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Antiretroviral nonadherence and condomless sex in the HIV Outpatient Study, USA, 2007–2014

MD Durham¹, R Hart², K Buchacz¹, J Hammer³, B Young⁴, D Yang⁵, K Wood², B Yangco⁶, JT Brooks¹,

HOPS Investigators

¹Division of HIV/AIDS Prevention, US Centers for Disease Control and Prevention, Atlanta, GA, USA

²Cerner Corporation, Kansas City, MO, USA

³Denver Infectious Disease Consultants, Rose Medical Center, Denver, CO, USA

⁴APEX Family Medicine, Denver, CO, USA

⁵BrightOutcomes, Buffalo Grove, IL, USA

⁶Infectious Disease Research Institute, Tampa, FL, USA

Abstract

Effective antiretroviral therapy (ART) reduces plasma HIV RNA viral load (VL) to undetectable levels and its effectiveness depends on consistent adherence. Consistent adherence and use of safe sex practices may substantially decrease the risk of HIV transmission. We sought to explore the potential association between self-reported nonadherence to ART and engaging in unsafe sexual practices capable of transmitting HIV. Using clinical and audio computer-assisted self-interview data from the prospective HIV Outpatient Study from 2007 to 2014, we assessed the frequency of self-reported ART nonadherence during the three days prior to the survey among HIV-infected persons in care and factors associated with self-reported ART nonadherence. Of 1729 patients included in this analysis (median age = 48 years, 74.3% men who have sex with men), 17% were nonadherent, 15% had a detectable VL, and 42% reported condomless anal or vaginal sex in the past six months. In multivariable analysis, self-reported nonadherence was independently associated with younger age (adjusted odds ratio [aOR] 0.8 per additional ten years, [95% CI] 0.7–1.0), non-Hispanic black race/ethnicity (aOR 1.9; 95% CI 1.4–2.6 versus white), public health insurance (aOR 1.6, 95% CI 1.2–2.3 compared with private), survey date in 2011–2014 versus 2007–2010 (aOR 0.7, 95% CI 0.5–0.9), CD4 cell count ≥ 500 versus < 200 cells/mm³ (aOR 0.3, 95% CI 0.2–0.5), greater number of ART regimen doses (aOR 1.6, 95% CI 1.3–2.2), and

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Corresponding author: MD Durham, MS Centers for Disease Control and Prevention, 1600 Clifton Road, MS-E45, Atlanta, GA 30333, USA. mvd8@cdc.gov.

Disclaimers

The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

Declaration of conflicting interests

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binge drinking (aOR 1.4, 95% CI, 1.1–1.9). In this analysis, self-reported nonadherence was not associated with engaging in condomless sex.

Keywords

HIV; risk behavior; condomless sex; adherence; antiretroviral therapy

Introduction

The medical management of HIV-infected persons requires consideration of psychosocial and behavioral risk factors, including alcohol and drug use, sexual risk behavior, and adherence to prescribed antiretroviral therapies.¹ Effective antiretroviral therapy (ART) reduces plasma HIV RNA viral load (VL) to undetectable levels, decreasing the risk of HIV-associated morbidity and mortality as well as HIV transmission.^{2,3} However, effectiveness of ART depends on consistent adherence,⁴ which should be routinely assessed.⁵ In addition to adherence support to aid virologic suppression, patients in HIV care should be counseled to maintain consistent condom use if they are sexually active^{6,7} and be informed of other HIV prevention options, such as pre-exposure prophylaxis (PrEP) for their HIV-uninfected sexual partners to further reduce the risk of HIV transmission to the uninfected partner.^{8,9} Published reports exploring the association of sexual risk behavior and ART adherence vary widely in their findings. Although some studies have documented increased unsafe sexual behavior among persons on ART^{10,11} others have documented decreased sexual risk behaviors among persons receiving ART.^{12,13} A meta-analysis of the topic found that condomless sex was not associated with being on ART.¹⁴ Additional data suggest an association between ART nonadherence and condomless sex but vary on the strength of that association.^{1,15,16}

The extent to which patients in routine HIV care who report being nonadherent versus adherent to ART engage in unsafe sexual practices capable of transmitting HIV has not been well described. Understanding the interplay between sexual risk behavior and ART adherence could provide insights to guide combination prevention strategies. We hypothesized that self-reported nonadherence may be associated with condomless sex, because some of the same underlying risk factors (e.g. drug and alcohol use, and nondisclosure of HIV serostatus to sexual partners) that may contribute to having sex without condoms¹⁵ may be associated with inconsistent use of ART.¹⁷ Such an association would point to the need for enhanced counseling of HIV-infected patients regarding the reduction of their sexual risk behaviors and improvements in ART adherence, both for their own health and for prevention of HIV transmission to sexual partners. Using data from the HIV Outpatient Study (HOPS), we sought to describe the frequency of self-reported antiretroviral nonadherence among HIV-infected persons in care and to identify factors associated with ART nonadherence.

Methods

The HOPS

The HOPS is an ongoing prospective observational cohort study of HIV-infected adults presently receiving care at nine participating HIV clinics (university based, public, and private) in six U.S. cities (Chicago, IL; Denver, CO; Stony Brook, NY; Philadelphia, PA; Tampa, FL; and Washington, DC) since 1993.³ The HOPS is an open cohort: patients may enter the study at any point after a diagnosis of HIV infection regardless of treatment history and may leave the study at any point for a variety of reasons such as patient request or loss to follow-up.¹⁸ Since its inception, the HOPS has been approved by institutional review boards at the Centers for Disease Control and Prevention (Atlanta, GA), Cerner Corporation (Kansas City, MO), and each of the local sites. Patient data, including sociodemographic characteristics, diagnoses, ART and other treatments, and laboratory values (including CD4+ cell count [CD4 cell count] and HIV viral load [HIV VL]) were abstracted from medical charts and entered into an electronic database by trained medical record abstractors with backgrounds in nursing or other healthcare-related fields.

In 2007, a supplemental survey was introduced that collected information on patients' sociodemographic characteristics and risk behaviors using a brief telephone audio computer-assisted self-interview (ACASI). In April 2014, a web version of the ACASI was implemented in addition to the telephone version. Patients' responses were kept confidential and individual responses were not available to their HIV care providers. During an annual study visit, patients in HOPS are invited to participate in the ACASI interview. HOPS patients were asked to either complete the survey via phone by dialing a toll free number from a private location in the clinic or from home or by accessing a secure website via a web-enabled device such as a computer or tablet. Patient participation in the interview, as in the larger medical abstraction study, is completely voluntary and patients are not provided any incentives to complete the interview. Data included sociodemographic information; use of tobacco, alcohol, and 'recreational' drugs (per wording in the survey); adherence to ART medication regimen; types and frequency of sexual activity; condom use (past six months)¹⁹; and disclosure of HIV status to sexual partners. Examples of ACASI items included but were not limited to the following: 'In the last six months have you used marijuana, also known as pot, hash, or cannabis?'; 'In the last three days have you missed taking any of your HIV medicines?'; 'Have you had sex in the past six months?'; and 'In the last six months have you had another person's penis in your anus without using a condom?'

Study population

Our analysis was limited to a cross-sectional convenience sample of HOPS patients who were surveyed via ACASI between March 2007 and December 2014 and who were either gay, bisexual, or other men who have sex with men (MSM) or heterosexual men and women (HET). Participants who declined to complete the entire survey or who did not answer the question regarding self-reported ART adherence were excluded, as were participants who were not prescribed an ART regimen at the time of the survey. An ACASI is offered to patients annually: if a participant completed multiple ACASIs, we analyzed the results of the most recent qualifying interview.

Variables

We analyzed behavioral and clinical factors associated with self-reported ART nonadherence. The participants were queried about their ART adherence during the three days preceding the ACASI. Nonadherence was defined as missing at least one HIV medication dose during the past three days. Additionally, we considered standard risk factor variables, all of which were ascertained by ACASI, including alcohol and drug use (the survey focused on illicit/nonprescribed drugs, by asking about 'recreational drug use'), number of sexual partners, and HIV status disclosure. Condomless sex was defined as self-report of anal or vaginal sex without a condom during the six months prior to ACASI; among those who engaged in condomless sex, we also obtained information on possible discordance, i.e. whether any sexual partners were HIV-negative or had an unknown HIV status. Data on age, sex, race/ethnicity, insurance payer, current ART regimen information, CD4 cell count, and a detectable HIV VL, within six months prior or 30 days after ACASI survey date, were obtained through medical chart abstraction.

Statistical analyses

We used descriptive statistics to compare the characteristics of participants who reported being adherent versus non-adherent to ART (Table 1). We calculated p -values for categorical variables using the Chi square test, Fisher's exact test, or Cochran–Armitage test for trend when appropriate; p -values for continuous variables were obtained from a two-sided Wilcoxon rank sum test. We used logistic regression to estimate the odds ratios (ORs) for the association of independent variables with ART nonadherence. Statistical associations with $p < 0.05$ were considered significant. Factors were selected for the multivariable logistic regression model via a forward selection process²⁰ utilizing a boundary p -value of 0.05 for inclusion. For this process, all univariate models were fitted, and the variable with the lowest p -value < 0.05 (i.e. the most significant covariate) was selected for inclusion. Then all bivariate models were fitted including the first selected variable and one other variable; again, the variable with the lowest p -value < 0.05 was included. This process continued until there were no more variables to add with p -value < 0.05 . All analyses were conducted using SAS version 9.4 (SAS Institute, Cary, NC).

Results

Of 4625 patients actively receiving care in the HOPS during 2007–2014, 2047 completed at least one ACASI including questions regarding self-reported ART adherence and condomless vaginal or anal sex (44% survey acceptance and completion rate). When compared to those who were offered but declined to take the survey, those who were included in this study were similar with regard to age and gender, but were more likely to be of non-Hispanic white race/ethnicity. We restricted analysis to participants who were either MSM or HET ($n = 1853$); 124 participants were further excluded because they were not prescribed antiretrovirals at the time of the survey, leaving a total of 1729 qualifying participants. In this population (median age 48.3 years, median CD4 cell count 570 cells/mm³), 74.3% were MSM and 25.7% were HET. Participants who reported being adherent versus nonadherent differed in their characteristics by age, gender, race/ethnicity, HIV risk group, insurance payer, and other factors (Table 1). Of the 16.5% who were nonadherent,

29.5% had a detectable VL (> 50 copies/ml), 42.1% engaged in condomless anal or vaginal sex in the past six months, and 50.0% reported no or limited disclosure of their HIV status to sexual partners (Table 1). By comparison (p-values contrasting with a respective measure for nonadherent participants), of the 83.5% who were adherent, 12.6% ($p < 0.001$) had detectable VL, 41.5% ($p = 0.96$) reported condomless anal or vaginal sex, and 43.4% ($p = 0.059$) reported no or limited disclosure of their HIV status to sexual partners. MSM were more likely to report having had condomless anal or vaginal sex compared with HET participants (47.0% versus 25.8%); however, they also reported higher medication adherence (86.3% versus 75.5%) and were more likely to have an undetectable VL (71.6% versus 63.4%) ($p < 0.001$ for all, Figure 1).

Participants who reported nonadherence to their ART were more likely to report binge drinking (≥ 5 drinks on at least one occasion in the last 30 days) than participants who were adherent (37.2% versus 30.1%, $p = 0.045$) (Table 2). Similarly, participants who reported nonadherence were more likely to be current tobacco smokers (39.6% versus 23.5%, $p < 0.001$). In univariate logistic regression analysis (Table 3), the following factors were associated with nonadherence ($p < 0.05$ for all): younger age, female gender, non-Hispanic black and Hispanic versus non-Hispanic white race/ethnicity, HET versus MSM transmission risk group, earlier survey date, lower CD4 cell counts, a greater number of doses in the ART regimen, a greater number of pills per day in the ART regimen, binge drinking, and drug use.

In multivariable analysis (Table 3), factors independently associated with self-reported nonadherence included younger age (adjusted odds ratio [aOR] 0.8 per additional ten years, 95% confidence interval [95% CI] 0.7–1.0), non-Hispanic black versus non-Hispanic white race/ethnicity (aOR 1.9; 95% CI 1.4–2.6), public versus private insurance (aOR 1.7, 95% CI 1.2–2.3), survey date in 2011–2014 versus 2007–2010 (aOR 0.7, 95% CI 0.5–0.9), CD4 cell count ≥ 500 versus < 200 cells/mm³ (aOR 0.3, 95% CI 0.2–0.5), a greater number of doses per day in the ART regimen (aOR 1.7, 95% CI 1.3–2.2), and binge drinking (aOR 1.4, 95% CI, 1.1–1.9). All p -values were < 0.05 . Gender of participant, HIV transmission risk, condomless sex, condomless sex with possible discordance, HIV status disclosure, years of ART use, years HIV diagnosed, ART regimen class, number of pills per day in the ART regimen, and drug use were not associated with self-reported nonadherence.

Among the 285 participants who self-reported being nonadherent to ART, 84 (29%) had a detectable VL near the time of the survey. Of the 84 participants who were both nonadherent to ART and had a detectable VL, 32 (38%) engaged in condomless anal or vaginal sex, 40 (48%) only had sex with condoms, and 12 (14%) did not engage in sexual activity in the six months prior to the survey.

Discussion

In this analysis of HIV-infected adults in care, nonadherence to ART was relatively uncommon, with 16.5% of participants reporting missing at least one dose of their HIV medication within the three days prior to completing the ACASI. Among participants reporting nonadherence, about 42% reported having had anal or vaginal condomless

sex in the previous six months. Although self-reported nonadherence was significantly associated with having detectable VL in our population, there was no association between nonadherence and the likelihood of engaging in anal or vaginal condomless sex or in condomless sex with HIV-negative or unknown status partners.

We identified several factors associated with self-reported HIV medication nonadherence. Younger HIV-infected participants were more likely to report nonadherence than older HIV-infected participants, as has been found in prior studies.^{21–23} This difference may be due to older participants surviving the early stages of the HIV epidemic in the US, and therefore being more attentive to and more experienced in regularly taking medications than their younger counterparts. Persons reporting binge drinking were also more likely to report being nonadherent than those reporting no binge drinking; this may be because binge drinking may lead to episodes of impairment that interfere with consistent HIV medication adherence, as documented previously.^{24–26} Additionally, those patients with a greater number of doses in their ART regimen, as well as those with a public insurance provider, were more likely to report missing at least one dose of ART during the past three days. Once-daily ART regimens may significantly reduce risk of nonadherence.²⁷

Our results are subject to some limitations. We analyzed self-reported behaviors, including self-reported adherence, and did not measure adherence by pill count or other methods. However, ACASI surveys facilitate honest responses and others have found that reported sexual behaviors did not differ significantly by length of the behavior recall window,^{28–31} and VL findings corroborated nonadherence in our study population. The ACASI survey was an optional component of HOPS study participation; since 2009 we have systematically tracked ACASI offer rates, and in 2014 added a web version to provide different options for patients to participate, to facilitate survey participation and disclosure. Data for this analysis were largely from the era before PrEP use, and we recognize that behaviors related to sexual activity and adherence may change over time with more widespread use of PrEP.

Our findings highlight the potential for transmission posed by participants who report being nonadherent, of whom close to one-third had detectable HIV VL at a proximal measurement. In this analysis, although viremic participants were more likely to report being nonadherent, nonadherence was not associated with reporting condomless vaginal or anal sex, contrary to our original hypothesis. Given that condomless sex was prevalent among patients engaged in HIV care, our findings remain relevant and can inform provider and patient conversations on the importance of HIV medication adherence and safer sexual practices and the design of comprehensive HIV prevention interventions.

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Appendix 1.: HOPS Investigators

The HOPS Investigators include the following persons and sites: Kate Buchacz, Marcus D. Durham, Division of HIV/AIDS Prevention, National Center for HIV, Viral Hepatitis, STD, and TB Prevention (NCHHSTP), Centers for Disease Control and Prevention (CDC), Atlanta, GA; Stacey Purinton, Kate Shelton, Nabil Rayeed, Carl Armon, Thilakavathy Subramanian, Cheryl Akridge, Linda Battalora Cerner Corporation, Kansas City, MO; Frank J. Palella, Saira Jahangir, Conor Daniel Flaherty, Patricia Bustamante, Feinberg School of Medicine, Northwestern University, Chicago, IL; John Hammer, Kenneth S. Greenberg, Barbara Widick, Rosa Franklin, Rose Medical Center, Denver, CO; Bienvenido G. Yangco, Kalliope Chagaris, Infectious Disease Research Institute, Tampa, FL; Douglas J. Ward, Troy Thomas, Cheryl Stewart, Dupont Circle Physicians Group, Washington, DC; Jack Fuhrer, Linda Ording-Bauer, Rita Kelly, Jane Esteves, State University of New York (SUNY), Stony Brook, NY; Ellen M. Tedaldi, Ramona A. Christian, Faye Ruley, Dania Beadle, Princess Davenport, Lewis Katz School of Medicine at Temple University, Philadelphia, PA; Richard M. Novak, Andrea Wendrow, University of Illinois at Chicago, Chicago, IL; Benjamin Young, Mia Scott, Barbara Widick, Billie Thomas, APEX Family Medicine, Denver, CO.

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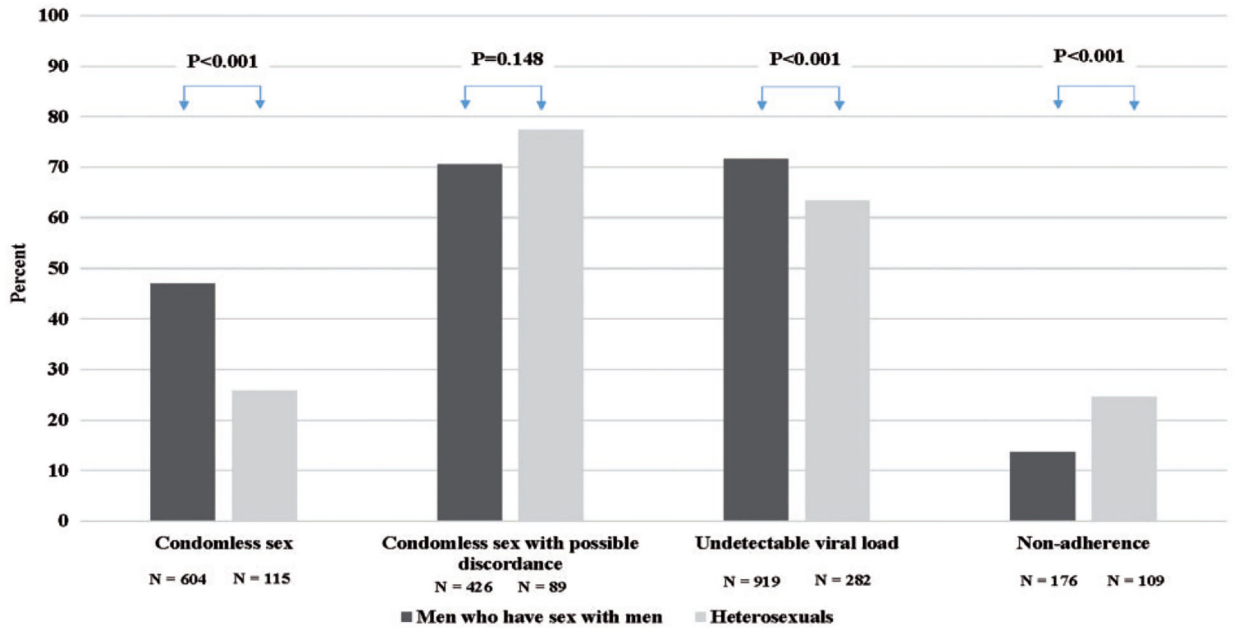


Figure 1. Characteristics of MSM and heterosexual patients completing an ACASI, HIV Outpatient Study, USA, 2007–2014 (N = 1729).

ACASI: audio computer-assisted self-interview; MSM: gay, bisexual and other men who have sex with men.

Condomless sex was defined as self-report of anal or vaginal sex without a condom in the six months before interview.

Discordance was defined as having condomless sex with partners of unknown HIV status or who were known to be HIV-negative and was only defined for those who have reported having condomless sex.

Viral load was the closest viral load to the date of ACASI within six months prior and one month after the survey.

Nonadherence was defined as missing at least one HIV medication dose during the three days prior to ACASI.

P-values for differences in categories were obtained using a Chi square test; N shows number with the characteristic (numerator).

Characteristics of HIV-infected patients by self-reported ARTadherence, HIV Outpatient Study, USA 2007–2014, N = 1729.

Table 1.

Characteristic	Adherent (n = 1444)	Nonadherent ^a (n = 285)	p-value ^b		
Age in years, median (IQR)	48.7 (42.5, 55.0)	46.0 (39.8, 52.1)	0.001		
Gender, n (%)	N (Column %)	Row %	N (Column %)	Row %	
Female	216 (15.0)	74.0	76 (26.7)	26.0	<0.001
Male	1228 (85.0)	85.0	209 (73.3)	14.5	
Race/ethnicity, n (%)					<0.001
Non-Hispanic white	904 (62.6)	88.5	118 (41.4)	11.5	
Non-Hispanic black	370 (25.6)	74.3	128 (44.9)	25.7	
Hispanic	133 (9.2)	81.1	31 (10.9)	18.9	
Other/unknown	37 (2.6)	82.2	8 (2.8)	17.8	
HIV transmission risk group, n (%)					<0.001
MSM	1108 (76.7)	86.3	176 (61.8)	13.7	
Heterosexual	336 (23.3)	75.5	109 (38.2)	24.5	
Insurance payer, n (%)					<0.001
Private	820 (56.8)	87.6	116 (40.7)	12.4	
Public	412 (28.5)	75.7	132 (46.3)	24.3	
Other or unknown	212 (14.7)	85.1	37 (13.0)	14.9	
Any condomless sex, n (%)					0.96
Yes	599 (41.5)	83.3	120 (42.1)	16.7	
No	615 (42.6)	83.8	119 (41.8)	16.2	
No sexual partners	210 (14.5)	83.7	41 (14.4)	16.3	
Unknown	20 (1.4)	80.0	5 (1.8)	20.0	
Condomless sex with possible discordance, ^c n (%)					0.98
At least one HIV- or unknown status partner	429 (71.6)	83.3	86 (71.7)	16.7	
All partners HIV+	168 (28.0)	83.6	33 (27.5)	16.4	
No sexual partners	210 (14.5)	83.7	41 (14.4)	16.3	
Unknown	2 (0.3)	66.7	1 (0.8)	33.3	
Disclosed HIV status to..., n (%)					0.059

None/some partners	536 (43.4)	81.5	122 (50.0)	18.5	
All partners	698 (56.6)	85.1	122 (50.0)	14.9	0.005
Year of ACASI					
2007–2010	493 (34.1)	80.2	122 (42.8)	19.8	
2011–2014	951 (65.9)	85.4	163 (57.2)	14.6	<0.001
CD4 cell count (cells/mm ³), ^d n (%)					
<200	55 (3.8)	57.9	40 (14.0)	42.1	
200–349	173 (12.0)	82.0	38 (13.3)	18.0	
350–499	224 (15.5)	81.8	50 (17.5)	18.2	
500	755 (52.3)	87.3	110 (38.6)	12.7	
Unknown	237 (16.4)	83.5	47 (16.5)	16.5	<0.001
HIV RNA viral load, ^d n (%)					
Undetectable ^e	1038 (71.9)	86.4	163 (57.2)	13.6	
Detectable	182 (12.6)	68.4	84 (29.5)	31.6	
Unknown	224 (15.5)	85.5	38 (13.3)	14.5	
Regimen type, n (%)					0.003
PI based	435 (30.1)	82.9	90 (31.6)	17.1	
NNRTI based	524 (36.3)	88.2	70 (24.6)	11.8	
Integrase/entry inhibitor based	230 (15.9)	81.0	54 (18.9)	19.0	
Based on two or more classes ^f	203 (14.1)	79.0	54 (18.9)	21.0	
Other antiretrovirals	49 (3.4)	75.4	16 (5.6)	24.6	
All other/unknown	3 (0.2)	75.0	1 (0.4)	25.0	
Hepatitis B coinfection, n (%)	126 (8.7)	84.0	24 (8.4)	16.0	0.87
Hepatitis C coinfection, n (%)	144 (10.0)	75.4	47 (16.5)	24.6	<0.001
Years on ART, median (IQR)	11.4 (5.6, 16.6)		10.9 (6.5, 15.7)	24.6	0.66
Number of pills per day, median (IQR)	3 (1, 4)		3 (2, 5)	24.6	<0.001
Number of daily doses in regimen, median (IQR)	1 (1, 2)		2 (1, 2)	24.6	<0.001
Years since HIV diagnosis, median (IQR)	13.7 (7.4, 19.5)		13.4 (8.2, 18.1)	24.6	0.68

ACASI: audio computer-assisted self-interview; ART: antiretroviral therapy; IQR: interquartile range; MSM: gay, bisexual, and other men who have sex with men; NNRTI: nonnucleoside reverse transcriptase inhibitor; PI: protease inhibitor.

^dNonadherence: missed at least one HIV medication dose during the past three days.

^b P-values for comparison of categorical variables were obtained using a Chi square test, Fisher's exact test, or Cochran–Armitage test of trend when appropriate; p-values for continuous variables were obtained from a two-sided Wilcoxon rank sum test.

^c Includes only patients who reported having sexual activity in the six months before interview.

^d Closest CD4 or viral load lab within six months prior and 30 days after date of interview

^e Defined as an undetectable viral load or < 50 copies/ml.

^f Regimen containing antiretrovirals in at least two of the following classes: protease inhibitor, nonnucleoside reverse transcriptase inhibitor, or integrase/entry inhibitors.

Table 2. Drug, alcohol, and tobacco use among patients adherent and nonadherent to ART, HIV Outpatient Study, USA, 2007–2014, N = 1729.

Characteristic	Adherent		Nonadherent ^a		P-value ^b
	N (Column %)	Row %	N (Column %)	Row %	
Total	1444	83.5	285	16.5	
Alcohol use, n (%)					0.228
Yes	1035 (71.7)	84.3	193 (67.7)	15.7	
No	398 (27.6)	81.9	88 (30.9)	18.1	
Unknown	11 (0.8)	73.3	4 (1.4)	26.7	
Days per week drinking, median (IQR)	1 (0, 3)		1 (0, 3)		0.79
Number of drinks per day, median (IQR)	2 (1, 3)		2 (1, 3)		0.007
Binge drinking, n (%)					0.045
Yes	435 (30.1)	80.4	106 (37.2)	19.6	
No	948 (65.7)	84.3	176 (61.8)	15.7	
Unknown	61 (4.2)	95.3	3 (1.1)	4.7	
Number of days of binge drinking in past 30 days, n (%)					0.18
0 days	948 (65.7)	84.3	176 (61.8)	15.7	
1–3 days	319 (22.1)	79.6	82 (28.8)	20.4	
4–7 days	78 (5.4)	82.1	17 (6.0)	17.9	
8 or more days	38 (2.6)	84.4	7 (2.5)	15.6	
Unknown	61 (4.2)	95.3	3 (1.1)	4.7	
Current tobacco smoker, n (%)					<0.001
Yes	339 (23.5)	75.0	113 (39.6)	25.0	
No	1101 (76.2)	86.5	172 (60.4)	13.5	
Unknown	4 (0.3)	100.0	0 (0.0)	0.0	
10 (4, 15)			8 (4, 15)		0.49
Number of cigarettes per day (median), n (%)					0.019
Drug use in past six months, n (%)					
Yes	784 (54.3)	83.1	160 (56.1)	16.9	
No	492 (34.1)	87.5	70 (24.6)	12.5	
Unknown	168 (11.6)	75.3	55 (19.3)	24.7	

Characteristic	Adherent		Nonadherent ^a		P-value ^b
	N (Column %)	Row %	N (Column %)	Row %	
Drug used during past six months, n (%)					
Marijuana	421 (29.2)	82.1	92 (32.3)	17.9	0.28
Cocaine	79 (5.5)	68.1	37 (13.0)	31.9	<0.001
Poppers	317 (22.0)	85.0	56 (19.6)	15.0	0.43
Heroin	8 (0.6)	50.0	8 (2.8)	50.0	0.002
Methamphetamines	83 (5.7)	83.0	17 (6.0)	17.0	0.89
Club/party drugs	41 (2.8)	78.8	11 (3.9)	21.2	0.35
Viagra, Cialis, etc. ^e	344 (28.0)	88.4	45 (21.5)	11.6	0.092
Injected drugs not prescribed by a doctor	35 (2.4)	71.4	14 (4.9)	28.6	0.021
Most common dual combinations of drug use in past six months (not mutually exclusive), n (%)					
Poppers/Viagra, Cialis, or Levitra	137 (9.5)	84.6	25 (8.8)	15.4	0.70
Marijuana/poppers	133 (9.2)	86.9	20 (7.0)	13.1	0.23
Marijuana/Viagra, Cialis, or Levitra	124 (8.6)	90.5	13 (4.6)	9.5	0.022
Poppers/methamphetamines	58 (4.0)	85.3	10 (3.5)	14.7	0.69
Methamphetamines/Viagra, Cialis, or Levitra	47 (3.3)	81.0	11 (3.9)	19.0	0.60
Marijuana/cocaine	37 (2.6)	64.9	20 (7.0)	35.1	<0.001
Cocaine/poppers	33 (2.3)	84.6	6 (2.1)	15.4	0.29
Marijuana/methamphetamines	35 (2.4)	77.8	10 (3.5)	22.2	0.85

ART: antiretroviral therapy; IQR: interquartile range.

^aNonadherence: missed at least one HIV medication dose during the past three days.

^bP-values for comparison of categorical variables were obtained using a Chi square test, Fisher's exact test, or Cochran-Armitage test of trend when appropriate; p-values for continuous variables were obtained from a two-sided Wilcoxon Rank-Sum Test.

^cBinge drinking was defined as self-report of having 5 drinks on at least one occasion in the last 30 days.

^dDefined only for current smokers.

^eDefined only for men.

Univariate and multivariable analysis of factors associated with self-reported nonadherence to ART in the past three days, HIV Outpatient Study, USA 2007–2014, N = 1729.

Table 3.

Characteristic	Univariate analysis		Multivariable analysis	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Age (per 10 years)	0.8 (0.7, 0.9)	< 0.001	0.8 (0.7, 1.0)	0.018
Gender				
Female	2.1 (1.5, 2.8)	< 0.001		
Male	Referent			
Race/ethnicity				
Non-Hispanic white	Referent		Referent	
Non-Hispanic black	2.7 (2.0, 3.5)	< 0.001	1.9 (1.4, 2.6)	< 0.001
Hispanic	1.8 (1.2, 2.8)	0.009	1.4 (0.9, 2.2)	0.17
Other/unknown	1.7 (0.8, 3.6)	0.209	1.3 (0.5, 3.3)	0.53
HIV risk				
MSM	Referent			
Heterosexual	2.0 (1.6, 2.7)	< 0.001		
Insurance payer				
Private	Referent		Referent	
Public	2.3 (1.7, 2.0)	< 0.001	1.6 (1.2, 2.3)	0.002
Other or unknown	1.2 (0.8, 1.8)	0.30	1.1 (0.7, 1.8)	0.58
Any condomless sex				
Yes	1.0 (0.8, 1.4)	0.81		
No	Referent			
No sexual partners	1.0 (0.7, 1.5)	0.96		
Unknown	1.3 (0.5, 3.5)	0.62		
Condomless sex with possible discordance				
At least one HIV or unknown status partner	Referent			
All partners HIV+	1.0 (0.6, 1.5)	0.93		
No sexual partners	1.0 (0.7, 1.3)	0.86		
Unknown	2.5 (0.2, 27.8)	0.46		

Characteristic	Univariate analysis		Multivariable analysis	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Disclosed HIV status to...				
None/some sexual partners	1.3 (1.0, 1.7)	0.060		
All sexual partners	Referent			
Had no sexual partners	1.1 (0.8, 1.6)	0.57		
Year of ACASI				
2007–2010	Referent		Referent	
2011–2014	0.7 (0.5, 0.9)	0.005	0.7 (0.5, 0.9)	0.010
CD4+ cell count (cells/mm ³)				
<200	Referent		Referent	
200–349	0.3 (0.2, 0.5)	<0.001	0.4 (0.2, 0.7)	0.001
350–499	0.3 (0.2, 0.5)	<0.001	0.4 (0.3, 0.8)	0.004
500+	0.2 (0.1, 0.3)	<0.001	0.3 (0.2, 0.5)	<0.001
Unknown	0.2 (0.2, 0.5)	<0.001	0.4 (0.2, 0.8)	0.004
1.0 (0.9, 1.1)	0.70			
Years on ART (per five years) ^a	1.0 (0.9, 1.1)	0.58		
Years from HIV diagnosis (per five years)	1.0 (0.9, 1.1)			
Regimen type				
PI based	Referent			
NNRTI based	0.6 (0.5, 0.9)	0.011		
Integrase/entry inhibitor based	1.1 (0.8, 1.6)	0.51		
Based on two or more classes ^a	1.3 (0.9, 1.9)	0.19		
Other antiretrovirals	1.6 (0.9, 2.9)	0.14		
# Doses in regimen ^b	1.6 (1.3, 2.1)	<0.001	1.6 (1.3, 2.2)	<0.001
# Pills per day ^b	1.1 (1.0, 1.1)	0.012		
Binge drinking ^c				
Yes	1.3 (1.0, 1.7)	0.045	1.4 (1.1, 1.9)	0.021
No	Referent		Referent	
Unknown	0.3 (0.1, 0.9)	0.026	0.5 (0.1, 1.6)	0.22
Drug use ^d				

Characteristic	Univariate analysis		Multivariable analysis	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Yes	Referent			
No	0.7 (0.5, 0.9)	0.020		
Unknown	1.6 (1.1, 2.3)	0.008		

ART: antiretroviral therapy; CI: confidence interval; dx: diagnosis; MSM: males who have sex with males; NNRTI: nonnucleoside reverse transcriptase inhibitor; OR: odds ratio; PI: protease inhibitor.

^aRegimen containing antiretrovirals in at least two of the following classes: protease inhibitor, nonnucleoside reverse transcriptase inhibitor, or integrase/entry inhibitors.

^bReduced sample size due to missing/unknown information.

^cBinge drinking is defined as self-report of having 5 drinks on at least one occasion in the last 30 days.

^dDrug use during the past six months.