetamine use, they perceived significantly fewer benefits to methamphetamine use than the Change-Resistant class. Further, their methamphetamine knowledge scores were significantly higher than those of the Change-Resistant class. Consistent with a pattern of IMB factors generally promoting change, this group was labeled *Change Ready*.

Class 3 was characterized by a pattern of IMB factors that are clearly conducive to change regarding medication adherence while simultaneously characterized by some ambivalence with regard to changing methamphetamine use. This group had significantly higher adherence knowledge and self-efficacy scores while perceiving fewer drawbacks to adherence compared with the Change-Resistant group. This

TABLE 1. DEMOGRAPHIC CHARACTERISTICS AND CLASS COMPOSITION

	Total N=210 n (%)	Latent class membership			Test statistic
		Class 1: change resistant n=46 n (%)	Class 2: change ready n=104 n (%)	Class 3: adherence ready/meth ambivalent n=60 n (%)	
Race and ethnicity					
Black	72 (34.3)	13 (28.3)	40 (38.5)	19 (31.7)	$\chi^2(6) = 4.29$
White	70 (33.3)	19 (41.3)	28 (26.9)	23 (38.3)	
Latino	54 (25.7)	11 (23.9)	28 (26.9)	15 (25.0)	
Other	14 (6.7)	3 (6.5)	8 (7.7)	3 (5.0)	
Sexual identity					
Gay	188 (89.5)	43 (93.5)	90 (86.5)	55 (91.7)	$\chi^2(2) = 2.05$
Bisexual	22 (10.5)	3 (6.5)	14 (13.5)	5 (8.3)	
Education					
<4 year degree	126 (60.6)	26 (59.1)	65 (63.1)	35 (58.3)	$\chi^2(2) = 0.55$
4 year degree or more	82 (39.4)	19 (40.9)	38 (36.9)	25 (41.7)	
Annual income					
<\$30,000	167 (79.5)	35 (76.1)	81 (77.9)	51 (85.0)	$\chi^2(4) = 2.52$
\$30,000 or more	42 (20.0)	11 (23.9)	22 (21.2)	9 (15.0)	
Relationship status					
Unpartnered	140 (66.7)	28 (60.9)	68 (65.4)	44 (73.3)	$\chi^2(2) = 1.97$
Partnered	70 (33.3)	18 (39.1)	36 (34.6)	16 (26.7)	
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	
Age	40.8 (8.8)	38.2 (9.3) ^a	41.0 (8.9) ^{a,b}	42.5 (7.7) ^b	$F(2,207) = 3.2^*$
Viral load	2.6 (1.4)	2.8 (1.6)	2.7 (1.4)	2.3 (1.2)	$F(2,207) = 2.7$
CD4 count	458.2 (262.4)	450.3 (315.7)	427.5 (240.7)	517.0 (247.8)	$F(2,206) = 2.3$
		<i>M (SE)</i>	<i>M (SE)</i>	<i>M (SE)</i>	
Severity of meth dependence [†]	5.1 (3.0)	4.3 (0.36) ^a	4.5 (0.28) ^a	6.6 (0.41) ^b	$\chi^2(2) = 21.3^{**}$
Depression (CESD) [†]	20.0 (11.2)	24.2 (1.49) ^a	15.5 (0.95) ^b	24.4 (1.42) ^a	$\chi^2(2) = 40.3^{**}$
No. of adherent days [†]	9.3 (4.3)	8.4 (0.63)	9.5 (0.42)	9.4 (0.52)	$\chi^2(2) = 2.4$
No. of meth use days [†]	5.8 (5.7)	5.2 (0.67)	5.4 (0.49)	6.8 (0.92)	$\chi^2(2) = 2.3$

Within variables, cells having different superscripts differ at $p < 0.05$ by Fisher's exact test (categorical variables) and LSD (continuous variables) post hoc.

* $p < 0.05$.

** $p < 0.01$.

[†]Analysis included age, race and ethnicity (white vs. non-white), and education as covariates.

CESD, Center for Epidemiological Studies Depression Scale.

group also perceived more benefits to medication adherence than either of the other groups. In contrast, although this group was characterized by high scores on methamphetamine knowledge and high perceived drawbacks of methamphetamine use, this group was also characterized by significantly

higher perceived benefits of methamphetamine use and significantly lower self-efficacy for reducing use than both other groups. This group was labeled *Adherence Ready/Meth Ambivalent* to reflect the pattern of observed IMB factors.

Latent profile demographic characteristics

Table 1 provides demographic data for each latent class group. Tests of between-group differences suggested that the groups were equivalent with respect to racial, sexual identity, education, income, and relationship status composition. Individuals in the Change-Resistant group were significantly younger than those in the Adherence Ready/Meth Ambivalent group.

Latent profiles and pretreatment functioning

Methamphetamine use. Results of a negative binomial regression model controlling for age, race and ethnicity, and

TABLE 2. LATENT CLASS ANALYSIS: MODEL FIT STATISTICS

	AIC	BIC	LMR-LRT	p	Entropy
1 class	8502.40	8505.97			
2 class	5329.49	8335.02	191.65	<0.01	0.75
3 class	8237.64	8245.14	111.95	<0.01	0.80
4 class	8155.74	8165.20	102.16	0.09	0.86

p Value associated with the adjusted Lo-Mendel-Ruben Log-likelihood ratio test.

AIC, Akaike's information criterion; BIC, Sample size-adjusted Bayesian information criterion; LMR-LRT, adjusted Lo-Mendell-Ruben Log-likelihood ratio test.

TABLE 3. CLASS DIFFERENCES IN INFORMATION, MOTIVATION, AND BEHAVIORAL SKILLS FACTORS

	Total N = 210 M (SD)	Latent class membership			Test statistic F(2, 207)
		Class 1: change resistant n = 46 M (SD)	Class 2: change ready n = 104 M (SD)	Class 3: adherence ready/meth ambivalent n = 60 M (SD)	
Adherence-related IMB factors					
Adherence knowledge	23.6 (4.7)	18.7 (5.0) ^a	24.6 (3.7) ^b	25.8 (3.2) ^b	48.9**
Adherence pros	3.9 (0.8)	3.0 (0.7) ^a	4.0 (0.7) ^b	4.3 (0.6) ^c	60.3**
Adherence cons	2.5 (0.9)	3.0 (0.9) ^a	2.4 (0.9) ^b	2.4 (0.9) ^b	7.0**
Adherence self-efficacy	56.0 (11.9)	46.7 (10.2) ^a	59.2 (10.4) ^b	57.6 (12.1) ^b	21.9**
Methamphetamine-related IMB factors					
Methamphetamine knowledge	39.6 (5.3)	36.2 (5.2) ^a	40.7 (4.9) ^b	40.5 (5.1) ^b	14.1**
Methamphetamine pros	2.6 (0.8)	2.7 (0.8) ^a	2.4 (0.8) ^b	3.0 (0.7) ^c	11.5**
Methamphetamine cons	2.5 (0.9)	2.3 (0.7) ^a	2.3 (0.9) ^a	3.0 (1.0) ^b	13.9**
Drug-taking confidence					
Urges and temptations	3.4 (1.3)	2.8 (0.8) ^a	4.2 (1.0) ^b	2.3 (0.8) ^c	98.7**
Pleasant times with others	3.1 (1.4)	2.7 (1.1) ^a	4.0 (1.2) ^b	1.9 (0.9) ^c	71.7**
Social pressure to use	2.6 (1.3)	1.8 (0.8) ^a	3.5 (1.2) ^b	1.5 (0.5) ^c	103.7**

Within variables, cells having different superscript letters differ at $p < 0.05$ by LSD post hoc.

** $p < 0.01$.

IMB, information, motivation, and behavioral skills.

education suggested that the number of methamphetamine use days did not differ significantly across latent class groups (Table 1). In contrast, the Adherence Ready/Meth Ambivalent group reported significantly higher methamphetamine dependence severity scores compared with the other two classes (Table 1). These latter classes did not differ significantly from one another.

Depression. Regression results suggested that—after controlling for age, race and ethnicity, and education—the Change Ready group reported depression scores that were significantly lower than either the Change Resistant or the Adherence Ready, Meth Ambivalent classes (Table 1). These latter groups did not differ significantly from one another.

Medication adherence and immune functioning. Results of a negative binomial regression model controlling for age, race and ethnicity, and education suggested that the number of missed medication days did not differ significantly across latent IMB classes (Table 1). Consistent with this, average CD4 count was also equivalent across IMB classes as was viral load.

Discussion

These results illustrate the potential for diversity in IMB factors even among GBM who present with similar levels of substance use and medication adherence. Three distinct patterns of IMB factors were observed in this sample of HIV-positive GBM who reported methamphetamine use. These patterns imply different foci for intervention and different potential responses to specific intervention strategies. This heterogeneity in IMB presentation occurred in the absence of significant differences in most demographic characteristics, methamphetamine use, and HIV medication adherence

across groups. In other words, the most important implication of these findings is that similar levels of a target behavior (methamphetamine use and/or medication adherence) may mask meaningful heterogeneity in the factors that predict, underlie, or maintain that behavior. Since these latter factors are often the target of intervention, ignoring this heterogeneity may diminish intervention effectiveness and/or overlook an important predictor of treatment outcome.

Given the well-established association between methamphetamine use and HIV medication adherence,^{11–13} it is perhaps not surprising that two of the observed IMB patterns were characterized by consistency across IMB factors for these two behaviors. The Change-Resistant group was characterized by a pattern of IMB factors that favored the status quo (continuing drug use and poor medication adherence), whereas the Change Ready group was characterized by a pattern of IMB factors that favored change (reducing drug use and improving HIV medication adherence). The presence of an Adherence Ready, Meth Ambivalent group highlights the potential for within-person variability in motivation and self-efficacy related to change.

Differences in IMB patterns had no significant associations with behavior and immunological outcomes (i.e., methamphetamine use, medication adherence, or CD4 count). This finding is not surprising given that eligibility criteria were such that all participants reported using crystal methamphetamine on at least 3 days in the previous 30 days and also missing their HIV medication at least three times in the previous 30 days. However, IMB patterns were significantly associated with psychological functioning. GBM with higher knowledge and self-efficacy related to medication adherence and methamphetamine reduction (Change Ready group) reported significantly fewer depressive symptoms than those in other IMB pattern groups. Further, GBM with low knowledge and self-efficacy related to medication adherence and

methamphetamine reduction (Change-Resistant group) reported significantly higher methamphetamine dependency—or feeling like one cannot function normally without using methamphetamines. These findings suggest that HIV-positive GBM's psychological well-being may partly be associated with how well they understand medication and drug knowledge and believe that they can effectively use that information to change their behaviors. This association between psychological and IMB factors is supported by qualitative findings in which HIV-positive Latino men reported believing that pressures to adhere to HIV medication contributed to feelings of depression.⁴⁸ Although several intervention studies have noted the correspondence between depression and methamphetamine use,^{21,22} no studies have reported findings that assess the relationships between psychological functioning and IMB factors preintervention. More inquiry in this line of research is needed before we can understand how our findings may fit a larger body of scholarly literature.

Clinical implications

These findings suggest the innovative hypothesis that preintervention levels of IMB factors may inform the tailoring of interventions. This would imply that providers of substance use and HIV treatment interventions may find it useful to assess preintervention IMB levels on a routine basis. Substance abuse counselors, physicians, and other healthcare providers who work with these men may find that they encounter HIV-positive GBM in the three different IMB pattern groups (i.e., Change Resistant; Change Ready; and Adherence Ready, Meth Ambivalent) we have described in this article. Providers may find it helpful to approach medication adherence and substance use differently depending on their patients' knowledge, motivational, and self-efficacy levels.

Providers who encounter patients with low knowledge and self-efficacy (Change-Resistant group) may find that they need to focus on psychoeducation and increasing motivation. Psychoeducation related to HIV medications and the effects of substance use on immunological functioning, coupled with motivational interviewing⁴⁹ may prove beneficial in increasing insight and decreasing barriers to change. Providers who have patients with high medication adherence knowledge and self-efficacy but low methamphetamine knowledge and self-efficacy (Adherence Ready, Meth Ambivalent group) may find that they need to focus their energy on substance use. Psychoeducation may be useful in increasing drug knowledge and motivational interviewing strategies (e.g., behavior change planning and exploration of barriers to change). Cognitive behavioral therapy (CBT) skills (e.g., craving management) may prove helpful in increasing these men's self-efficacy related to drug use and decrease substance dependency. Finally, providers may find that using CBT methods (e.g., relaxation training and thought challenging) and supportive therapy help their patients with high knowledge and self-efficacy related to medication adherence and methamphetamine use (Change Ready) maintain mental and physical well-being. Overall, because many of the patterns observed had multiple deficits, there is compelling evidence for using a combination of interventions that integrate these components and allow for flexible sequencing. Information deficits might be best addressed by providing

psychoeducation to clients. Motivational interviewing and CBT may work best for addressing motivational and skill deficits, respectively. Interventions that incorporate all three components may prove particularly beneficial with HIV-positive GBM.

Strengths, limitations, and future directions

HIV-positive GBM have different levels of IMB factors when presenting for HIV and drug treatment. This study is the only study—to the authors' knowledge—that has found that this variation is related to differences in psychological distress. However, one limitation of our study is that we are unable to determine causation. The direction of the relationship between IMB factors and psychological functioning is unknown at this time. IMB factors may affect psychological well-being or the effect may be in the opposite direction; there may also be a bidirectional effect. Future studies may find it beneficial to study these factors longitudinally and conduct data analysis that permit directional hypothesis testing. IMB factors are amenable to change.^{29–31} We have proposed several behavioral change strategies (e.g., motivational interviewing, CBT, and psychoeducation) that have potential to increase IMB components and decrease negative psychological presentations. It has previously been shown that motivational interviewing and CBT skills can successfully reduce alcohol use and improve HIV medication adherence;⁵⁰ however, no studies have assessed the efficacy of an IMB intervention that is aimed at medication adherence and methamphetamine use among an exclusively HIV-positive GBM sample. Thus, the effectiveness of behavioral change strategies for this specific population remains unknown. Future studies may wish to examine these factors.

Conclusions

This is the first study to examine the preintervention levels of IMB among an exclusively HIV-positive GBM sample. We found that these men differ in their IMB levels related to medication adherence and drug use before they receive treatment. These preintervention IMB levels are related to differences in mental health that may have implications for HIV medication adherence and self-efficacy. Providers are encouraged to take IMB components into consideration when working with this population and to use tailored behavioral change techniques to increase the likelihood of the effectiveness of their treatments.

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