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Testing the efficacy of combined Motivational Interviewing and Cognitive Behavioral Skills Training to reduce methamphetamine use and improve HIV medication adherence among HIV-positive gay and bisexual men

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Abstract

Prior research has identified subgroups of HIV-positive gay and bisexual men (GBM) based upon information, motivation, and behavioral skills (IMB) profiles related to HIV medication adherence and methamphetamine use. We conducted a randomized controlled trial of a combined motivational interview (MI) and cognitive behavioral therapy (CBT) intervention tailored specifically to the unique context of HIV-positive GBM, and tested whether IMB profiles moderated treatment effects. HIV-positive GBM ($N = 210$) were randomized to MI+CBT or an attention-matched education control. Both conditions resulted in reduced methamphetamine use, improved medication adherence (and higher CD4 and lower viral loads), and fewer acts of condomless anal sex at 3, 6, 9 and 12 months post-intervention. Furthermore, the MI+CBT condition achieved greater improvements in medication adherence for men who had greater barriers to change compared to similarly-classified men in the control condition, suggesting the importance of pre-intervention profiles for tailoring future interventions.

Keywords

Crystal methamphetamine; HIV; men who have sex with men (MSM); drug intervention; IMB model

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COMPLIANCE WITH ETHICAL STANDARDS

Conflict of Interest: The authors declare that they have no conflict of interest.

Ethical Approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent: Informed consent was obtained from all individual participants included in the study.

INTRODUCTION

Use of methamphetamine ('crystal meth,' 'ice,' 'speed,' 'crank') remains a prominent health concern for many gay and bisexual men (GBM) in the United States—particularly among HIV-positive GBM, for whom recent estimates of use have approached 17% [1]. This rate was markedly higher than that reported by HIV-negative GBM (6.4%), and by the general population (0.3%) [2]. There is also evidence that rates of use are even higher in cities such as Los Angeles where rates ranging from 23–27% were observed among substance-using men who have sex with men (MSM) [3], and New York City (NYC) where a rate of 19.7% was observed among young GBM with a negative or unknown HIV status [4]. While trends in substance use have changed over the last decade with increasing rates of marijuana and opiate use, rates of methamphetamine use have remained relatively constant since the decline that occurred prior to the initiation of our study (i.e., 2008) [5,6].

The numerous serious health consequences of methamphetamine use include physical [7,8], neurological [9–11], psychological [12], and general health [13] problems. Among HIV-positive GBM, methamphetamine use has also been associated with increased viral load [14] and lowered immune functioning [15]. Methamphetamine use may also compound the deleterious impacts of HIV on neurological functioning [16–18] and immune functioning [19–21]. The possibility of harmful interactions with certain HIV medications [22] and the potential for methamphetamine to increase HIV replication and mutation [14,23] add further to concerns about methamphetamine use among HIV-positive GBM.

In addition to these health consequences, methamphetamine use in HIV-positive GBM is especially concerning given well-established links with reduced adherence to HIV medications [24–26] and with increased rates of sexual risk behaviors such as condomless anal sex [27]. More recently, the methamphetamine-sexual risk link has been substantiated in HIV-negative or unknown status GBM in NYC [26], in HIV-negative MSM in San Diego over an extended period of seeking HIV testing [28], and in HIV-positive patients in San Francisco [29].

Given the serious health consequences of methamphetamine use and its concerning effects, intervention development efforts to reduce methamphetamine use are vital and ongoing. Interventions for methamphetamine users in general (regardless of gender or sexual identity), as well as interventions tailored towards GBM, have produced improvements in various outcomes (e.g., reductions in methamphetamine use and/or in sexual risk behavior). These interventions have utilized a range of approaches: cognitive behavioral therapy (CBT) combined with contingency management [30], which was expanded to include sexual risk reduction intervention and gay-specific social support therapy [31]; a Matrix or manualized treatment model [32]; contingency management [33]; motivational interviewing (MI) combined with CBT [34]; behavioral activation combined with risk reduction counseling [35]; a single session of MI [36]; text-messaging [37]; and acceptance and commitment therapy combined with CBT and MI [38]. A 7-session couples-based approach was also effective in reducing use and sexual risk among Black GBM couples [39]. In approaches that combine MI and CBT, such as the intervention tested in the current study, MI—which conceptualizes behavior change in a manner consistent with the transtheoretical model of

intentional behavioral change [40]—is typically utilized in early sessions to clarify the participant's goals and identify barriers to, and support for, change. As participants move towards later stages of the transtheoretical model, CBT is utilized to increase awareness of links between cognitions and behaviors, and cognitive behavioral skills training is implemented to facilitate desired changes. Throughout these later sessions, MI is used to sustain engagement, reduce resistance, and maintain ongoing motivation for change and the utilization of the CBT skills.

This emergent body of intervention development research illustrates the promise and potential of multi-component interventions to address methamphetamine use. However, only one intervention study, of which we are aware, has focused solely on HIV-positive GBM [41], and such an approach presents a valuable opportunity to simultaneously address points along the HIV treatment cascade, including HIV medication adherence, engagement and retention in care, and specific HIV-related issues (e.g., medical comorbidities, HIV stigma, minority stress). In our previous work in addressing alcohol use among HIV-positive GBM [42], an 8-session treatment integrating MI and CBT (MI+CBT) produced significant improvements in medication adherence and CD4 outcomes, along with reductions in alcohol use and viral load. Adapting this MI+CBT intervention tailored for HIV-positive GBM in order to address methamphetamine use and medication adherence thus represents a valuable next step in improving the health of this population.

Most research in this area has examined the omnibus effects of treatment, whereas less attention has been given to the identification of significant moderators of treatment effects. Reback and colleagues [37] noted that treatment gains were strongest among participants who were White, had fewer years of lifetime methamphetamine use, and reported higher levels of sexual risk. Such studies are essential because they can inform the targeting of interventions to subpopulations where they may be most useful, and can also serve to guide future development of interventions for populations where existing options have limited impact. Recent research has utilized the information-motivation-behavioral skills (IMB) model [43] to identify distinct subtypes of GBM who use methamphetamine: those ready to change both methamphetamine use and medication adherence (i.e., “change ready”), those ready to change medication adherence but who are ambivalent about reducing their methamphetamine use (i.e., “adherence ready /meth ambivalent”), and those with “global barriers” to changing either outcome [42]. Central tenets of the IMB model are that individuals must be well-informed, motivated, and behaviorally skilled to initiate health behavior change, and this has been supported by empirical evidence on relevant outcomes of condom use, HIV medication adherence, and substance use cessation [44–46]. While prior research has demonstrated the importance of each of these constructs, our own research identified three unique subgroups of drug users based on profiles of readiness to change [42]. We identified these profiles by running a latent class analysis on participants' IMB scores regarding both methamphetamine use and medication adherence. The presence of the three subgroups of GBM who display varying levels of motivation to change their methamphetamine use and/or HIV medication adherence suggests two specific hypotheses. First, it suggests that interventions which blend strategies that address the spectrum of readiness for change will have a greater impact on participants as a whole. Second, it suggests that the treatment effectiveness of a flexible and adaptive intervention approach

compared to a psychoeducational approach may be greatest for those GBM who are the least motivated to change.

Accordingly, we tested the efficacy of an 8-session MI+CBT intervention to target methamphetamine use and medication adherence outcomes in a sample of HIV-positive GBM in the NYC metropolitan area. These men, who were not specifically treatment-seekers, were classified into one of the three IMB profiles outlined previously, based on their pre-treatment intake [42]. Therefore, we tested whether participants' IMB profiles acted as moderators of treatment effectiveness herein.

METHODS

Participants

Participants were recruited from the NYC area between August 2008 and December 2011 for participation in a randomized clinical trial of an intervention entitled *ACE*, aimed at reducing methamphetamine use and addressing medication adherence. Both active and passive recruitment methods were utilized, including in-person field recruitment at bars, clubs, and clinics, and the distribution of flyers, referral cards, and online ads promoting the study. Eligible participants were biologically male, reported having sex with other men, at least 18 years of age, HIV-positive (confirmed with documentation), currently prescribed a highly-active antiretroviral therapy (HAART) medication regimen, and able to speak and read English. Additionally, screening criteria required that participants report at least three days of methamphetamine use during the previous 90 days and one day in the last 30 days, as well as having missed a minimum of three days of HIV medication in the last 30 days. Those eligible and interested in participating were scheduled for a 2-hour baseline appointment at our research center, for which they were compensated \$40.

Following their baseline assessment, eligible participants were randomized to receive eight 1-hour sessions of either the MI+CBT intervention or an attention-matched education sessions (i.e., Education), which served as the comparison group. Participants were randomized using urn randomization procedures [47], which enabled stratification on race/ethnicity, years on HIV medication, viral load, number of days that participant missed their HIV medications in the last 30 days, and number of days of methamphetamine use in the last 90 days. The first session (either MI+CBT or Education) typically occurred immediately after baseline with an assigned therapist or health educator. Participants were compensated \$10 per session and varying amounts for follow-up assessments (\$45 for 3-month follow-up, \$50 for 6-month, \$55 for 9-month, and \$60 for 12-month). All procedures were approved by the Institutional Review Board of the City University of New York.

Intervention Procedures

Experimental (MI+CBT intervention) condition—The aims of the intervention were to provide information about methamphetamine use and medication adherence, enhance motivation and perceived self-efficacy for change, and develop cognitive and behavioral skills that support reduced substance use and increased medication adherence. The intervention blends aspects of MI with CBT techniques. The first two sessions of *ACE*

primarily utilizes an MI approach to establish rapport and elicit the participant's perspective on the target behaviors. MI provides a framework for therapists to identify, attend to, draw out, and enhance a participant's own reasons for change. Session 3 utilized information obtained in earlier sessions to develop a functional analysis, which outlines the events, emotions, and cognitions that preceded the target behaviors and the behavior's subsequent contingencies; the therapist and participant then collaboratively identified four modules to be covered in Sessions 4 through 7 (one module per session). Sessions 4–7 involve cognitive behavioral skills training for the participant, focused on specific components of their functional analysis. The *ACE* manual is comprised of 14 modules containing common cognitive behavioral skills training techniques for managing thoughts and feelings, communicating effectively in interpersonal situations, identifying values and priorities, moderating substance use, and managing HIV medication adherence. The intervention sessions were delivered by Masters- and PhD-level therapists who were thoroughly trained in MI, CBT, and study protocols, and received weekly individual and group supervision throughout the project. A manual was developed, pilot-tested, and refined for the purposes of training and as a guide for the therapists.

Education Condition—Participants assigned to this condition attended eight 1-hour educational sessions with a health educator (a trained research assistant) who presented factual information about HIV; HIV medication regimens, adherence, and their impact on health; HIV transmission risk behaviors; and the deleterious health effects of methamphetamine use. Information was disseminated using video, information pamphlets, referrals, and brief conversations with an educator. Educators were trained in delivering information in a respectful, non-judgmental manner. In order to preserve the integrity of the comparison condition, educators were not trained in MI or CBT; educators were only instructed to prepare videos to be shown to the participants, discuss reactions to the videos with the participant, and provide informational pamphlets at the end of the session.

We produced and compiled educational video segments for use in these sessions that incorporated standard HIV risk reduction messages, factual information about the physical and cognitive effects of five club drugs (methamphetamine, ketamine, MDMA/ecstasy, GHB, and cocaine), and information about the evidence in support of a link between club drug use and high-risk sex. Discussion questions centered around methamphetamine use as a part of sex and sexual identity, consequences of methamphetamine use, relapse, abstinence, and recovery, perceived benefits of use, and how sexual identity and sexual behavior may be interconnected with methamphetamine use.

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).

Methamphetamine use, HIV medication adherence, and condomless anal sex—Self-reported measures of methamphetamine use, HIV medication adherence, and condomless anal sex were collected using Timeline Follow-Back (TLFB) interviews [26,

48–50]. A 14-day recall window was used for HIV medication adherence, whereas methamphetamine use and condomless anal sex were assessed using a 30-day recall window. Count variables of the number of methamphetamine use days and HIV medication adherence days were used for analysis, but condomless anal sex was dichotomized based on any reported condomless anal sex regardless of type (i.e., insertive versus receptive and overall versus under the influence). In order to minimize any under-reporting of methamphetamine use, participants also completed a urine drug-screen. While the sensitivity period for the urine drug-screen was shorter than the TLFB assessment window, concordance between urine screen results and self-report were high (90.1%), providing support for the validity of TLFB responses.

Biological indicators of immune functioning—Immune functioning was assessed using two biological indicators: viral load and CD4 count. All participants provided a blood sample collected by an onsite certified phlebotomist, which was sent to a laboratory for analysis. To reduce skew, viral load was log-transformed for analysis.

Data Analysis

To determine the success of our randomization procedure, we used baseline data to test for between-group differences of demographic characteristics and baseline outcome values (methamphetamine use, medication adherence, and immune functioning). Subsequently, an analysis of attrition was conducted to evaluate the presence of differential retention across conditions.

A latent growth modeling approach was used to assess between-condition differences in methamphetamine use, medication adherence and biological indicators of immune functioning, and any condomless anal sex across post-intervention time points. Separate models were calculated for each outcome testing the associations of treatment condition and IMB class on each outcome. We also tested for a condition-by-IMB class interaction for each outcome, but reported main effects only when non-significant interaction effects resulted. For continuous outcome variables (i.e., CD4 count and log-viral load) common model fit indices were used to guide an estimation of overall model fit. Good model fit was assumed when the χ^2/df ratio was 3 or less, root-mean square error of approximation (RMSEA) ≤ 0.05 , Tucker-Lewis fit index (TLI) > 0.95 , and comparative fit index (CFI) > 0.95 [51–53]. For variables with counts (i.e., number of methamphetamine use days and number of HIV medication adherent days) and dichotomous indicators (i.e., condomless anal sex), model fit was evaluated using a Satorra-Bentler scaled χ^2 difference test (SB χ^2) comparing the specified model to the null model [54]. As an additional check, we ran the analyses separately for insertive and receptive condomless anal sex; we present results below for condomless anal sex combining both insertive and receptive positioning because the results were not substantially different.

RESULTS

Participants

Figure 1 illustrates the study's enrollment flow chart. Of the 2,416 eligibility phone screenings, 274 men provided informed consent and 210 completed at least one session of treatment (MI + CBT) or control (Education) interventions. Table 1 describes the participants' demographics by condition. Participants in this sample were racially diverse; a third were White, a third were Black/African-American, and a quarter were of Latino race/ethnicity. Many (75.2%) had some college or more of education, but only 22.9% reported some level of employment and many (69.1%) made less than \$20,000 in the past year. Most (89.5%) self-identified as gay and the remaining 10.5% as bisexual, and the mean age of participants was 40.8 years old. There were no significant differences in demographics by condition.

Retention Over Time

Of the 210 men who were randomized and participated in at least one session, 69% completed all assessments up to the 12-month time point. Retention at 3-, 6-, 9-, and 12-month follow-up was 79%, 82%, 80%, and 82%, respectively. In a small number of instances, biological specimens were not gathered or testing results were invalid. As a result, rates of missingness were slightly higher for biological outcomes at follow-up (CD4 count analyses retention: 77%, 79%, 74%, and 77%; and viral load retention: 78%, 81%, 77%, and 79%, respectively). Attrition was not significantly associated with condition or baseline outcome measures.

Baseline Outcomes

At baseline, participants averaged 5.76 days ($SD = 5.69$) of methamphetamine use in the past 30 days. Participants reported taking their HIV medications on 9.29 days ($SD = 4.25$) of the past 14 days prior to baseline; participants' average viral load was 413.64 copies/ml ($SD = 25.04$) and CD4 count was 458.21 cells per cubic millimeter ($SD = 262.45$). Regarding sexual behavior, 84.76% of participants reported engaging in at least one event of condomless anal sex in the past 30 days. No significant differences between baseline outcomes by condition were found; the randomization procedure resulted in similar participants being designated to each condition based on substance use, HIV medication adherence measures, and condomless anal sex. Baseline and longitudinal outcomes are reported by condition in Table 2.

Post-Intervention Differences Over Time

Methamphetamine use—Table 3 contains the results of the latent growth curve model predicting number of methamphetamine use days over time. In a preliminary model, no significant interactions between treatment condition and IMB class were found and thus these moderation terms were excluded. The final model reported had significantly better model fit compared to the null [$SB \chi^2 = -5379.17$ ($df = 7$); $p = 0.01$]. Men in both the treatment and control conditions reported significant reductions in days of methamphetamine use at 3-month follow-up, and the two conditions were not significantly

different in their magnitude of reduction over time. Men classified within the change ready group had significantly fewer substance use days than men in the global barriers and adherence ready /meth ambivalent groups at 3-month follow-up; however, the slope of substance use trends over time by IMB class were not significantly different.

Medication adherence and biological markers—Tables 4–6 provide results of the latent growth curves modeling the number of days adherent to HIV medications, log-viral load, and CD4 count, respectively. Our model testing the condition and IMB class effects on HIV medication adherence had significantly better fit compared to the null [$SB \chi^2 = -262.77$ ($df = 11$); $p = 0.01$]. However, our model testing these effects on viral load had modest model fit [χ^2/df ratio = 3.0; RMSEA = 0.11; TLI = 0.86; CFI = 0.91] because of non-significant effects across all variables predicting viral load. Finally, good model fit was observed for our model of CD4 count over time [χ^2/df ratio = 0.77; RMSEA = 0.00; TLI = 1.00; CFI = 1.00].

Both the treatment and education conditions yielded significant improvements in number of days of medication adherence. However, a significant interaction between treatment condition and IMB group was observed in the prediction of medication adherence. Among men who were classified into the global barriers IMB group, those who received the MI +CBT intervention showed a significantly greater positive slope coefficient than those in the control condition. However, the simple main effect of treatment was not significant at 12-month follow-up, despite this slope pattern. Men in the MI+CBT condition classified in the global barriers group had increasing days of HIV medication adherence over time, whereas men in the Education condition similarly classified as having global barriers had decreasing days of HIV medication adherence but comparable adherence days by 12-month follow-up. The treatment-by-global barriers interaction is illustrated in Figure 2(a–b). Elsewhere, no significant difference in slope was observed between the change ready and adherence ready /meth ambivalent classified participants who received the MI+CBT intervention. Treatment condition and IMB group were unrelated to growth factors for biological indicators of adherence (CD4 count and viral load). No significant interactions between viral load and CD4 count outcomes by condition were found and thus not reported in final models.

Condomless anal sex—Results of the latent growth curve model assessing post-intervention condomless anal sex over time is reported in Table 7. The specified model for condomless anal sex provided a significantly better fit to the data when compared to a null model [$SB \chi^2 = 98.32$ ($df = 7$); $p = 0.01$], and IMB group assignment was a significant predictor of sexual behavior. At 3-month follow-up (i.e., intercept), men classified in the change ready group were significantly less likely to report engaging in any condomless anal sex compared to the global barriers group, but a significant decreasing trend over time was observed. This difference in intercepts at 3-month follow-up was offset by a difference in slopes. Those in the global barriers group showed a significantly more negative slope than those in the change ready group, but no significant group differences were observed at the 12-month follow-up assessment. The slopes of the adherence ready /meth ambivalent and change ready groups did not significantly differ.

DISCUSSION

Our findings showed efficacy for a combined MI+CBT intervention tailored for HIV-positive GBM, with gains observed in methamphetamine use reduction, medication adherence, CD4 count, and condomless anal sex reduction relative to baseline levels. Days of methamphetamine use decreased by more than 60% (dropping substantially from an average of more than 5.5 days per month to 2.0 days per month post-intervention), days of medication adherence increased by two days for each subsequent 14-day recall period, and the percentage of men reporting condomless anal sex decreased from 82% to 50%, over the one-year follow-up in the MI+CBT condition. Improvements in medication adherence and decreases in methamphetamine use among men in the MI+CBT condition resulted in slightly higher CD4 counts and lower viral loads up until the 6-month follow-up before regressing to similar baseline levels by the 12-month follow-up. Individuals in the attention-matched education control condition responded similarly to the experimental intervention; however, analyses of pre-intervention IMB profiles revealed that the MI+CBT intervention produced greater improvements in medication adherence among men classified in the “global barriers” to change profile compared to those who received the Education condition. Therefore, while findings support the utility of individual-level conjoint intervention on methamphetamine use and medication adherence among HIV-positive GBM, our findings also underscore the importance of pre-intervention IMB profiles as being predictive of post-intervention outcomes.

Taken together, these findings have the potential to guide the next stages of intervention work targeting methamphetamine use and HIV medication adherence among GBM. The nature of the IMB classes used to define pre-intervention functioning provides guidance on how future interventions might be enhanced. Our findings that men with greater global barriers to change tended to experience greater improvements in medication adherence when receiving the MI+CBT compared to receiving the Education condition may be because the MI+CBT condition engages more with the individual’s motives for behavior change than the Education condition. It can also be expected that greater reductions in methamphetamine use will be achieved by those in the change-ready group, irrespective of the condition of treatment provided.

Similar to the findings of Ingersoll and colleagues [55], who examined medication adherence and crack-cocaine use in a sample of 54 HIV-positive GBM, individuals in our MI+CBT condition did not significantly differ from those in the Education condition in their improvements over time. This finding is in contrast to others who have found that CBT-based interventions were comparatively efficacious, with their effectiveness enhanced by the addition of contingency management [56,57]. The finding of non-significant differences between our conditions must be understood in the context of three factors: the substantial levels of medication non-adherence and methamphetamine use at baseline, the enriched and comparably intensive nature of the Education control condition, and historical events in the GBM community of NYC.

Descriptive data suggested that all study participants benefitted from having received their respective interventions (MI+CBT or Education) in terms of reduced substance use,

improved medication adherence, and increased CD4 count relative to baseline. The covariation of outcomes is not surprising in light of the strong connections identified among methamphetamine use, medication adherence, and immunologic functioning. Stimulant use is associated with more rapid HIV disease progression, even after controlling for HIV medication adherence [58–60]. Methamphetamine specifically is associated with increased production of HIV [61], while injection methamphetamine use is associated with longer delays in viral load suppression after initiating antiretroviral therapy [62]. Complicating its effect on the health of HIV-positive persons, methamphetamine use is also associated with decreased HIV treatment adherence [63]. In qualitative and ethnographic research, methamphetamine users cite their use as a direct cause of medication non-adherence, above and beyond other barriers to adherence such as side effects and complex regimens [24,64].

The Education condition implemented was comparably intensive, involving the one-on-one presentation of content and structured reflection questions across eight sessions, utilizing a neutral and judgment-free approach. While educators were trained to avoid the use of MI and CBT strategies, these sessions may have replicated some of the therapist-client alliance factors which have been associated with positive therapy outcomes [65]. These findings may suggest that the mere presence of non-judgmental educators that endures across an extended period of one-on-one time, using a structured protocol with intensive supervision to protocol adherence, may be effective in reducing substance use and improving medication adherence. Future studies may explore the use of the individually-delivered educational intervention delivered by health workers with training in basic interpersonal skills as a low-cost and scalable alternative to individual psychotherapy. With the move to eHealth and mobile technology-based interventions, it will be important to evaluate if these approaches achieve the same kinds of gains as face-to-face contact as identified in our study.

Similar to findings in Ingersoll and colleagues [55], the current sample demonstrated substantial levels of medication non-adherence, immune compromise, and substance use at baseline. Other researchers have found that individuals with longer lifetime use of methamphetamine and higher levels of HIV-transmission risk behavior showed greater response to intervention [66]. It is possible that, among a population experiencing levels of use and immune compromise such as those in the current sample, any intervention accompanied by ongoing assessment may produce a substantial decrease in use. These common factors associated with the receipt of any intervention may have overwhelmed any effects associated with a specific form of treatment. This possibility suggests the utility of continued examination of reactance effects to assessment procedures [67,68] and/or relative effectiveness of sequencing interventions (e.g., initial psychoeducation provided by a lay-person followed by MI+CBT administered by a psychologist vs. continued psychoeducation) to determine if treatment effects emerge in subsequent intervention with individuals who demonstrated a reduction in use in response to an initial intervention. Nonetheless, further research using a Solomon four group design is needed to evaluate the extent to which internal validity was threatened by demand characteristics of participants after the pre-intervention assessment [69], a plausible reason for the larger improvements observed in self-reported behaviors compared to biological assessments of immune functioning. A future study with a “no treatment” control group would similarly provide a

better evaluation for determining individuals' response in our Education and MI+CBT conditions compared to those who do not receive any intervention.

While methamphetamine use remains a public health concern in the GBM community of NYC [70], historical changes in substance use within the GBM community of NYC may have meaningfully altered the social context of methamphetamine use in the sample population. Rates of methamphetamine use among HIV-positive GBM in NYC declined from 23.6% in 2003 to 12.3% in 2007 [6]; however, rates of methamphetamine have remained stagnant nationally since [5]. This broader change in the social context of substance use may have altered sensitivity to intervention and/or ongoing assessment in a general way that prevented detection of condition-specific effects.

There are several limitations to our findings. First, our outcome variables used differential recall periods for HIV medication adherence and drug use, reducing interpretability between the two. Second, these results represent primary analyses in the total analytic sample. It is possible that subgroups of individuals exist for whom MI+CBT and Education differ in their effectiveness. In subgroup analyses, Reback and colleagues [66] found that White race, fewer years of substance use, a greater number of recent sexual partners, and high risk sexual behavior were associated with greater responsiveness to a contingency management intervention. Future analyses may reveal similar subgroups within the current sample. Third, while these findings suggest the efficacy of both MI+CBT and the Education condition, and the importance of pre-intervention IMB profiles, they do not address questions of potential mediators of the effects of these interventions. It is possible that active agents and mechanisms of effect transmission differ across conditions. Future research should examine the influence of condition on potential mediators, as well as comparisons between our MI+CBT intervention and shorter modalities such as a single MI session. Mediating factors might include components of the IMB model, and other factors identified in the literature such as cognitive decision-making processes [24] and drug use assertiveness [71]. Fourth, in the absence of a wait-list control condition, it is not possible to distinguish the effects of assessment from intervention in the current study. These results point to the potential efficacy of lay-person administered psychoeducation and individually administered MI+CBT; however, future research examining changes over time in the presence of assessment alone would be needed to identify the effect size associated with the interventions themselves. The potential for such interventions to be delivered by lay-people should also be explored, with the aim of maximizing reach and minimizing costs. Fifth, the combined MI+CBT intervention compared to a time-matched educational control condition does not allow us to delineate the individual effects of the MI or CBT intervention components; however, these approaches were combined because MI has the potential to complement the CBT components of the intervention and to support the participants' engagement and maintenance of these skills beyond treatment. Finally, results may not be generalizable to samples beyond New York City because of unique contextual factors in methamphetamine use.

CONCLUSIONS

Our findings from the *ACE* study indicate that structured MI+CBT and Education interventions are both effective in reducing methamphetamine use and improving medication adherence (and related CD4 count) among HIV-positive GBM in NYC. Across both intervention conditions, individuals reported using methamphetamine less frequently, more frequent medication adherence (and positive health indicators), and fewer acts of condomless anal sex at all follow-up assessments in the one year post-intervention period. These findings point to the potential viability of structured interventions administered by lay-personnel for the delivery of educational content to reduce methamphetamine use and improve health outcomes among GBM living with HIV. These results also lend support to calls for continued investigation into novel approaches to intervention for methamphetamine use which address the complex individual and social factors that influence use and are sensitive to IMB profiles. Such interventions should be tailored to the culturally-specific needs of the GBM population.

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Figure 1.
Participant enrollment flowchart.

Figure 2a.

Figure 2b.

Figure 2.

Figure 2a. HIV medication self-reported adherence over time by randomized group and IMB classification.

Figure 2b. HIV medication self-reported adherence over time by randomized group and IMB classification.

Table 1

Demographic characteristics by treatment group (N = 210)

Categorical characteristics	Overall (N = 210)		MI+CBT (n = 105)		Education (n = 105)		χ^2
	n	%	n	%	n	%	
Race/Ethnicity							7.30
White	70	33.3	34	32.3	36	34.3	
Black	72	34.3	30	28.6	42	40.0	
Latino	54	25.7	30	28.6	24	22.9	
Other	14	6.7	11	10.5	3	2.9	
Education							0.32
HS Grad or Less	52	24.8	27	25.7	25	23.8	
Some College	76	36.2	39	37.1	37	35.2	
College Grad or More	82	39.1	39	37.1	43	41.0	
Employment							0.11
Working	48	22.9	25	23.8	23	21.9	
Not Working	162	77.1	80	76.2	82	78.1	
Yearly Income [/]							0.12
Less than \$20K	145	69.1	74	70.5	71	67.6	
\$20K or More	64	30.5	31	29.5	33	31.4	
Sexual Orientation							1.83
Gay	188	89.5	97	92.4	91	86.7	
Bisexual	22	10.5	8	7.6	14	13.3	
Continuous characteristics	M	SD	M	SD	M	SD	t
Age (Age range)	40.8 (24–63)	8.7	40.8	8.9 (25–63)	40.8	8.6 (24–57)	0.04

Note.

* $p < 0.05$.[/] one participant refused to answer. Percentages may not add up to 100 because of rounding.

Table 2

Average outcome values over time by condition

	Baseline	3-month	6-month	9-month	12-month
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
Methamphetamine use days (past 30)					
Treatment	5.54 (5.91)	2.00 (4.03)	2.25 (4.57)	2.81 (6.01)	2.21 (4.49)
Education	5.97 (5.48)	1.43 (2.41)	1.68 (3.85)	1.94 (4.03)	1.93 (3.18)
Medication adherence days (past 14)					
Treatment	9.34 (4.31)	11.27 (4.12)	11.41 (3.89)	11.09 (4.34)	11.26 (4.21)
Education	9.23 (4.21)	12.19 (3.15)	11.59 (3.79)	11.69 (3.83)	11.76 (3.58)
Viral load (log scale)					
Treatment	2.61 (1.44)	2.55 (1.33)	2.35 (1.30)	2.41 (1.33)	2.57 (1.46)
Education	2.62 (1.37)	2.41 (1.27)	2.53 (1.47)	2.45 (1.50)	2.26 (1.29)
CD4 count					
Treatment	441.30(256.48)	451.51(260.76)	463.60(259.03)	447.12(239.54)	449.58(248.52)
Education	475.28(268.50)	510.00(300.62)	507.48(286.14)	513.38(316.09)	501.64(294.47)
Any CAS [†] (percentage; past 30 days)					
Treatment	81.90%	50.00%	57.65%	55.00%	50.00%
Education	87.62%	47.62%	47.73%	40.45%	43.82%

Notes:

[†]CAS = condomless anal sex

Table 3

Number of methamphetamine use days over time (n = 187)

	<i>B</i>	<i>SE</i>	<i>β</i>
Intercept			
Intercept	-1.32 **	0.34	-0.64
Treatment Condition (Ref: Education only)	0.04	0.35	0.01
IMB Class (Ref: Change Ready)			
Global Barriers	0.96 *	0.40	0.19
Adherence Ready /Meth Ambivalent	0.90 *	0.43	0.19
Slope			
Intercept	0.24	0.13	0.55
Treatment Condition	-0.03	0.10	-0.04
IMB Class			
Global Barriers	-0.14	0.14	-0.13
Adherence Ready /Meth Ambivalent	-0.18	0.12	-0.19

Note.

*
p 0.05,**
p 0.01

Table 4

Days adherent to HIV medications in the last 14 days over time (n = 187)

	<i>B</i>	<i>SE</i>	<i>β</i>
Intercept			
Intercept	2.46**	0.05	11.91
Treatment Condition (Ref: Education only)	0.01	0.06	0.02
IMB Class (Ref: Change Ready)			
Global Barriers	-0.03	0.08	-0.06
Adherence Ready /Meth Ambivalent	0.03	0.06	0.07
Treatment by Global	-0.25	0.14	-0.36
Treatment by Adherence Ready /Meth Ambivalent	-0.05	0.10	-0.08
Slope			
Intercept	-0.00	0.02	-0.02
Treatment Condition	-0.02	0.03	-0.21
IMB Class			
Global Barriers	-0.05	0.04	-0.43
Adherence Ready /Meth Ambivalent	-0.02	0.02	-0.18
Treatment by Global Barriers	0.14*	0.06	0.79
Treatment by Adherence Ready /Meth Ambivalent	0.01	0.04	0.06

Note:

* $p < 0.05$,** $p < 0.01$

Table 5

Log viral load over time (n = 186)

	<i>B</i>	<i>SE</i>	<i>β</i>
Intercept			
Intercept	2.43 **	0.17	2.16
Treatment Condition (Ref: Education only)	-0.03	0.20	-0.01
IMB Class (Ref: Change Ready)			
Global Barriers	0.43	0.28	0.16
Adherence Ready /Meth Ambivalent	-0.22	0.22	-0.09
Slope			
Intercept	-0.07	0.05	-0.29
Treatment Condition	0.06	0.06	0.12
IMB Class			
Global Barriers	-0.10	0.09	-0.17
Adherence Ready /Meth Ambivalent	0.11	0.07	0.20

Note:

**
p 0.01

Table 6

CD4 count over time (n = 186)

	<i>B</i>	<i>SE</i>	<i>β</i>
Intercept			
Intercept	487.94 **	35.24	1.91
Treatment Condition (Ref: Education only)	-49.68	40.02	-0.10
IMB Class (Ref: Change Ready)			
Global Barriers	-7.32	54.86	-0.01
Adherence Ready /Meth Ambivalent	64.05	46.32	0.11
Slope			
Intercept	4.78	6.23	1.58
Treatment Condition	-2.04	7.75	-0.34
IMB Class			
Global Barriers	-7.17	9.74	-0.98
Adherence Ready /Meth Ambivalent	-3.33	9.34	-0.50

Note:

**
p 0.01

Table 7

Any reported condomless anal sex over time (n = 187)

	<i>B</i>	<i>SE</i>	<i>β</i>
Intercept			
Thresholds			
3-Month Follow-Up	0.69	0.64	0.16
6-Month Follow-Up	0.69	0.64	0.19
9-Month Follow-Up	0.69	0.64	0.22
12-Month Follow-Up	0.69	0.64	0.26
Treatment Condition (Ref: Education only)	0.50	0.76	0.07
IMB Class (Ref: Change Ready)			
Global Barriers	1.95*	0.99	0.21
Adherence Ready /Meth Ambivalent	0.76	0.86	0.09
Slope			
Intercept	0.13	0.21	0.18
Treatment Condition	0.05	0.25	0.04
IMB Class			
Global Barriers	−0.80**	0.31	−0.47
Adherence Ready /Meth Ambivalent	−0.46	0.27	−0.29

Note:

* $p < 0.05$,** $p < 0.01$