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Factors Associated with Amplified HIV Transmission Behavior among American Men who have Sex with Men Engaged in Care: Implications for Clinical Providers

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Abstract

Background—The HIV epidemic continues unabated in the United States, with men who have sex with men (MSM) being most frequently infected.

Purpose—To understand the biological and behavioral risk factors associated with increased HIV transmission efficiency, that is HIV transmission risk behavior in the context of uncontrolled HIV replication or intercurrent sexually transmitted infections.

Methods—Participants were 201 HIV-infected MSM who received their primary care at an HIV ambulatory care center in Boston. Logistic regression models were conducted to determine factors associated with engaging in behavior associated with potentially amplified transmission.

Results—In the final model, heavy alcohol use (AOR: 3.27; 95% CI 1.37–7.79), as well as stimulant drug use (crystal meth, crack, or other cocaine; AOR: 3.00; CI 1.32–6.84), having at least a college degree (OR: 2.74; CI: 1.15–6.54), and decreased duration of HIV infection (OR: 0.91; CI: 0.85–0.97) were each uniquely associated with enhanced HIV transmission behavior.

Conclusions—HIV primary care providers should routinely assess patients for potential HIV transmission behaviors, particularly those who are younger and more recently diagnosed with HIV, who drink alcohol heavily, and who use any nonprescription drugs, particularly stimulants, in order to decrease the spread of HIV.

Keywords

HIV transmission; MSM; primary care

INTRODUCTION

The HIV epidemic continues unabated in the United States, with 50,000 new infections annually over the past decade, despite advances in therapeutics (1, 2). Men who have sex with men (MSM) comprise the largest subgroup of Americans living with HIV, and have the greatest HIV incidence (3). While antiretroviral therapy has been demonstrated to decrease

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infectiousness and the efficiency of HIV transmission (4), the uptake of treatment by MSM has not yet been associated with a general decrease in new transmissions in this subpopulation (2). Although the minority of people living with HIV who are unaware of their status are most likely to engage in behaviors that can transmit HIV to others, close to half of new infections are transmitted by individuals previously diagnosed with HIV (5, 6). Because current HIV care standards suggest that patients see their primary providers several times a year even when they are clinically stable (7, 8), the medical care setting may provide a unique opportunity for risk assessment and prevention interventions.

The efficiency of HIV transmission or acquisition via high risk sexual practices (i.e. unprotected receptive or insertive anal intercourse) may be amplified by biological factors that potentiate HIV infectiousness (9,10, 11). Individuals with higher plasma HIV RNA levels have been found to be more likely to transmit to their partners (9) and antiretroviral therapy has been associated with decreased transmission (4). Additionally, untreated sexually transmitted infections (STI), which are common among MSM, increase HIV transmission by increasing genital tract HIV replication (10, 11). Several studies have documented high levels of depression among HIV-infected MSM (12, 13), often in conjunction with the use of behaviorally disinhibiting substances (14, 15). Depression and problematic substance use interfere with optimal HIV disease management and have been consistently associated with poorer antiretroviral therapy adherence (16–19). A recent meta-analysis (comprised of 99 independent samples) found a significant relationship between depression and decreased antiretroviral therapy adherence (20). In addition, depression and substance use have been associated with accelerated HIV disease progression (i.e., steeper decline in CD4 cells and poorer control over HIV viral replication over time; (21–26).

The high co-prevalence of depression and substance use in this population may enhance the likelihood of HIV transmission to partners several different ways, by decreasing medication adherence leading to increased viral burden (27,28), through behavioral disinhibition resulting in unprotected sex and associated sexually transmitted infection (11), and by altering host immune function (29). Since HIV-infected MSM with either uncontrolled HIV infection and/or a sexually transmitted infection who engage in unprotected anal sex most likely to transmit HIV, the current study was designed to understand the demographic and behavioral characteristics of HIV-infected MSM in care who may be at greatest risk of transmitting HIV to others.

METHODS

Participants and Procedures

The participants were 201 HIV-infected MSM who received their primary care at Fenway Health, the largest ambulatory HIV care center in New England. Between August 2004 and May 2007, the men consented to participate in a randomized controlled trial aimed at increasing condom use behavior with sex partners of negative or unknown status (30). At baseline, participants completed a comprehensive, self-administered, computer-based questionnaire that assessed sexual risk and psychosocial variables. Baseline data on sexually transmitted infections included serological testing for syphilis (RPR, with positive results confirmed by FTA-ABS), and urine and rectal screening by NAAT (Gonorrhea and Chlamydia), using the APTIMA COMBO 2® nucleic acid amplification test kits (Gen-Probe, Inc; San Diego, CA). Subsequent sexually transmitted infection data were collected through systematic medical record extraction of electronic health records (Centricity, Inc), as were CD4 counts, plasma HIV RNA concentrations, and antiretroviral drug histories. Participants provided informed consent for all study procedures, which were approved by the independent Fenway Health Institutional Review Board.

Measures

Outcome Variable—The potential for amplified transmission behavior of study participants was the dependent variable, which was operationalized as engaging in unprotected insertive or receptive anal intercourse with HIV-uninfected or unknown status partners within the past 6 months, and either having a detectable plasma HIV RNA (HIV RNA >75 copies/ml), or having a sexually transmitted infection diagnosis (gonorrhea, syphilis, or chlamydia) within the past year. potentially amplified transmission was analyzed as a dichotomous variable.

Independent Variables—The primary independent variables were substance use indicators assessed within the past 3 months: (1) heavy alcohol use, defined as having 5 or more drinks in a single day at least once a week, and (2) drug use, which was classified as a categorical variable as follows. Participants were asked if they had used any drugs within the past 3 months (through sniffing, snorting, smoking, swallowing or injecting). Those who reported any drug use were asked about specific drugs, including crystal methamphetamine (meth), crack, and cocaine. Participants who reported not using drugs were classified into a no drug use category (coded as '0'), those who reported using crystal meth, crack, or cocaine were classified into a stimulant drug use category (coded as '1'), as prior studies correlate these particular substances with the highest levels of HIV risk (12– 15, 27, 31–36), and those who reported using other drugs were classified into a non-stimulant drug use category (coded as '2').

Demographic variables included age, measured as a continuous variable, and categorical indicators of race/ethnicity, education, and income; HIV disease stage variables included the number of years since HIV diagnosis and a continuous measure of CD4 count. Mental health problem variables included meeting screen-in criteria for depression as measured by the depression severity scale of the Patient Health Questionnaire (37), and childhood sexual abuse, operationalized as having had a sexual experience with a person who was at least 5 years older when the participant was 12 years old or younger, or with a person who was at least 10 years older when the participant was between 13 and 16 years of age (38).

Analysis

Initially, univariate procedures were run on the dependent and independent variables separately to obtain descriptive statistics. Next, four logistic regression analyses were run, based on an a priori model building process, using engaging in potentially amplified transmission behavior as the dependent variable. The first model included the two substance use indicators, heavy alcohol use and drug use, as the independent variables; the second model added demographic variables (age, race/ethnicity, education, and income); the third model included the HIV disease stage variables; and the final model added the mental health problem variables.

RESULTS

The demographic and HIV disease stage and treatment characteristics of the sample are presented in Table 1. The mean age was 40.7 years (SD: 7.8); the majority of participants were Caucasian (74.6%), had at least a college degree (54.7%), and had an annual income less than $40,000 per year (53.8%). On average, participants had been diagnosed with HIV for 7.2 years (SD: 6.3). The median CD4 cell count was 476 cells/mm^3 [Interquartile Range (IQR): 75–13,838), and the median plasma HIV RNA was 78 copies/ml (IQR: 359–675) at baseline.

Table 2 displays the prevalence of potentially amplified transmission behavior characteristics and substance use patterns in the sample. Approximately half (49.3%) had detectable plasma HIV RNA at their most recent visit, 11.9% had been diagnosed with a sexually transmitted infection within the past year, and 69.3% had engaged in unprotected insertive or receptive anal sex with HIV-uninfected or unknown status partners within the past 6 months. Almost half (45.0%) of the participants met criteria for engaging in potentially amplified transmission behavior; of those, 14 (15.6%) engaged in potentially amplified transmission, and had detectable plasma viremia and a sexually transmitted infection; 68 (89.5%) engaged in potentially amplified transmission and had detectable plasma viremia but not a sexually transmitted infection, and 8 (10.5%) engaged in potentially amplified transmission and had a sexually transmitted infection but their plasma HIV RNA was undetectable.

Logistic Regression Analyses

Throughout the model building process, both substance use indicators, heavy alcohol use and drug use, specifically stimulants (crystal meth, crack, or other cocaine), within the past 3 months were associated with increased odds of engaging in potentially amplified transmission behavior; non-stimulant drug use was not associated with the outcome in any model (Table 3). In the final model, compared to those who did not drink heavily, men who reported having 5 or more drinks at least weekly within the past 3 months had a 3.27 greater odds of engaging in potentially amplified transmission (95% CI: 1.37–7.79). Similarly, compared to those who did not report drug use, those who reported stimulant drug use had a 3.00 greater odds of engaging in potentially amplified transmission (95% CI: 1.32–6.84). A greater number of years since being diagnosed with HIV [Adjusted Odds Ratio (AOR): 0.91; 95% CI: 0.85–0.97] was associated with a decreased risk for engaging in potentially amplified transmission behavior. Having completed college (AOR: 2.74; 95% CI: 1.15–6.54) was associated with an increased risk of potentially amplified transmission behavior. None of the other independent variables were significantly related to potentially amplified transmission behavior.

In order to determine if the associations of potentially amplified transmission behavior were consistent with the variables that comprised it, we re-ran the analyses, evaluating transmission risk behavior and detectable plasma HIV RNA as separate outcomes. We found that stimulant drug use, but not heavy alcohol use, was associated with an increased odds of engaging in transmission risk behavior alone, and heavy alcohol use, but not other drug use, was significantly associated with an increased odds of having detectable plasma HIV RNA (results not shown). These findings suggest that potentially amplified transmission have specific determinants that differ from the constituent variables that are related to the likelihood of engaging in the behaviors that are behaviorally and biologically most likely to result in HIV transmission.

DISCUSSION

Despite the advent of highly active antiretroviral therapy, which could conceivably slow the spread of HIV in the United States by decreasing the number of infectious people living with HIV, the number of new infections has not declined among MSM (2). In the present study, we documented that substantial levels of ongoing potential transmitting behaviors are occurring among some HIV-infected MSM in care. Additionally, we found that some of the men had biological factors associated with enhanced infectiousness: 69.3% engaged in unprotected insertive or receptive anal intercourse with HIV-uninfected or unknown status partners within the past 6 months, 49.3% had detectable plasma HIV RNA, and 11.9% had an intercurrent sexually transmitted infection. Almost half of the men had 2 or more of these factors, and therefore had a greater likelihood of transmitting HIV to their sexual partners.

Men who were more recently diagnosed with HIV, had a college education, drank heavily, and used stimulant drugs, were more likely to engage in sexual behaviors more efficient in HIV transmission because of the potentiating effects of the sexually transmitted infection and/or uncontrolled HIV replication.

These findings are consistent with what is known about younger MSM who use drugs and who do not take HIV medication. Stimulant use has been shown to be associated with sexual risk behaviors (31–36) and correspondingly with the acquisition of HIV and other sexually transmitted infections (39,40). Use of crystal methamphetamine has also has been associated with decreased medication adherence, thus decreasing viral suppression (41–42). Interventions to decrease crystal methamphetamine use could decrease HIV transmission, and deserve further study. Younger MSM have been shown to be more likely to engage in riskier sexual behavior, with risk behaviors decreasing with age (43). Also this group has been shown to have increased risk for sexually transmitted infections (44, 45). In this study, we also showed that they tended to have higher plasma HIV RNA levels, so prevention interventions should be culturally tailored to address the concerns of MSM youth.

Finally, not taking HIV medication was associated with the likelihood to engage in potentially amplified transmission behavior. Some of the younger MSM, and others who were recently infected, were not likely to be on treatment because of having higher CD4 cell counts, and not meeting conventional standards for the initiation of treatment. However, the most recent USPHS guidelines suggest that earlier treatment should be considered for those who might transmit HIV to others (46). Thus, clinicians should begin discussions about the use of antiretroviral medication with treatment-naïve MSM engaging in potentially amplified transmission. Some of the other MSM engaging in potentially amplified transmission behavior in this study were treatment-experienced, so providers will need to focus on adherence interventions for this population. Both medication adherence and sexual risk behaviors are self-care behaviors, and have been shown to be associated with each other in the past (47, 48). The co-occurrence of uncontrolled plasma viremia and sexual risk taking behaviors underscores the need to develop culturally acceptable interventions to encourage sexually risky MSM to initiate highly active antiretroviral therapy for their individual and public health benefit, and to integrate risk reduction education with medication adherence counseling, when these patients begin treatment.

There are several limitations to the present study. First, behavioral data are self-report and thus may be prone to bias, especially when inquiring about sensitive subjects such sexual risk and substance use behaviors. The use of audio-computer assisted self-interview, however, is a standard way to try to reduce underreporting (49, 50). Also it is difficult to determine the timing of the sexually transmitted infections and the sexual activity that participants reported on audio-computer assisted self-interview. Second, the sample was largely Caucasian and included men who received HIV care at a community-based urban health clinic, which limits the generalizability of the findings. Third, the study was cross-sectional, so we were unable to establish the temporality of the associations between the risk factors and the outcome of potentially amplified transmission behavior.

Because HIV-infected MSM with a detectable viral load or a sexually transmitted infection who engage in unprotected sex may more efficiently transmit HIV, it is important that busy primary care providers feel comfortable in routinely discussing sexual risk with their patients, particularly those who have uncontrolled virus or a recent sexually transmitted infection, and of these, those who are more recently diagnosed, use stimulant drugs, and drink alcohol heavily. Provider-initiated interventions may help to decrease sexual risk taking behaviors (51, 52), but uptake has been limited (53), suggesting the need for further

refinement of tools for efficient risk assessment and triage of risky patients into evidence programs to address concomitant issues, such as substance use.

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Table 1

Demographic and HIV disease stage and treatment characteristics among HIV-infected men who have sex with men in the sample (n=201).

	Mean (SD) or N (%)
Demographic Characteristics	
Age	40.7 (7.8)
Race/Ethnicity	
White, not of Hispanic origin	150 (74.6%)
African American	24 (11.9%)
Latino/Hispanic	17 (8.5%)
Other	10 (5.0%)
Education	
Less than a college degree	91 (45.3%)
College degree	60 (29.9%)
Some graduate school	17 (8.5%)
Graduate degree	33 (16.4%)
Annual income	
$20,000 or less	58 (28.9%)
$20,001 – $40,000	50 (24.9%)
$40,001 – $60,000	32 (15.9%)
Greater than $60,000	61 (30.3%)
HIV Disease Stage and Treatment	
Years since HIV diagnosis	7.2 (6.3)
Median CD4 cell count (cells/mm^3) (IQR)	476 (359–675)
Median Plasma HIV RNA (copies/ml) (IQR)	78 (75–13,838)
Detectable HIV RNA (≤75)	101 (50.3%)
Currently on HIV ART	114 (56.7%)

Table 2

Prevalence of potential for amplified transmission (PAT) behavior characteristics and substance use patterns in the sample of HIV-infected men who have sex with (n=201).

	N (%)
Characteristics of PAT behavior	
Detectable viral load	99 (49.3)
STI[1] diagnosis within the past year	24 (11.9)
UIA[2] or URA[3] with negative or unknown status partners within the past 6 months	139 (69.3)
Meeting criteria for PAT behavior [4]	
Met PAT criteria (TRB[5] in the context of detectable viral load or an STI)	90 (45.0)
2 criteria met	76 (84.4)
TRB and detectable viral load	68 (89.5)
STI and detectable viral load	8 (10.5)
3 criteria met	14 (15.6)
Substance Use Indicators	
Heavy alcohol use	
No	154 (76.6)
Yes	47 (23.4)
Drug Use	70 (34.9)
Stimulant Drug Use	82 (40.9)
Drug use other than stimulants	49 (24.2)

[1] STI: Sexually transmitted infection

[2] UIA: Unprotected insertive anal intercourse

[3] URA: Unprotected receptive anal intercourse

[4] Engaging in PAT behavior is defined as having unprotected insertive or receptive anal intercourse with HIV-uninfected or unknown status partners within the past 6 months, and either having a detectable plasma HIV RNA (HIV RNA >75 copies/ml), or having an STI diagnosis (gonorrhea, syphilis, or chlamydia) within the past year.

[5] TRB: Transmission risk behavior (unprotected insertive or receptive anal intercourse)

Table 3

Results from the multivariable logistic regression analyses examining associations of potential for amplified transmission (PAT) behavior.

Variable	Model 1	Model 2	Model 3	Model 4
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Substance Use Indicators				
Heavy alcohol use				
No	1.00	1.00	1.00	1.00
Yes	1.99 (0.99–4.00)~	2.61 (1.18–5.81)*	2.69 (1.19–6.09)*	3.27 (1.37–7.79)**
Drug use				
No drug use	1.00	1.00	1.00	1.00
Stimulant drug use	2.93 (1.47–5.83)**	2.97 (1.41–6.24)*	3.60 (1.65–7.85)**	3.00 (1.32–6.84)*
Drug use other than stimulants	1.40 (0.64–3.09)	1.77 (0.75–4.19)	1.67 (0.69–4.03)	1.36 (0.54–3.41)
Demographic Characteristics				
Age		0.93 (0.89–0.97)**	0.95 (0.90–0.99)**	0.95 (0.91–1.00)~
Race/Ethnicity				
White, not of Hispanic origin		1.00	1.00	1.00
African American		2.40 (0.88–6.57)~	2.79 (0.96–8.13)	3.04 (0.99–9.25)~
Latino/Hispanic		1.61 (0.52–4.98)	1.94 (0.59–6.42)	1.90 (0.55–6.56)
Other		0.37 (0.08–1.76)~	0.28 (0.05–1.40)	0.21 (0.04–1.14)
Education				
Less than a college degree		1.00	1.00	1.00
College degree or higher		1.81 (0.84–3.91)	1.79 (0.81–3.95)	2.74 (1.15–6.54)*
Annual income				
$20,000 or less		1.00	1.00	1.00
$20,001 – $40,000		1.66 (0.67–4.09)	1.52 (0.59–3.92)	2.06 (0.75–5.65)
$40,001 – $60,000		0.80 (0.29–2.23)	0.73 (0.24–2.18)	0.73 (0.23–2.67)
Greater than $60,000		0.84 (0.35–2.03)	0.84 (0.35–2.05)	0.95 (0.36–2.48)
HIV Disease Stage				
Years since HIV diagnosis			0.93 (0.87–0.99)*	0.91 (0.85–0.97)**
CD4 cell count (cells/mm^3)			1.00 (1.00–1.00)*	1.00 (1.00–1.00)*
Mental Health Problems				
Depressed				
No				1.00
Yes				2.65 (0.91–7.69)~
Childhood sexual abuse				
No				1.00
Yes				1.32 (0.64–2.73)

~ $p<0.10$

* $p<0.05$

** $p<0.01$

*** $p<0.001$