UCLA
UCLA Previously Published Works

Title

Unsafe Sexual Behavior Among Gay/Bisexual Men in the Era of Combination Antiretroviral Therapy (cART)

Permalink

Journal

ISSN

Authors

Surkan, Pamela J
Li, Ying
Jacobson, Lisa P
et al.

Publication Date

DOI

Peer reviewed

Unsafe sexual behavior among gay/bisexual men in the era of combination antiretroviral therapy (cART)

Pamela J. Surkan[1], **Ying Li**[2], **Lisa P. Jacobson**[3], **Christopher Cox**[3], **Anthony Silvestre**[4], **Pamina Gorbach**[5], **Linda Teplin**[6], and **Michael Plankey**[2]

[1] Social and Behavioral Interventions Program, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD

[2] Department of Medicine, Division of Infectious Diseases, Georgetown University Medical Center, Washington, DC

[3] Department of Epidemiology, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD

[4] Department of Infectious Diseases and Microbiology, School of Public Health, University of Pittsburgh, Pittsburgh, PA

[5] Department of Epidemiology, Division of Infectious Diseases, David Geffen School of Medicine, University of California at Los Angeles, Los Angeles, CA

[6] Health Disparities and Public Policy, Department of Psychiatry and Behavioral Sciences, Feinberg School of Medicine, Northwestern University, Chicago, IL

Abstract

The aim of this study was to determine the association between psychosocial determinants of unprotected receptive anal intercourse (URAI) and unprotected insertive anal intercourse (UIAI). Data from 417 HIV positive MSM in the Multicenter AIDS Cohort Study (MACS) from April 1999 to March 2012 were analyzed and adjusted odds were calculated. It was found that 66% (n=277) and 72% (n=299) reported any UIAI or URAI over follow-up, respectively. Cumulative cART-years (median=5.30 years) was associated with 33% and 47% increases in UIAI and URAI, respectively. Not having reduced concern about HIV transmission (UIAI: OR=0.37, p-value=0.0004; URAI: OR=0.57, p-value=0.04), increased safe sex fatigue (UIAI: OR=2.32, 95% p-value=0.0002; URAI: OR=1.94, p-value=0.003), and sexual sensation seeking (UIAI: OR=1.76, p-value=0.002; URAI: OR=1.56, p-value=0.02) were associated with UIAI and URAI. Serosorting was associated with UIAI (OR=6.11, p-value<0.0001) and URAI (OR=6.80, p-value<0.0001). Findings suggest that negative attitudes about HIV transmission are sustained among older MSM.

Abstract

El objetivo del estudio fue evaluar la asociación entre determinantes psicosociales de sexo anal receptivo desprotegido (CARD) y sexo anal insertivo desprotegido (CAID). Datos de 417 participantes VIH positivos del Estudio Multicéntrico de Cohorte de SIDA (English: Multicenter AIDS Cohort Study, MACS) de abril del 1999 a marzo del 2012 fueron analizados y las oportunidades relativas (OR) ajustadas fueron calculadas. Se encontró que 66% (n=277) y 72% (n=299) reportaron alguna actividad de CARD o CAID durante el tiempo del seguimiento, respectivamente. El tiempo cumulativo de tratamiento antiretroviral combinado en años (median=5.30 años) estuvo asociado con un incremento de 33% y 47% de la actividad de CARD y CAID, respectivamente. No haber experimentado este tipo de actividades sexuales redujo el riesgo de transmisión de VIH (CARD: OR=0.37, p=0.0004; CAID: OR=0.57, p=0.04), aumento la fatiga sexual segura (CARD: OR=2.32, 95% p=0.0002; CAID: OR=1.94, p=0.003), e incremento la búsqueda de sensaciones sexuales (CARD: OR=1.76, p=0.002; CAID: OR=1.56, p=0.02). Serodiscriminación estuvo asociado con CARD (OR=6.11, p<0.0001) y CAID (OR=6.80, p<0.0001). Estos hallazgos sugieren que las actitudes negativas sobre la transmisión del VIH se mantienen entre participantes mayores del estudio de hombres que tienen relaciones sexuales con hombres (HSH).

Keywords

INTRODUCTION

Although overall HIV incidence has been fairly stable in recent years, the incidence of male-to-male transmission of HIV infection and other sexually transmitted infections (STIs) [1,2] and unprotected sex in the US continues to rise [3]. According to 2008 data from the Centers for Disease Control (CDC), males account for 76% of people living with HIV in the US, and the majority of those (69%) are men who have sex with men (MSM) [4]. Not surprisingly, HIV incidence in MSM is estimated to be 44 times higher compared to other men [5], resulting in the prioritization of prevention in gay and bisexual men as part of the 2010 National HIV/AIDS Strategy [6]. Among MSM, HIV/AIDS complacency has been linked to unprotected sexual risk behaviors with a partner with HIV or unknown status [7].

Determinants of behavioral changes include demographic, psychosocial and attitudinal characteristics [8]. Several studies have suggested that beliefs about risks or risk behaviors may be affected by the use of highly active combination antiretroviral therapies (cART) [9-13]. For example, men engaging in unprotected sex with HIV negative or unknown-status partners were more likely to believe that taking a protease inhibitor or having an undetectable viral load would lower the risk of transmitting HIV [11]. Likewise, unprotected receptive anal sex was more common in HIV-negative men who indicated that cART reduced concern about becoming infected [12]. However, other studies have not indicated higher risk behaviors in men on cART [11,14].

It is unclear how, over almost the past twenty years since cART became available, risk behaviors have changed. It is not known whether these changes are directly related to cART's effectiveness or whether high risk behaviors have persisted over the long-term or both. In particular, the need for longitudinal studies to help elucidate the relationship between cART and risk behaviors in gay men has been identified [15]. The longitudinal, standardized data collection of the Multicenter AIDS Cohort Study (MACS) allowed us to assess demographic, behavioral and attitudinal factors and to determine whether cumulative time on cART was predictive of engaging in high risk sexual behavior among men who have sex with men in the current era.

METHODS

Population and Study Design

The MACS is a longitudinal study of HIV infection among gay, bisexual men and other MSM in the United States. Detailed descriptions of the MACS have been published elsewhere [16,17], therefore we only describe methods relevant to the present analyses. A total of 6,972 men were enrolled in three fixed cohorts: 4954 in 1984-5, 668 in 1987-90 and 1,350 in 2001-3. The participants return every six months to the sites, located in Baltimore, Chicago, Los Angeles and Pittsburgh, for detailed interviews and a physical examination. An interviewer-administered questionnaire elicits medical history including antiretroviral therapy and an audio computer-assisted structured interview (ACASI) is used for self-administered reporting of behaviors. In addition, participants provide blood specimens for storage in repositories and for concomitant laboratory analyses including HIV RNA determinations using a Roche Assay (Roche Diagnostics, Indianapolis, Indiana). Positive ELISAs with confirmatory Western blot tests were used to determine HIV seropositivity. Beginning in 1999 and every two years (4 study visits) thereafter, participants were also asked to complete a Men's Attitude Survey (MAS) [12]. The MACS study protocols were approved by institutional review boards of each of the participating centers and informed consent was obtained from all the men. Copies of the study questionnaires may be found at www.aidscohortstudy.org. Human subject approval for this study was received from the Institutional Review Boards at each study of the four study sites.

The population investigated in this study was composed of the HIV positive MACS participants reporting multiple partners (defined as at least 2 anal sex partners since the last visit). The analysis was restricted to HIV positive men who were enrolled prior to the cART era (before 1996) and used cART. We used longitudinal data collected in the MACS from visits 31-56 (April 1999 - March 2012) to assess the impact of cART on risky sexual behavior and the introduction of the MAS at visit 31 allowed us to consider the impact of attitudes and beliefs concerning cART and HIV transmission on risky sexual behavior.

Outcome - unprotected anal sex

Our primary outcomes were unprotected receptive and insertive anal intercourse (URAI, UIAI) among the sampled HIV positive men. The number of anal sexual partners with whom the participants reported always using a condom was subtracted from the total

number of partners for each respective activity (receptive or insertive) to obtain the number of partners with whom the participant engaged in unprotected anal sex.

Potential determinants

Predictors were collected at the 6-month visit prior to the outcome ascertainment. Use of recreational drugs (marijuana, downers, poppers, ecstasy, uppers, cocaine) and alcohol were obtained by an ACASI or person-to-person interview. We examined the effect of the change in the number of drugs reported over the course of a six month period. Herein, the cut point of 3 drugs was chosen based on the sample distribution, but did not correspond to either the mean or median. Men who increased their number of drugs between consecutive visits (from < 3 drugs to 3 drugs) were categorized as having increased drug use, men who decreased their number of drugs (from 3 to < 3 drugs) were categorized as having decreased drug use, men who reported < 3 drugs at both time points were persistently low users (the reference group), and those who reported 3 drugs at both time points were classified as persistently high users. Type of alcohol use was classified using frequency of drinking and average number of drinks the participant drank per day since the last visit. Binge drinking was defined as 5 or more drinks per occasion occurring at least monthly. Moderate to heavy drinking was at least weekly drinking of 3-4 drinks or drinking 5 or more drinks less than monthly [18]. The remaining participants who had low to moderate or no drinking comprised the reference group of alcohol use in this analysis. Indication of depressive symptoms associated with possible clinical depression was defined as scoring 16 on the Center for Epidemiologic Studies Depression (CES-D) scale (with a score of <16 as the reference) [19].

Date of birth, race, study site, and education were obtained from a self-administered form at study entry. White race, Los Angeles, and postgraduate education were used as the reference groups for those variables, respectively. Age at visit was categorized as < 45, 45-55, and 55 years (the reference group). According to MACS [20] and established guidelines [21] to define cART use, we used antiretroviral medications reported at each visit to calculate cumulative cART use-years. HIV RNA was categorized as detectable versus undetectable (the reference) using results from the Chiron HIV-1 RNA 2.0 assay (Chiron Diagnostics, Emeryville, CA), standard and ultrasentive Amplicor HIV-1 monitor assays, and COBAS Taqman v2.0 assay (Roche Molecular Systems, Branchburg, NJ). The assay used to measure HIV RNA changed during study follow-up so the higher limit of detection, < 40 copies/mL, was used to define undetectable HIV RNA.

To examine the effect of serosorting, we characterized participants based on whether there was discordancy between their HIV status and the HIV status of any primary or casual sexual partners that were reported on the MACS questionnaires. Given that this analysis was restricted to HIV positive participants, if a participant responded affirmatively to any of the questions that he had sexual activity with a partner who was also HIV positive since the last visit, then he was characterized as serosorter. If the HIV positive participant never reported sexual activity with another HIV positive partner since the last visit, but reported sex with one or more HIV negative partner(s), then he was characterized as a non-serosorter (the

reference group). If information on serosorting was missing at some visit, the serosorting status was defined by using the previous last non-missing record.

Personal Attitudes

The MAS consisted of 20 questions grouped into five topic-related subscales including reduced HIV concern, perception of HIV as a threat, safe sex fatigue, viral load/transmission beliefs, and sexual sensation seeking (Table 1). Participants responded on a Likert scale choosing whether they strongly disagree (score = 1), disagree (score = 2), neither agree nor disagree (score = 3), agree (score = 4), or strongly agree (score = 5) for each question. Subscale scores were calculated by taking the average score of all items within the subscale. Subscale scores were then stratified as follows: 1.0 – 2.5 for disagree, 2.6 – 3.5 for neutral (the reference group), and 3.6 – 5 for agree.[22]

Statistical analysis

To characterize our study population, descriptive statistics were generated for each independent variable using the first MACS visit on or after visit 31 with available data (referred to as the baseline visit). Due to the fact that MAS was performed every 2 years (i.e., every 4 MACS visit), the personal attitude variables were missing at visits when the MAS was not administered. For this reason the personal attitude data were carried forward for the three consecutive visits after the visit with MAS. If MAS data were missing at a visit when the survey was administered, these data of the three consecutive visits remained missing. This is standard practice in MACS because of participant burden and because over the years personal attitudes in the MACS cohort have been found to be relatively stable over a period as short as two years; this is also true of sexual behavior. For all other variables collected at each 6 month visit, missing data were not replaced via imputation. Univariate and multivariate logistic regression models using GEE with working independence to account for repeated measurements on each subject were used for analysis. These models predicted a 'yes' response for each of the two outcome variables. PROC GENMOD in SAS (SAS Institute, Cary, NC, USA) was used for logistic regression modeling. All estimates and 95% confidence intervals were obtained. Statistical significance was defined as a p-value < 0.05.

RESULTS

Of the 417 HIV positive men reporting multiple anal sex partners since the last visit in our study 66% (n = 277) reported UIAI, while 72% (n = 299) reported URAI over median of 6 (IQR: 3, 11) follow-up visits. Approximately 45% of the HIV positive men, reporting URAI and/or UIAI were aged 45 to 55 years old at baseline. Around 80% were non-Hispanic White and nearly half had no college degree. Among these HIV positive men, 29% had depressive symptoms (CESD score > 16), 59% were low-to-moderate drinkers, and 82% were persistent infrequent drug users (i.e., < 3 drugs for two consecutive semi-annual visits). Forty-seven percent of our sample had a detectable viral load and twenty-eight percent were serosorters at the baseline visit (Table 2). Through 2012, the median cumulative cART-use time ranging from 0.01 to 15.30 years was 5.30 years (IQR: 2.91, 8.55).

Associations among HIV positive men engaging in UIAI were similar to those engaging in URAI (Tables 3 and 4), which is not be surprising since these two groups overlapped substantially. In multivariable models adjusting for socio-demographic, behavioral, psychosocial and health status variables, we found that the cumulative time on cART was associated with an increase in odds of UIAI (adjusted odds ratio (AOR) for five-year increase of cART = 1.33, 95% CI: 1.02, 1.74), and URAI (AOR for 5-year increase = 1.47, 95% CI: 1.13, 1.91). High levels of drug usage over time (persistent 3 drugs at consecutive visits) was also associated with an increased odds of UIAI (AOR = 1.70, 95% CI: 1.04, 2.79) and URAI (AOR = 1.93, 95% CI: 1.17, 3.18). Compared to a non-serosorter, being a serosorter was statistically significantly associated with an increased odds of UIAI (AOR = 6.11, 95% CI: 4.50, 8.31) and URAI (AOR = 6.80, 95% CI: 4.88, 9.47).

Regarding attitudinal measures, we found strong associations between attitudes about sex and URAI and UIAI in models adjusted for sociodemographic, behavioral, psychosocial and health status variables (Tables 3 and 4). Men who did not have a reduced concern about HIV had a statistically significantly lower odds of engaging in UIAI (AOR = 0.37, 95% CI: 0.21, 0.64) and engaging in URAI (AOR = 0.57, 95% CI: 0.34, 0.97). Likewise, there was an increased odds of both UIAI and URAI (AOR = 2.32, 95% CI: 1.49, 3.61; AOR = 1.94, 95% CI: 1.25, 3.01, respectively) associated with increased safe sex fatigue. Sexual sensation seeking was also positively associated with both UIAI (AOR = 1.76, 95% CI: 1.23, 2.53) and URAI (AOR = 1.56, 95% CI: 1.07, 2.27).

DISCUSSION

This is the first study with longitudinal follow-up since the cART to document sexual risk behaviors among MSM. Importantly, we found that cumulative time on cART during the period between 1999 and 2012 was associated with an increase in risky sexual behavior among a large cohort of sexually active gay/bisexual HIV positive men (66% reporting UIAI and 72% reporting in URAI sometime over the follow-up). Our results further indicated that attitudes, such as MSMs' reduced HIV concern since the availability of cART, MSMs' endorsement of safe sex fatigue, and their pursuit of sexual sensation were important behavioral factors associated with both insertive and receptive anal intercourse among older HIV positive MSM. Other studies in the MACS, conducted earlier in the cART era (ten or more years ago), using the same measures from one and two points in time, found that HIV positive men who were less concerned about HIV disease consequences, and who experienced "safe sex burn-out" had high risk sexual behavior, but showed inconsistent results regarding sensation seeking [12,22].

Cumulative time on cART

MSMs' lower levels of concern associated with anti-retroviral treatment and increased sexual risk taking may explain the increase in high risk sexual behaviors associated with cumulative time on cART observed in our study [23,24]. Interestingly, our findings of increased risky sexual behavior associated with time on cART differ from the results of a meta-analytic review of 21 studies conducted between 1996 and 2003, that did not show an overall difference in sexual risk behaviors comparing HIV positive patients on cART to

those who were not [25]. The higher prevalence we found is likely due to the standardized semi-annual assessment of sexual risk over a relatively long time period. Many studies in both HIV negative and HIV positive individuals that have examined attitudes about the effect of cART in reducing the risk and severity of HIV have shown their associations with risky behavior [23,24,26], consistent with our findings. Lower perceived need since cART has been associated with seroconversion among MSM [27]. In a survey of gay festival attendees, perceived risk of HIV infection was associated with HIV status of a partner, cART use, and viral load [28]. Another study, among HIV positive gay couples found higher HIV optimism, a component of which was faith in treatment to reduce HIV transmission, was associated with greater risk for unprotected anal intercourse [29]. In contrast, a study of African-American MSM showed no association between perceived threat of HIV because of cART and risky sexual behaviors [30].

Safe-sex fatigue and sexual sensation seeking

By using longitudinal data, our study extends the previous work conducted in the MACS [12,22] as well expands the extant literature regarding men's attitudes towards safe sex fatigue and sexual sensation seeking and serosorting. Similar to our results, a study conducted among 222 HIV positive MSM in an STD clinic in Amsterdam showed a relationship between safer sex fatigue and prevalence of rectal gonorrhea, which was mediated by unprotected anal intercourse with casual partners [31]. This relation between safe-sex fatigue and unprotected anal intercourse, however, was not observed a smaller cross-sectional study including 105 MSM recruited from gay bars in San Francisco. However, cART optimism was positively associated with higher prevention fatigue [32]. Boily et al. has suggested that, although safe sex fatigue has been postulated as one of the main explanations for increases in high risk behaviors among MSM, the initial risk declines observed in the early years of the HIV/AIDS epidemic and subsequent increase in risk behaviors might instead be attributable to reduced availability of high risk-taking individuals followed by their increased availability, paralleling the pattern of changing AIDS morbidity and mortality prior to and after cART [33]. The fact that we observed a sustained relationship between safe-sex fatigue and sexual risk behaviors well into the cART era suggests that safe-sex fatigue may still be an important risk factor.

In terms of sexual sensation seeking and sexual risk behaviors, our results confirm findings from several other studies in varied settings including MSM recruited through the internet, clinics, or gay-related venues in the Netherlands and several US cities [34-37]. One of these studies found higher sexual self-control diminished the relationship between sensation seeking and unprotected anal intercourse [34]. Other research has highlighted that sensation seeking is more common among MSM in non-exclusive relationships [36]. In qualitative work with MSM regarding factors associated with barebacking, participants described condomless sex as being emotionally satisfying and increasing physical sensation [38]. Pleasure/emotion was also identified as one of two underlying factors in the development of a scale to measure motivations for barebacking [39]. Finally, in a sample of US Latino men, significantly greater pleasure loss has been associated with condom use in the insertive versus receptive position [40], whereas in our study sexual sensation seeking was a significant predictor of both unprotected insertive and receptive anal intercourse.

HIV serosorting

We found that serosorting HIV-positive men were approximately six times more likely to have unprotected insertive or receptive intercourse. This is double that of estimates from a nationally online survey that found approximately three-fold risk of UAI among serosorting HIV positive men, when intention was not taken into account, and only an approximately two-fold risk associated with intentional serosorting [41]. Given that men with high HIV prevention altruism have been less likely to engage in anal intercourse, one motivation of serosorting for HIV positive men may be to continue to be sexually active without risk infecting others[42]. Data suggest that for HIV positive men, serosorting may be fairly effective at reducing HIV transmission [43,44]. As a result, men in sero-concordant relationships are prone to consider that condom use is less necessary [45], which may then put them at risk for other STIs [46].

Depressive symptoms, disease severity, and substance use

We did not observe a relationship between depressive symptoms and unprotected anal intercourse in this study. Survivor guilt (possibly related to post-traumatic stress disorder) [47,48] among MSM in the early days of the AIDS era manifested frequently in dysfunctional behaviors such as unprotected anal sex, substance abuse, difficulty planning for the future, and resistance to intimate relationships [49]. With successful treatment, most HIV-positive individuals are living well with what is considered now a chronic disease; therefore the psychological effects and the extent to which these experiences affect depressive symptoms have likely diminished.

Given the public health impact of cART in the population, i.e., lower HIV-related morbidity and mortality with concurrent improvement of attitudes about HIV being a "controllable" disease, our data indicated that engaging in risky sexual behavior was not due to the direct effect of cART on HIV disease within the individual. cART users were likely to engage in risky behavior regardless of their HIV RNA levels.

Similar to other research [50-55], we observed that risky sexual behavior was highly positively associated with recreational drug use, which may reflect risk taking in general as well as sexual dis-inhibition associated with substance use [56,57]. However, condomless anal intercourse among MSM seems to vary by the type of drug and the frequency of use [58]. It has been suggested that frequent alcohol and drug use are common in urban gay male culture [59]. Contrary to the several studies that have found alcohol use at least once a week [55] or excess alcohol consumption [54,60] related to unsafe sexual practices in MSM, we found no association in our study. Our results, however, are closer to those of a meta-analysis not specific to MSM that found drinking alcohol was unrelated to condom use [61] and Peruvian study of MSM finding a non-significant association between problem drinking and receptive or insertive anal intercourse in the last 6 months [62].

A major strength of this study was the use of extended longitudinal follow-up data in which we were able to examine cumulative time on cART for over a decade in among a large, well-characterized cohort of middle- to older- aged MSM. HIV-positive older adults frequently engage in high-risk sexual behaviors [63-65], yet most of the risk management strategies

have been studied among younger MSM [66-69]. All the behavioral data used in these analyses were obtained by using ACASI or person-to-person interviews across the cohort. One limitation was that the attitudinal variables in our study were only assessed every two years rather than on every study visit, though attitudinal variables changed usually around 20% to 35% across the two year follow-up period. Nonetheless, we were still able to use imputed data from these variables during the follow-up period. Because the analysis was restricted to men who were enrolled prior to the cART era (in or before 1996), our participant pool is not representative of the population overall, but rather an older group of MSM. A strength of our serosorting variable was that we were able to factor in multiple sexual partnerships over time, while a drawback of our measure was our inability to take into account the intentionality of serosorting behavior. Whereas generalizability of this study is probably limited to men who are similar to those in this study, the results may not be representative of other MSM in the US.

A recent causal framework outlines a pathway from the belief that cART can lead to reduced concern about susceptibility to HIV/AIDS [70] and ultimately to an increase in sexual risk behaviors. The model also posits a direct pathway between the belief that cART mitigates HIV/AIDS and a reduced concern for HIV/AIDS.[70] This model is useful for understanding possible pathways through which the attitudes assessed in the present study population may be operating to increase sexual risk behaviors among MSM.

Additionally, fatigue associated with long-term behavior change, and other factors such as sexual sensation seeking and reduced concern for HIV/AIDS remain salient attitudes associated with risky sexual behaviors. Assessment of these factors to promote behavior change should be addressed by providers providing care of MSM who have been on cART for long duration. Ultimately in the era of treatment as prevention optimization of sustained adherence to cART by clinical among these MSM is paramount.

Acknowledgments

References

1. Prejean J, Song R, Hernandez A, et al. Estimated HIV incidence in the United States, 2006-2009. PLoS One. 2011; 6(8):e17502. doi: 10.1371/journal.pone.0017502. [PubMed: 21826193]

2. Wolitski RJ, Fenton KA. Sexual health, HIV, and sexually transmitted infections among gay, bisexual, and other men who have sex with men in the United States. AIDS Behav. Apr; 2011 15(Suppl 1):S9–17. doi: 10.1007/s10461-011-9901-6. [PubMed: 21331797]

3. Dosekun O, Fox J. An overview of the relative risks of different sexual behaviours on HIV transmission. Curr Opin HIV AIDS. Jul; 2010 5(4):291–297. doi: 10.1097/COH. 0b013e32833a88a3. [PubMed: 20543603]

4. Centers for Disease Control and Prevention. HIV Surveillance Report, 2014. Nov.2015 26 http:// www.cdc.gov/hiv/library/reports/surveillance/.

5. Centers for Disease Control and Prevention. CDC Analysis Provides New Look at Disproportionate Impact of HIV and Syphilis Among U.S. Gay and Bisexual Men. 2010. http://www.cdc.gov/ nchhstp/newsroom/msmpressrelease.html

6. White House Office of National AIDS Policy. National HIV/AIDS Strategy for the United States. Washington: DC2010.

7. MacKellar DA, Hou SI, Whalen CC, et al. HIV/AIDS complacency and HIV infection among young men who have sex with men, and the race-specific influence of underlying HAART beliefs. Sex Transm Dis. Aug; 2011 38(8):755–763. doi: 10.1097/OLQ.0b013e31820d5a77. [PubMed: 21336231]

8. Glantz, K., Rimer, BK., Viswanath, K. Health Behavior and Health Education: Theory, Research and Practice. 2nd ed.. Jossey-Bass Inc.; San Francisco: 1997.

9. Dilley JW, Woods WJ, McFarland W. Are advances in treatment changing views about high-risk sex? N Engl J Med. Aug 14; 1997 337(7):501–502. doi: 10.1056/NEJM199708143370715. [PubMed: 9254339]

10. Halkitis PN, Wilton L. Beyond complacency: the effects of treatment on HIV transmission. Focus. Apr; 1999 14(5):1–4.

11. Remien RH, Halkitis PN, O'Leary A, Wolitski RJ, Gomez CA. Risk Perception and sexual risk behaviors among HIV-positive men on antiretroviral therapy. AIDS Behav. Jun; 2005 9(2):167– 176. doi: 10.1007/s10461-005-3898-7. [PubMed: 15933836]

12. Ostrow DE, Fox KJ, Chmiel JS, et al. Attitudes towards highly active antiretroviral therapy are associated with sexual risk taking among HIV-infected and uninfected homosexual men. AIDS. Mar 29; 2002 16(5):775–780. [PubMed: 11964534]

13. Kelly JA, Hoffman RG, Rompa D, Gray M. Protease inhibitor combination therapies and perceptions of gay men regarding AIDS severity and the need to maintain safer sex. AIDS. Jul 9; 1998 12(10):F91–95. [PubMed: 9677158]

14. Stephenson JM, Imrie J, Davis MM, et al. Is use of antiretroviral therapy among homosexual men associated with increased risk of transmission of HIV infection? Sex Transm Infect. Feb; 2003 79(1):7–10. [PubMed: 12576605]

15. Elford J, Hart G. HAART, viral load and sexual risk behaviour. AIDS. Jan 28; 2005 19(2):205– 207. [PubMed: 15668547]

16. Kaslow RA, Ostrow DG, Detels R, Phair JP, Polk BF, Rinaldo CR Jr. The Multicenter AIDS Cohort Study: rationale, organization, and selected characteristics of the participants. Am J Epidemiol. Aug; 1987 126(2):310–318. [PubMed: 3300281]

17. Detels R, Phair JP, Saah AJ, et al. Recent scientific contributions to understanding HIV/AIDS from the Multicenter AIDS Cohort Study. J Epidemiol. 1992; 2:S11–S19.

18. National Institute on Alcohol Abuse and Alcoholism. [June 21, 2016] Drinking Levels Defined. https://www.niaaa.nih.gov/alcohol-health/overview-alcohol-consumption/moderate-binge-drinking.

19. Radloff LS. The CES-D scale: A self-report depression scale for research in the general population. Applied Psychological Measurement. 1977; 1:385–401.

20. Jacobson LP, Li R, Phair J, et al. Evaluation of the effectiveness of highly active antiretroviral therapy in persons with human immunodeficiency virus using biomarker-based equivalence of disease progression. Am J Epidemiol. Apr 15; 2002 155(8):760–770. [PubMed: 11943695]

21. Carpenter CC, Cooper DA, Fischl MA, et al. Antiretroviral therapy in adults: updated recommendations of the International AIDS Society-USA Panel. JAMA. Jan 19; 2000 283(3):381–390. [PubMed: 10647802]

22. Ostrow DG, Silverberg MJ, Cook RL, et al. Prospective study of attitudinal and relationship predictors of sexual risk in the multicenter AIDS cohort study. AIDS Behav. Jan; 2008 12(1):127–138. doi: 10.1007/s10461-007-9223-x. [PubMed: 17410419]

23. Halkitis PN, Zade DD, Shrem M, Marmor M. Beliefs about HIV non-infection and risky sexual behavior among MSM. AIDS Educ Prev. Oct; 2004 16(5):448–458. doi: 10.1521/aeap. 16.5.448.48739. [PubMed: 15491956]

24. Huebner DM, Gerend MA. The relation between beliefs about drug treatments for HIV and sexual risk behavior in gay and bisexual men. Ann Behav Med. 2001; 23(4):304–312. Fall. [PubMed: 11761348]

25. Crepaz N, Hart TA, Marks G. Highly active antiretroviral therapy and sexual risk behavior: a meta-analytic review. JAMA. Jul 14; 2004 292(2):224–236. doi: 10.1001/jama.292.2.224. [PubMed: 15249572]

26. MacKellar DA, Hou SI, Whalen CC, et al. HIV/AIDS complacency and HIV infection among young men who have sex with men, and the race-specific influence of underlying HAART beliefs. Sex Transm Dis. Aug; 2011 38(8):755–763. doi: 10.1097/OLQ.0b013e31820d5a77. [PubMed: 21336231]

27. van der Snoek EM, de Wit JB, Mulder PG, van der Meijden WI. Incidence of sexually transmitted diseases and HIV infection related to perceived HIV/AIDS threat since highly active antiretroviral therapy availability in men who have sex with men. Sex Transm Dis. Mar; 2005 32(3):170–175. [PubMed: 15729154]

28. Suarez TP, Kelly JA, Pinkerton SD, et al. Influence of a partner's HIV serostatus, use of highly active antiretroviral therapy, and viral load on perceptions of sexual risk behavior in a community sample of men who have sex with men. J Acquir Immune Defic Syndr. Dec 15; 2001 28(5):471–477. [PubMed: 11744837]

29. Van de Ven P, Crawford J, Kippax S, Knox S, Prestage G. A scale of optimism-scepticism in the context of HIV treatments. AIDS Care. Apr; 2000 12(2):171–176. doi: 10.1080/09540120050001841. [PubMed: 10827857]

30. Bakeman R, Peterson JL, Community Intervention Trial for Youth Study T. Do beliefs about HIV treatments affect peer norms and risky sexual behaviour among African-American men who have sex with men? Int J STD AIDS. Feb; 2007 18(2):105–108. doi: 10.1258/095646207779949637. [PubMed: 17331282]

31. Stolte IG, de Wit JB, Kolader M, Fennema H, Coutinho RA, Dukers NH. Association between 'safer sex fatigue' and rectal gonorrhea is mediated by unsafe sex with casual partners among HIV-positive homosexual men. Sex Transm Dis. Apr; 2006 33(4):201–208. doi: 10.1097/01.olq. 0000194596.78637.8e. [PubMed: 16505749]

32. Stockman JK, Schwarcz SK, Butler LM, et al. HIV prevention fatigue among high-risk populations in San Francisco. J Acquir Immune Defic Syndr. Apr 1; 2004 35(4):432–434. [PubMed: 15097163]

33. Boily MC, Godin G, Hogben M, Sherr L, Bastos FI. The impact of the transmission dynamics of the HIV/AIDS epidemic on sexual behaviour: a new hypothesis to explain recent increases in risk taking-behaviour among men who have sex with men. Med Hypotheses. 2005; 65(2):215–226. doi: 10.1016/j.mehy.2005.03.017. [PubMed: 15922091]

34. Adam PC, Teva I, de Wit JB. Balancing risk and pleasure: sexual self-control as a moderator of the influence of sexual desires on sexual risk-taking in men who have sex with men. Sex Transm Infect. Nov; 2008 84(6):463–467. doi: 10.1136/sti.2008.031351. [PubMed: 19028948]

35. Bancroft J, Janssen E, Strong D, Carnes L, Vukadinovic Z, Long JS. Sexual risk-taking in gay men: the relevance of sexual arousability, mood, and sensation seeking. Arch Sex Behav. Dec; 2003 32(6):555–572. [PubMed: 14574099]

36. Crawford I, Hammack PL, McKirnan DJ, et al. Sexual sensation seeking, reduced concern about HIV and sexual risk behaviour among gay men in primary relationships. AIDS Care. Aug; 2003 15(4):513–524. doi: 10.1080/0954012031000134755. [PubMed: 14509866]

37. Kalichman SC, Weinhardt L, DiFonzo K, Austin J, Luke W. Sensation seeking and alcohol use as markers of sexual transmission risk behavior in HIV-positive men. Ann Behav Med. 2002; 24(3): 229–235. Summer. [PubMed: 12173680]

38. Balan IC, Carballo-Dieguez A, Ventuneac A, Remien RH. Intentional condomless anal intercourse among Latino MSM who meet sexual partners on the Internet. AIDS Educ Prev. Feb; 2009 21(1): 14–24. doi: 10.1521/aeap.2009.21.1.14.

39. Bauermeister JA, Carballo-Dieguez A, Ventuneac A, Dolezal C. Assessing motivations to engage in intentional condomless anal intercourse in HIV risk contexts ("Bareback Sex") among men who have sex with men. AIDS Educ Prev. Apr; 2009 21(2):156–168. doi: 10.1521/aeap.2009.21.2.156. [PubMed: 19397437]

40. Calabrese SK, Reisen CA, Zea MC, Poppen PJ, Bianchi FT. The pleasure principle: the effect of perceived pleasure loss associated with condoms on unprotected anal intercourse among immigrant Latino men who have sex with men. AIDS Patient Care STDS. Jul; 2012 26(7):430–435. doi: 10.1089/apc.2011.0428. [PubMed: 22663165]

41. Siegler AJ, Sullivan PS, Khosropour CM, Rosenberg ES. The role of intent in serosorting behaviors among men who have sex with men sexual partnerships. J Acquir Immune Defic Syndr. Nov 1; 2013 64(3):307–314. doi: 10.1097/QAI.0b013e3182a0e880. [PubMed: 23846562]

42. O'Dell BL, Rosser BR, Miner MH, Jacoby SM. HIV prevention altruism and sexual risk behavior in HIV-positive men who have sex with men. AIDS Behav. Sep; 2008 12(5):713–720. doi: 10.1007/s10461-007-9321-9. [PubMed: 17985229]

43. McConnell JJ, Bragg L, Shiboski S, Grant RM. Sexual seroadaptation: lessons for prevention and sex research from a cohort of HIV-positive men who have sex with men. PLoS One. 2010; 5(1):e8831. doi: 10.1371/journal.pone.0008831. [PubMed: 20098616]

44. Truong HM, Kellogg T, Klausner JD, et al. Increases in sexually transmitted infections and sexual risk behaviour without a concurrent increase in HIV incidence among men who have sex with men in San Francisco: a suggestion of HIV serosorting? Sex Transm Infect. Dec; 2006 82(6):461–466. doi: 10.1136/sti.2006.019950. [PubMed: 17151031]

45. Eaton LA, West TV, Kenny DA, Kalichman SC. HIV transmission risk among HIV seroconcordant and serodiscordant couples: dyadic processes of partner selection. AIDS Behav. Apr; 2009 13(2): 185–195. doi: 10.1007/s10461-008-9480-3. [PubMed: 18953645]

46. Marcus U, Schmidt AJ, Hamouda O. HIV serosorting among HIV-positive men who have sex with men is associated with increased self-reported incidence of bacterial sexually transmissible infections. Sex Health. Jun; 2011 8(2):184–193. doi: 10.1071/SH10053. [PubMed: 21592432]

47. Broun SN. Understanding "post-AIDS survivor syndrome": a record of personal experiences. AIDS Patient Care STDS. Jun; 1998 12(6):481–488. doi: 10.1089/apc.1998.12.481. [PubMed: 11361996]

48. LetsKickASS.org.. AIDS Survivor Syndrome. Revised April 2016; http://letskickass.org/aids-survivor-syndrome/#.VwZyUTYrKX0

49. Odets, W. In the shadow of the epidemic: Being HIV negative in the age of AIDS. Duke University Press; Durham, North Carolina: 1995.

50. Mackesy-Amiti ME, Fendrich M, Johnson TP. Symptoms of substance dependence and risky sexual behavior in a probability sample of HIV-negative men who have sex with men in Chicago. Drug Alcohol Depend. Jul 1; 2010 110(1-2):38–43. doi: 10.1016/j.drugalcdep.2010.01.016. [PubMed: 20219291]

51. Hatfield LA, Horvath KJ, Jacoby SM, Simon Rosser BR. Comparison of substance use and risky sexual behavior among a diverse sample of urban, HIV-positive men who have sex with men. J Addict Dis. Jul; 2009 28(3):208–218. doi: 10.1080/10550880903014726. [PubMed: 20155589]

52. Melendez-Torres GJ, Hickson F, Reid D, Weatherburn P, Bonell C. Nested Event-Level Case-Control Study of Drug Use and Sexual Outcomes in Multipartner Encounters Reported by Men Who Have Sex with Men. AIDS Behav. Jul 3.2015 doi: 10.1007/s10461-015-1127-6.

53. Xu JJ, Zhang C, Hu QH, et al. Recreational drug use and risks of HIV and sexually transmitted infections among Chinese men who have sex with men: Mediation through multiple sexual partnerships. BMC Infect Dis. 2014; 14:642. doi: 10.1186/s12879-014-0642-9. [PubMed: 25443542]

54. Julio RS, Friedman RK, Cunha CB, et al. Unprotected sexual practices among men who have sex with women and men who have sex with men living with HIV/AIDS in Rio de Janeiro. Arch Sex Behav. Feb; 2015 44(2):357–365. doi: 10.1007/s10508-014-0357-4. [PubMed: 25318623]

55. Pham QD, Nguyen TV, Nguyen PD, et al. Men who have sex with men in southern Vietnam report high levels of substance use and sexual risk behaviours but underutilise HIV testing services: a cross-sectional study. Sex Transm Infect. May; 2015 91(3):178–182. doi: 10.1136/sextrans-2014-051574. [PubMed: 25182158]

56. Mullens AB, Young RM, Hamernik E, Dunne M. The consequences of substance use among gay and bisexual men: a Consensual Qualitative Research analysis. Sex Health. Jun; 2009 6(2):139–152. doi: 10.1071/SH08061. [PubMed: 19457294]

57. Stall R, McKusick L, Wiley J, Coates TJ, Ostrow DG. Alcohol and drug use during sexual activity and compliance with safe sex guidelines for AIDS: the AIDS Behavioral Research Project. Health Educ Q. 1986; 13(4):359–371. Winter. [PubMed: 3781860]

58. Rendina HJ, Moody RL, Ventuneac A, Grov C, Parsons JT. Aggregate and event-level associations between substance use and sexual behavior among gay and bisexual men: Comparing retrospective and prospective data. Drug Alcohol Depend. Sep 1.2015 154:199–207. doi: 10.1016/j.drugalcdep.2015.06.045. [PubMed: 26190557]

59. Stall R, Paul JP, Greenwood G, et al. Alcohol use, drug use and alcohol-related problems among men who have sex with men: the Urban Men's Health Study. Addiction. Nov; 2001 96(11):1589–1601. doi: 10.1080/09652140120080723. [PubMed: 11784456]

60. Hess KL, Chavez PR, Kanny D, et al. Binge drinking and risky sexual behavior among HIV-negative and unknown HIV status men who have sex with men, 20 US cities. Drug Alcohol Depend. Feb 1.2015 147:46–52. doi: 10.1016/j.drugalcdep.2014.12.013. [PubMed: 25555622]

61. Leigh BC. Alcohol and condom use: a meta-analysis of event-level studies. Sex Transm Dis. Aug; 2002 29(8):476–482. [PubMed: 12172533]

62. Deiss RG, Clark JL, Konda KA, et al. Problem drinking is associated with increased prevalence of sexual risk behaviors among men who have sex with men (MSM) in Lima, Peru. Drug Alcohol Depend. Sep 1; 2013 132(1-2):134–139. doi: 10.1016/j.drugalcdep.2013.01.011. [PubMed: 23434130]

63. Illa L, Brickman A, Saint-Jean G, et al. Sexual risk behaviors in late middle age and older HIV seropositive adults. AIDS Behav. Nov; 2008 12(6):935–942. doi: 10.1007/s10461-008-9370-8. [PubMed: 18404364]

64. Onen NF, Overton ET, Seyfried W, et al. Aging and HIV infection: a comparison between older HIV-infected persons and the general population. HIV Clin Trials. Mar-Apr;2010 11(2):100–109. doi: 10.1310/hct1102-100. [PubMed: 20542846]

65. Pilowsky DJ, Wu LT. Sexual risk behaviors and HIV risk among Americans aged 50 years or older: a review. Subst Abuse Rehabil. 2015; 6:51–60. doi: 10.2147/SAR.S78808. [PubMed: 25960684]

66. Bruce D, Harper GW, Suleta K, Adolescent Medicine Trials Network for HIVAI. Sexual risk behavior and risk reduction beliefs among HIV-positive young men who have sex with men. AIDS Behav. May; 2013 17(4):1515–1523. doi: 10.1007/s10461-012-0155-8. [PubMed: 22350830]

67. Phillips G 2nd, Outlaw AY, Hightow-Weidman LB, et al. Sexual behaviors of racial/ethnic minority young men who have sex with men. AIDS Patient Care STDS. Aug; 2011 25(Suppl 1):S47–53. doi: 10.1089/apc.2011.9876. [PubMed: 21682587]

68. Mizuno Y, Purcell DW, Latka MH, et al. Is sexual serosorting occurring among HIV-positive injection drug users? Comparison between those with HIV-positive partners only, HIV-negative partners only, and those with any partners of unknown status. AIDS Behav. Feb; 2010 14(1):92–102. doi: 10.1007/s10461-009-9548-8. [PubMed: 19308717]

69. Halkitis PN, Moeller RW, Pollock JA. Sexual practices of gay, bisexual, and other nonidentified MSM attending New York City gyms: patterns of serosorting, strategic positioning, and context selection. J Sex Res. Jul-Sep;2008 45(3):253–261. doi: 10.1080/00224490802204456. [PubMed: 18686154]

70. Mackellar DA, Hou SI, Whalen CC, et al. A plausible causal model of HAART-efficacy beliefs, HIV/AIDS complacency, and HIV-acquisition risk behavior among young men who have sex with men. AIDS Behav. May; 2011 15(4):788–804. doi: 10.1007/s10461-010-9813-x. [PubMed: 20862605]

Table 1

Attitudinal variables and answer categories

Reduced HIV concern (5 items):

• I am somewhat more willing to take a chance of getting infected or infecting someone else now that combination drug treatments are available.

• Because of combination drug treatments for HIV, I am less concerned about becoming HIV+ or infecting someone.

• I am a lot less worried about sexual slipping now that treatments may be given after unprotected sex.

• The availability of combination drug treatments for HIV makes me less worried about having unprotected sex.

• I am less concerned about having unprotected anal sex now that combination drug treatments are available.

Perception of HIV as a threat (2 items):

• HIV is no longer the threat it used to be.

• HIV is now a controllable disease like diabetes.

Safe sex fatigue (3 items):

• I feel tired of always having to monitor my sexual behavior.

• I find it difficult to maintain my commitment to safer sex.

• It takes a lot of effort to keep my sexual behavior safe.

Viral load/Transmission beliefs (3 items):

• It would be more difficult for an HIV+ person to infect a partner through unsafe sex if the HIV+ person was taking combination drug treatments.

• By taking combination drug treatments, an HIV+ person decreases the chances that he/she will infect a partner with HIV.

• An HIV+ person whose level of virus in the blood is undetectable is unlikely to transmit HIV to a sex partner.

Sexual sensation seeking (3 items):

• I like wild "uninhibited" sexual encounters.

• I like new and exciting sexual experience and sensations.

• I am interested in trying out new sexual experiences.

Table 2

Baseline Characteristics of MACS Seropositive Men Reporting Unprotected Intercourse with Multiple Partners [*]

	HIV+ ever Unprotected Insertive Anal Intercourse (UIAI), n (%) N =277	HIV+ ever Unprotected Receptive Anal Intercourse (URAI), n (%) N = 299	Total HIV+, n (%) N = 417
Age category			
55 years	34 (12)	33 (11)	54 (13)
45 - 55 years	117 (42)	129 (43)	188 (45)
< 45 years	126 (46)	137 (46)	175 (42)
Race			
White, non-Hispanic	220 (80)	243 (81)	332 (80)
Black, non-Hispanic	34 (12)	37 (13)	52 (12)
Hispanic/Other	23 (8)	19 (6)	33 (8)
Baseline education level			
Post-graduate	78 (28)	86 (29)	128 (31)
No college degree	119 (43)	126 (42)	171 (41)
College	80 (29)	87 (29)	118 (28)
Center			
Los Angeles	101 (37)	109 (37)	143 (34)
Pittsburgh	45 (16)	51 (17)	71 (17)
Chicago	72 (26)	87 (29)	111 (27)
Baltimore	59 (21)	52 (17)	92 (22)
Depressive Symptom Score			
< 16	206 (74)	217 (73)	298 (71)
16	71 (26)	82 (27)	119 (29)
Alcohol Use			
None	50 (18)	58 (20)	80 (19)
Low-Moderate	168 (61)	174 (58)	247 (59)
Moderate-Heavy	45 (16)	51 (17)	69 (17)
Binge	14 (5)	16 (5)	21 (5)
Longitudinal drug use			
Persistent < 3 drugs [**]	217 (78)	233 (78)	342 (82)
Decrease to < 3 drugs	16 (6)	18 (6)	22 (5)
Increase to 3 drugs	20 (7)	22 (7)	22 (5)
Persistent 3 drugs	24 (9)	26 (9)	31 (8)
Detectable HIV RNA			
No	133 (48)	148 (49)	198 (47)
Yes	144 (52)	151 (51)	219 (53)
Serosorting status			
Non-serosorter	184 (66)	198 (66)	299 (72)
Serosorter	93 (34)	101 (34)	118 (28)

*
Baseline defined as the first MACS visit on or after visit 31 with available data (Men's Attitude Survey was introduced at visit 31)

**
Participants in this category reported using fewer than 3 drugs at consecutive visits.

Table 3

Odds ratios and 95% confidence intervals for unprotected anal insertive intercourse among HIV seropositive men reporting multiple partners (after introduction of the Men's Attitude Survey; visits 31-56; 2482 participant-visits from 371 unique participants)

Characteristic	Univariate models		Multivariate model	
	Odds ratios (95% CI)	p-value	Odds ratios (95% CI)	p-value
Cumulative cART years (for a 5-year increase)	1.57 (1.26, 1.96)	< 0.0001	1.33 (1.02, 1.74)	0.04
Longitudinal drug use				
Persistent < 3 drugs	1.0		1.0	
Decrease to < 3 drugs	1.12 (0.71, 1.78)	0.62	0.80 (0.47, 1.35)	0.40
Increase to 3 drugs	1.55 (0.96, 2.49)	0.07	1.41 (0.84, 2.36)	0.19
Persistent 3 drugs	2.85 (1.60, 5.09)	0.0004	1.70 (1.04, 2.79)	0.03
Drinking Status				
None	1.0		1.0	
Low-Moderate	1.63 (1.11, 2.38)	0.01	1.19 (0.76, 1.83)	0.42
Moderate-Heavy	1.30 (0.80, 2.11)	0.30	1.09 (0.64, 1.86)	0.76
Binge	0.90 (0.46, 1.78)	0.76	0.89 (0.41, 1.91)	0.76
Depressive Symptom Score				
< 16	1.0		1.0	
16	1.09 (0.79, 1.51)	0.59	0.93 (0.67, 1.29)	0.66
Age				
55 years	1.0		1.0	
45 - 55 years	0.74 (0.50, 1.09)	0.13	0.87 (0.58, 1.30)	0.48
< 45 years	0.72 (0.45, 1.17)	0.19	0.81 (0.45, 1.45)	0.48
Race				
White, non-Hispanic	1.0		1.0	
Black, non-Hispanic	0.79 (0.46, 1.35)	0.38	1.06 (0.58, 1.95)	0.84
Hispanic	0.49 (0.24, 0.99)	0.049	0.69 (0.35, 1.36)	0.28
Baseline education				
Post-graduate	1.0		1.0	
No college degree	1.19 (0.74, 1.92)	0.48	1.48 (0.89, 2.46)	0.13
College	0.96 (0.58, 1.59)	0.87	1.09 (0.66, 1.83)	0.73
Detectable HIV RNA				
No	1.0		1.0	
Yes	1.30 (0.96, 1.76)	0.10	1.07 (0.79, 1.45)	0.64
Center				
Los Angeles	1.0		1.0	
Pittsburgh	0.55 (0.33, 0.90)	0.018	0.48 (0.28, 0.82)	0.007
Chicago	0.91 (0.55, 1.50)	0.72	0.83 (0.49, 1.40)	0.48
Baltimore	0.66 (0.39, 1.11)	0.12	0.60 (0.36, 0.99)	0.048
Reduced HIV concern				
Neutral	1.0		1.0	

Characteristic	Univariate models		Multivariate model	
	Odds ratios (95% CI)	p-value	Odds ratios (95% CI)	p-value
Agree	2.27 (0.82, 6.23)	0.11	1.87 (0.54, 6.49)	0.32
Disagree	0.20 (0.12, 0.32)	< 0.0001	0.37 (021, 0.64)	0.0004
Perception of HIV as a threat				
Neutral	1.0		1.0	
Agree	1.09 (0.66, 1.80)	0.74	1.26 (0.68, 2.33)	0.47
Disagree	0.73 (0.51, 1.04)	0.08	0.97 (0.69, 1.36)	0.87
Safe sex fatigue				
Neutral	1.0		1.0	
Agree	2.85 (1.92, 4.22)	< 0.0001	2.32 (1.49, 3.61)	0.0002
Disagree	0.50 (0.36, 0.71)	< 0.0001	0.66 (0.46, 0.96)	0.03
Viral load / transmission beliefs				
Neutral	1.0		1.0	
Agree	1.52 (0.94, 2.45)	0.09	0.80 (0.46, 1.37)	0.41
Disagree	0.67 (0.48, 0.95)	0.024	0.74 (0.51, 1.07)	0.11
Sexual sensation seeking				
Neutral	1.0		1.0	
Agree	2.52 (1.80, 3.52)	< 0.0001	1.76 (1.23, 2.53)	0.002
Disagree	0.68 (0.46, 0.99)	0.049	0.92 (0.60, 1.41)	0.70
Serosorting status				
Non-serosorter	1.0		1.0	
Serosorter	5.76 (4.29, 7.75)	<0.0001	6.11 (4.50, 8.31)	<0.0001

*All variables listed in the table were controlled for in the multivariate model.

Table 4

Odds ratios and 95% confidence intervals for unprotected anal receptive intercourse among HIV seropositive men reporting multiple partners (after introduction of MAS; visits 31 – 56; 2679 participant-visits from 385 unique participants)

Characteristic	Univariate models		Multivariate model[*]	
	Odds ratios (95% CI)	p-value	Odds ratios (95% CI)	p-value
Cumulative cART years (for a 5-year increase)	1.52 (1.21, 1.90)	0.0003	1.47 (1.13, 1.91)	0.004
Longitudinal drug use				
Persistent < 3 drugs	1.0		1.0	
Decrease to < 3 drugs	0.89 (0.57, 1.38)	0.60	0.64 (0.40, 1.02)	0.06
Increase to 3 drugs	1.67 (1.07, 2.61)	0.02	1.59 (0.92, 2.74)	0.10
Persistent 3 drugs	3.58 (2.11, 6.09)	< 0.0001	1.93 (1.17, 3.18)	0.01
Drinking Status				
None	1.0		1.0	
Low-Moderate	1.69 (1.11, 2.57)	0.01	1.25 (0.82, 1.89)	0.30
Moderate-Heavy	1.55 (0.94, 2.56)	0.08	1.19 (0.69, 2.04)	0.52
Binge	1.43 (0.66, 3.08)	0.37	1.45 (0.68, 3.07)	0.33
Depressive Symptom Score				
< 16	1.0		1.0	
16	0.93 (0.67, 1.29)	0.65	0.76 (0.54, 1.06)	0.11
Age				
55 years	1.0		1.0	
45 - 55 years	0.83 (0.57, 1.19)	0.30	1.04 (0.69, 1.56)	0.86
< 45 years	0.77 (0.48, 1.22)	0.26	1.10 (0.62, 1.95)	0.74
Race				
White, non-Hispanic	1.0		1.0	
Black, non-Hispanic	0.59 (0.34, 1.06)	0.08	0.68 (0.37, 1.25)	0.21
Hispanic	0.42 (0.21, 0.83)	0.01	0.62 (0.31, 1.21)	0.16
Baseline education				
Post-graduate	1.0		1.0	
No college degree	1.14 (0.70, 1.85)	0.59	1.35 (0.80, 2.30)	0.26
College	1.15 (0.71, 1.88)	0.57	1.51 (0.91, 2.52)	0.11
Detectable HIV RNA				
No	1.0		1.0	
Yes	1.44 (1.06, 1.97)	0.02	1.11 (0.82, 1.51)	0.51
Center				
Los Angeles	1.0		1.0	
Pittsburgh	0.62 (0.37, 1.03)	0.07	0.61 (0.36, 1.03)	0.06
Chicago	0.82 (0.49, 1.36)	0.44	0.87 (0.50, 1.51)	0.63
Baltimore	0.65 (0.36, 1.17)	0.15	0.68 (0.38, 1.21)	0.19
Reduced HIV concern				
Neutral	1.0		1.0	

Characteristic	Univariate models		Multivariate model[*]	
	Odds ratios (95% CI)	p-value	Odds ratios (95% CI)	p-value
Agree	1.06 (0.48, 2.35)	0.88	0.83 (0.33, 2.06)	0.68
Disagree	0.24 (0.15, 0.39)	< 0.0001	0.57 (0.34, 0.97)	0.04
Perception of HIV as a threat				
Neutral	1.0		1.0	
Agree	1.03 (0.62, 1.70)	0.91	1.05 (0.62, 1.77)	0.86
Disagree	0.78 (0.53, 1.15)	0.21	1.04 (0.69, 1.57)	0.85
Safe sex fatigue				
Neutral	1.0		1.0	
Agree	2.37 (1.58, 3.55)	< 0.0001	1.94 (1.25, 3.01)	0.003
Disagree	0.43 (0.31, 0.60)	< 0.0001	0.52 (0.37, 0.72)	< 0.0001
Viral load / transmission beliefs				
Neutral	1.0		1.0	
Agree	1.33 (0.87, 2.03)	0.19	0.98 (0.59, 1.66)	0.95
Disagree	0.53 (0.38, 0.74)	0.0002	0.69 (0.48, 1.07)	0.054
Sexual sensation seeking				
Neutral	1.0		1.0	
Agree	2.23 (1.57, 3.16)	< 0.0001	1.56 (1.07, 2.27)	0.02
Disagree	0.72 (0.49, 1.07)	0.11	1.01 (0.68, 1.49)	0.97
Serosorting status				
Non-serosorter	1.0		1.0	
Serosorter	6.62 (4.86, 9.01)	<0.0001	6.80 (4.88, 9.47)	<0.0001

[*]
All variables listed in the table were controlled for in the multivariate model. 1