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Alcohol and Adherence to Antiretroviral Medications: Interactive Toxicity Beliefs among People Living with HIV

Seth C. Kalichman, PhD [Professor of Psychology],

University of Connecticut Storrs, CT, USA

Christina M. Amaral, BA [Research Assistant],

University of Connecticut Storrs, CT, USA

Denise White, MA [Research Assistant],

University of Connecticut Storrs, CT, USA

Connie Swetsze, LPN [Research Assistant],

University of Connecticut Storrs, CT, USA

Moirra O. Kalichman, MSW [Project Manager],

University of Connecticut Storrs, CT, USA

Chauncey Cherry, MPH [Project Manager], and

University of Connecticut Storrs, CT, USA

Lisa Eaton, PhD [Assistant Research Professor]

University of Connecticut Storrs, CT, USA

Abstract

When taken without interruption, antiretroviral therapies (ART) effectively treat HIV infection. Alcohol is a well-known direct and indirect influence on ART adherence. Believing that drinking is harmful while taking ART (interactive toxicity beliefs) is also associated with poor adherence. The current study included 333 people living with HIV who were taking ART and actively using alcohol. Participants were recruited from health care providers and social services in a major southern U.S. city. Results showed that 52% of persons found non-adherent to ART stated that they stopped taking their medications when they were drinking. Multivariate analyses showed that interrupting treatment when drinking was related to current non-adherence, over and above several common correlates of non-adherence including frequency of alcohol use itself. These results confirm and extend past research, indicating an urgent need for medication adherence interventions designed for people living with HIV who drink.

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Keywords

alcohol; antiretroviral therapy; beliefs; HIV treatment adherence

Alcohol consumption is a risk factor for liver disease and significantly contributes to mortality of people with HIV infection. Alcohol can also induce cirrhosis, impeding medication metabolism and absorption (Kresina et al., 2002). Braithwaite and colleagues (2008) found that high levels of alcohol consumption can lead to as many as 6 lost years of life among people living with HIV (PLWH). In addition to the hazards that alcohol itself poses to the health of people with HIV, drinking is linked to poor medication adherence. Antiretroviral therapies (ART) effectively suppress HIV replication and improve the health of PLWH. Poor adherence to ART is the most common cause of treatment failure, viral resistance to ART, and advancing HIV disease (Volberding & Deeks, 2010). HIV treatment regimens vary in terms of their demand for adherence in order to achieve sustained viral suppression (Bangsberg, Kroetz, & Deeks, 2007). However, patients are told to take every dose of their medications and that adherence of less than 85% of doses taken poses considerable risks for developing viral resistance. Studies show dose-response relationships between alcohol consumption and ART adherence, with drinkers missing more ART doses than non-drinkers, and binge drinkers missing more doses than non-binge drinkers (Braithwaite et al., 2008, 2005). Alcohol use can disrupt medications by the direct effects of intoxication on memory, planning, organizational, and other cognitive abilities as well as residual effects, such as hangovers (Braithwaite et al., 2005).

Prolonged treatment interruptions are more concerning than sporadic missed doses. Medication interruptions of 10 days are associated with a 20% probability of treatment failure and interruptions of 15 days are associated with a 50% chance of failure (Parienti et al., 2008). With respect to alcohol use, extended periods of non-adherence are more closely associated with deliberately stopping medications during periods of drinking. Drinking can also delay calling in refills and picking up prescriptions from the pharmacy. In addition, prolonged treatment interruptions may occur when persons believe that they should stop taking their medications to avoid mixing with alcohol.

Beliefs that mixing alcohol with ART results in a toxic combination (interactive toxicity beliefs) can lead to deliberate treatment interruptions. Sankar, Wunderlich, Neufeld, and Luborsky (2007) studied 82 HIV-infected patients receiving care from an infectious disease clinic and found that two out of three light drinkers, 55% of moderate drinkers, and 29% of heavy drinkers believed that mixing alcohol with antiretroviral medications was toxic, and these beliefs were associated with forgoing medications. Sankar and colleagues' (2007) findings were based on qualitative research and illustrated common alcohol interactive toxicity beliefs, with people commonly stating, "If I know I'm drinking alcohol, I won't take my meds that day" (page 198). Additional research with 145 people receiving ART found that 82% of non-drinkers and 62% of drinkers believed that alcohol and ART should never be mixed (Kalichman, Amaral, White et al., 2009). Nearly one in five drinkers reported occasionally stopping their HIV medications when they were drinking and 25% indicated that they planned to stop taking their medications when they drank in the future. Stopping

medications when drinking predicted HIV treatment non-adherence over and above participant demographic characteristics, quantity/frequency of alcohol use, and indicators of problem drinking. These findings suggest that beliefs about drinking alcohol while taking HIV treatments leads some patients to stop drinking, whereas other patients stop taking their medications when drinking.

People who believe that it is toxic to mix alcohol and ART are at risk for discontinuing medications before, during, and after they have been drinking. Although previous research has focused on individual's beliefs about the adverse impact of drinking alcohol on ART, there has been less attention to the sources of interactive toxicity beliefs and subsequent behaviors that lead to non-adherence. For example, interactive toxicity beliefs may stem from communications with health care providers or from perceptions of others' actions (e.g., social norms). In addition, beliefs may be expressed in a variety of behaviors that can impact ART adherence, including failure to plan ahead of time to miss doses when drinking, taking drug holidays when drinking, or waiting to take medications until the effects of alcohol have dissipated, each leading to different interventions. Identifying the behaviors that are directly associated with interactive toxicity beliefs will help guide education and counseling efforts to prevent medication lapses in relation to drinking alcohol.

The current study investigated the prevalence of ART-alcohol interactive toxicity behaviors in a sample of PLWH who drank alcohol and were taking ART. We examined potential social sources of interactive toxicity beliefs, specifically communications with medical care providers and perceived social norms among people currently treated with ART. In addition, we investigated the associations among alcohol use, interactive toxicity beliefs, and HIV treatment adherence. We hypothesized that ART adherence would be associated with avoiding mixing alcohol and medications. We also hypothesized that perceived norms and communication with providers about the hazards of mixing alcohol with medications would be associated with HIV treatment non-adherence beyond alcohol use itself.

Methods

Participants and Recruitment

PLWH ($N = 678$) were recruited through targeted community sampling to participate in a cross-sectional study. We used both targeted venue recruitment and snowball sampling techniques. Recruitment used brochures placed in waiting rooms of HIV service providers and infectious disease clinics, as well as a systematic approach to word-of-mouth chain recruitment. Participants were given brochures that described the study opportunity with the phone number to the research offices. Participants were encouraged to use the brochures to refer their HIV-infected friends to the study. These procedures were designed to extend recruitment beyond service settings in order to achieve a broad community sample of PLWH.

Interested persons contacted our research program to schedule an appointment. The study entry criteria were 18 years of age or older, proof of HIV status using a photo ID, and either a matching prescription bottle, HIV clinic card, positive HIV test result, or any other proof of HIV status. Written informed consent was obtained from participants prior to initiating

any study activities. Participants received \$25 for completing the study measures, which required approximately 1 hour. Data were collected using computerized interviews during December 2009 to January 2011. All study procedures were approved by our university institutional review board.

Measures

Participants completed audio-computer assisted self-interviews (ACASI) designed to reduce demand characteristics and socially evoked response biases (Gribble et al., 2000; Morrison-Beedy, Carey, & Tu, 2006). Measures included demographic and health characteristics, medication adherence, substance use, and interactive toxicity behaviors, social norms, and provider communications.

Demographic and health characteristics—Participants were asked their age, years of education, income, ethnicity, employment status, and history of incarceration. To assess health status, participants reported the date that they tested positive for HIV infection, their most recent CD4+ T-cell count, and most recent viral load. HIV related symptoms were assessed using a previously developed measure of 14 common symptoms of HIV infection, including developing a new skin rash, recurring fever, chronic diarrhea, and persistent shortness of breath (Kalichman, Rompa, & Cage, 2000).

Medication adherence—We used a visual analogue rating scale to assess ART adherence over the previous month. The visual analogue adherence rating scale asks individuals to indicate the point along a continuum showing the amount of ART they have taken in the previous month. For the computerized administration we adapted the response format to use a 100-point slide bar tool anchored by 0%, 50% and 100% adherence. The standard instructions were designed to counter socially desirable response biases by acknowledging that it can be difficult to take ART (Simoni et al., 2006). The instructions read, “We would be surprised if most people take 100% of their medications. Below, 0% means you have taken none of your HIV medications this past month, 50% means you have taken half of your HIV medications this past month and 100% means you have taken every single dose this past month. What percent of your HIV medications did you take?” Participants indicated the percentage of medications taken by clicking their mouse anywhere on the 100-point slide bar continuum. The adherence rating scale used in this study correlated $r = .48$ with adherence obtained by unannounced pill counts and was significantly associated with HIV suppression (Bangsberg, Hecht, Charlebois, Chesney, & Moss, 2001; Giordano, Guzman, Clark, Charlebois, & Bangsberg, 2004; Kalichman, Amaral, Swetzes et al., 2009).

Substance use—To assess alcohol use we administered the Alcohol Use Disorders Identification Test (AUDIT), a 10-item scale designed to measure alcohol consumption and identify risks for alcohol abuse and dependence (Saunders, Aasland, Babor, DeLaFuentes, & Grant, 1993). The first three items of the AUDIT represent quantity and frequency of alcohol use, with the remaining items addressing problems incurred from drinking alcohol. Scores on the AUDIT range from 0 – 40. Scores greater than 8 indicate high-risk for alcohol use disorders and problem drinking, with demonstrated specificities between .80 and .90

(Maisto, Conigliaro, McNeil, Kraemer, & Kelley, 2000). In the current sample, the AUDIT was internally consistent, $\alpha = .90$. We also asked participants if they were currently using marijuana, cocaine/crack, inhalants (e.g., poppers), amphetamines, and other drugs. We computed an index of non-alcohol drug use by summing the number of drugs used in the previous 4 months.

Interactive toxicity behaviors, social norms, and provider communications—

Participants completed measures to assess impacts and sources of beliefs regarding mixing alcohol and ART. The measures developed for this study concentrated on: (a) recent behaviors associated with interactive toxicity beliefs, (b) perceived norms regarding mixing alcohol with medications, and (c) communication with providers regarding mixing alcohol with ART. Items were derived from previous research on interactive toxicity beliefs (Altice, Mostashari, & Friedland, 2001; Sankar et al., 2007).

To determine interactive toxicity behaviors, participants completed nine items concerning actions that they had taken regarding their ART and drinking alcohol. This measure reflected specific behaviors directly associated with interactive toxicity beliefs (Altice et al., 2001; Kalichman, Amaral, White et al., 2009; Sankar et al., 2007). Participants reported whether they had engaged in behaviors to avoid mixing ART with alcohol including not drinking when taking medications as well as not taking medications while drinking. Items are shown in the results section and were responded to regarding whether participants had ever performed each of the nine actions. The alcohol interactive toxicity behaviors were internally consistent ($\alpha = .73$).

Participants also responded to five interactive toxicity norm items regarding their perceptions of how ART was affected by alcohol use among other PLWH. These items were constructed to assess descriptive norms for behaviors related to not taking medications during periods of alcohol use. We asked participants to indicate how often they believed others take their medications with alcohol, take ART after drinking, stop taking ART if they are drinking, refuse to drink if taking ART, and get sick if they mix alcohol and ART. Participants were asked how often other people performed each of the described behaviors on a 4-point scale ranging from *all of the time* to *never*. The perceived alcohol toxicity norms items were internally consistent ($\alpha = .74$).

Finally, we assessed experiences with provider communications regarding alcohol use and medications. Three items asked whether their providers had talked with them in the past year about their use of alcohol ($\alpha = .67$). In addition, two items specifically asked about whether their provider had warned them not to mix ART with alcohol and other drugs ($\alpha = .81$). Responses indicated whether each communication occurred or not, with *yes* or *no* responses.

Data Analyses

Analyses were restricted to 333 participants who were both currently drinking and receiving ART. We conducted descriptive analyses that included comparisons between participants who were non-adherent and those who were adherent to ART in the previous month as measured by the visual analogue adherence rating scale. Non-adherence was defined as less

than 85% of medications taken because most ART regimens are ineffective in suppressing HIV when adherence is below 85% of doses taken (Bangsberg et al., 2007; Parienti et al., 2008). We therefore used bivariate logistic regressions to compare participants who were less than or equal to 85% adherent to those who were greater than 85% adherent. First, we compared adherence groups on demographic, substance use, and health-related characteristics. Next, we tested the two main study hypotheses. Our first hypothesis stated that ART adherence would be associated with avoiding mixing alcohol and medications. This hypothesis was tested by comparing the adherence groups on the interactive toxicity behaviors. Our second hypothesis stated that perceived norms and communications with providers about mixing alcohol with medications would be associated with HIV treatment non-adherence over and above alcohol use itself. Comparisons were again made using logistic regressions to compare adherence groups on perceived norms and provider communications measures.

We also examined independent associations with ART adherence by testing a multiple logistic regression model that included all non-redundant variables found significant in the bivariate tests. To reduce the number of variables included in the model we calculated composite indexes for interactive toxicity behaviors, perceived norms, and provider communications (see measures for internal consistency reliabilities). Finally, we examined social norms and provider communications as predictors of stopping ART during periods of alcohol use. For these analyses, participants who reported either (a) stopping ART if they were drinking, or (b) stopping ART if they anticipated drinking, were compared to participants who reported neither behavior. A logistic regression model was tested that included alcohol and drug use, perceived interactive toxicity norms, and having been told by a provider not to mix alcohol and medications. For all logistic regressions we report odds ratios and 95% confidence intervals (95% CI).

Results

The sample ($N = 678$) was primarily African American (91%), with a median 12 years of education, 35% unemployment, and 68% with a history of incarceration. One in five participants ($n = 143$, 21%) were not currently taking ART, among which 51% stated that their provider told them that it was not time to start treatment, 21% stated that they did not want to take medications at this time, and 8% indicated that they were not currently taking medications because they drank alcohol. The majority of the sample ($n = 441$, 65%) reported that they currently drank alcohol. Among the 535 participants who were taking ART, 333 (63%) were also currently drinking alcohol. All further analyses were conducted with the 333 participants who were currently taking ART and drinking alcohol.

Table 1 shows the demographic, health, and substance use characteristics of non-adherent and adherent participants. Results comparing non-adherent and adherent participants showed that persons who were non-adherent to ART were significantly younger, more likely to have been incarcerated, more likely to have recently used non-alcoholic drugs, and had experienced more HIV-related symptoms.

Interactive Toxicity Behaviors

Table 2 shows that in most cases, at least half of participants who drank alcohol and were taking ART reported alcohol interactive toxicity-related behaviors that interrupted ART adherence. Non-adherent participants were significantly more likely to have not taken medications and more likely to have stopped taking medications in anticipation of drinking alcohol, skipped their medications if they had been drinking, and not taken medications if they were hung-over from drinking alcohol, confirming our first hypothesis.

Perceived Interactive Toxicity Norms

A majority of participants perceived frequent use of alcohol in conjunction with ART among other PLWH. Confirming our second hypothesis, non-adherent participants were significantly more likely to believe that others skipped their medications when drinking and that others refused alcohol when taking medications. Thus, perceived norms for not mixing medications with alcohol were associated with non-adherence among drinkers. In contrast, adherence was not associated with perceptions that other people with HIV took their medications while drinking or that mixing alcohol and ART made people sick (see Table 3).

Provider Communications

A majority of non-adherent and adherent participants reported that their medical providers had discussed their medications and discussed alcohol and other drug use. More than 80% of participants reported that their provider had told them not to mix alcohol or other drugs with HIV medications (see Table 3). Failing to support our hypothesis, none of the provider communications, however, were associated with ART non-adherence.

Multivariable Models

A multiple logistic regression was performed to predict non-adherence/adherence using non-redundant demographic variables found significant in the previous analyses, interactive toxicity behaviors, norms, and provider communications. As shown in Table 4, participants who were non-adherent were younger, heavier drinkers, and engaged in more behaviors that interrupted taking ART when they were drinking. The remaining variables, including perceived behavioral norms and provider communications, were not significantly independently associated with ART adherence.

A second multivariable model was performed for stopping medications when drinking. We found that 168 (50%) of people taking ART and currently drinking alcohol had stopped taking ART either in anticipation of drinking or after drinking alcohol. Participants who had stopped taking their medications in relation to drinking reported significantly more HIV symptoms, used more illicit drugs, and were more likely to report that their providers had told them not to mix alcohol and ART (see Table 5).

Discussion

Substance use was common in this sample of people receiving ART. One in four participants indicated potential problem drinking and a majority of the sample reported recent illicit drug use. Replicating previous research, we found that medication adherence

was significantly associated with alcohol and other drug use. In particular, heavier drinkers and participants who reported cannabis use demonstrated poorer adherence. Overall, the greater amount of drinking and the greater number of drugs used, the more likely participants were to have suboptimal adherence. Behaviors associated with beliefs about mixing alcohol and antiretroviral medications were also prevalent among PLWH. We found that more than half of participants in the current study reported skipping HIV medications if they knew that they would be drinking and nearly half stated that they did not take their medications until alcohol was completely out of their systems. We found interactive toxicity behaviors were more often reported by persons who were non-adherent to their medications. In a multivariable model, we found that interrupting medications to avoid mixing them with alcohol was associated with medication non-adherence over and above alcohol use and other participant characteristics. These results replicate and extend past research and confirm an important role of interactive toxicity beliefs in medication adherence among PLWH.

We found that more than two thirds of participants perceived that interactive toxicity beliefs were held by other PLWH and perceived norms regarding skipping medications when drinking were associated with non-adherence. In addition, more than 80% of participants stated that their providers had told them not to mix alcohol with their medications. We cannot, therefore, conclude that provider messages lead to interactive toxicity beliefs and non-adherence. On the other hand, intentionally stopping ART when drinking was associated with having had a provider advise participants not to mix ART and alcohol. It is, therefore, likely that a combination of messenger and receiver factors are at play in formulating interactive toxicity beliefs and behaviors. Research is needed to determine what providers tell their patients about alcohol and ART and how patients interpret these communications.

The current study has several limitations. First, we utilized a non-representative convenience sample of PLWH. The study sample was recruited from multiple services in a major metropolitan area. Caution is warranted in generalizing these findings to other populations. Second, we relied on self-reported alcohol use and medication adherence. The validity of self-report substance use is often questioned because of under-reporting, suggesting that our data should be considered a lower-bound estimate of drinking. Similarly, the tendency to over-report adherence may have influenced results. Thus, our sample may have been drinking more and taking medications less than we report. In addition, our measure of provider communication evidenced low internal consistency, suggesting that the item content for this scale was somewhat heterogeneous. Another potential limitation is how we defined non-adherence. Different ART regimens have different resistance profiles and new drug regimens are more forgiving of missed doses. Our use of a standard criterion of 85% of medications taken to define adherence across ART regimens may have over-estimated non-adherence. Finally, we relied on cross-sectional data, precluding any causal conclusions. With these study limitations in mind, we believe that our results have implications for HIV treatment adherence counseling.

HIV treatments have improved the health and increased the life expectancy of PLWH. The benefits of ART, however, are dependent on adherence to medication regimens. The detrimental impacts of alcohol use on medication adherence have been well described

(Hendershot, Stoner, Pantalone, & Simoni, 2009), but only a few studies have examined interactive toxicity beliefs in relation to non-adherence. Interventions are, therefore, needed to correct misinformation, dispel myths, and dispute interactive toxicity beliefs.

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Clinical Considerations

- HIV-infected patients should be counseled to reduce their drinking as a matter of general health improvement. State-of-the-art alcohol treatments do not need adaption or special tailoring for people living with HIV and are easily adapted for use in clinical care.
- Reducing alcohol use will also likely facilitate optimal levels of medication adherence. Alcohol treatment should be considered an initial step in adherence improvement for people who drink heavily and are prescribed ART.
- Interventions are needed to correct misinformation, dispel myths, and dispute interactive toxicity beliefs. Because some interactive toxicity beliefs may result from misinformation and misunderstandings, educating patients about the importance of adherence even when drinking may be sufficient to counter these false beliefs.
- Providers should be clear in their communication about drinking and ART. While patients are well advised not to drink when on ART because alcohol can interfere with medication metabolism and adherence, it is essential that patients are also told to take their ART even if they have been drinking.
- Clinical interventions should first aim to reduce alcohol intake and use harm reduction approaches to enhance adherence for those patients who continue to drink.

Table 1

Demographic and Health Characteristics of Drinkers Currently Taking ART who are Non-Adherent and Adherent

	Non-adherent (<i>N</i> = 100)		Adherent (<i>N</i> = 233)		OR	95%CI
	<i>N</i>	%	<i>N</i>	%		
Gender						
Male	71	71	187	80		
Female	29	29	45	19	1.69	0.98-2.91
Race/Ethnicity						
White	3	3	15	6		
African American	97	97	211	91		
Latino	0		3	1		
Other	0		3	1	0.88	0.46-1.68
Income < \$10,000/year	65	65	135	58	0.79	0.46-1.21
Unemployed	89	89	213	92	1.08	0.64-1.83
History of incarceration	75	75	136	58	2.11 **	1.25-3.57
Lab values						
Last CD4+ T cell count						
< 200 cells/cc ³	29	29	51	22	0.62	0.36-1.08
Last viral load undetectable	54	54	149	64	1.38	0.81-2.33
AUDIT score 8	37	37	46	20	2.37 **	1.41-3.98
Drug use in previous 4 months						
Marijuana/cannabis	45	45	95	41	1.18	0.73-1.89
Cocaine/crack	42	42	57	25	2.22 **	1.325-3.65
Inhalants	16	16	27	12	1.46	0.74-2.82
Amphetamine	4	4	8	3	1.16	0.34-3.96
Injected drugs	1	1	7	3	0.32	0.03-2.67
Other drugs	12	12	14	6	2.12	0.94-4.77
Any drug use	69	69	125	53	1.90 **	1.16-3.12
	M	SD	M	SD		
Age	43.6	8.4	45.8	7.4	0.96 *	0.93-0.99
Education	12.2	1.4	12.5	1.5	0.88	0.75-1.02
Years since HIV diagnosis	13.4	6.9	13.0	7.2	1.00	0.97-1.04
HIV symptoms	4.3	3.1	2.9	3.2	1.13 **	1.05-1.21
CD4+ T cell count (cells/cc ³)	379	291	427	313	0.99	0.99-1.0
VAS Adherence	61.8	22.1	95.3	4.4	N/A	
AUDIT score	7.5	6.9	4.8	5.0	1.07 **	1.03-1.12
Total number of drugs used	1.3	1.2	1.0	1.1	1.24 *	1.03-1.50

Note: OR = odds ratio; CI = confidence interval; AUDIT = Alcohol Use Disorders Identification Test; VAS = Visual Analogue Scale

*
 $p < .05$

**
 $p < .01$

Table 2

Alcohol Toxicity Behaviors Among Drinkers Currently Taking ART who are Non-Adherent and Adherent

Behaviors	Non-adherent (N = 100)		Adherent (N = 233)		OR	95% CI
	N	%	N	%		
I stop taking my HIV medications if I will be drinking alcohol.	52	52	69	30	2.61 **	1.61-4.24
If I know I'm going to be drinking alcohol, I won't take my medications that day.	58	58	78	34	2.72 **	1.68-4.41
I wait at least a couple hours after I take my medicine to drink alcohol.	63	63	145	63	1.02	0.62-1.66
I do not drink alcohol if I have taken HIV medications.	76	76	178	77	0.96	0.55-1.66
I wouldn't go out to a bar or club if I know that I have to take my HIV medications.	38	38	97	42	0.85	0.52-1.38
I skip taking my medicine if I have been drinking.	62	62	83	35	2.92 **	1.80-4.75
I do not mix alcohol and HIV medications because it is not safe.	78	78	172	74	1.29	0.73-2.27
I do not take my medications until alcohol is completely out of my system.	50	50	102	44	1.27	0.79-2.03
I will not take medications if I am hung over from drinking alcohol.	43	43	68	29	1.81 *	1.11-2.95

Note. OR = odds ratio; CI = confidence interval

**
p < .01

*
p < .05

Table 3

Perceived Interactive Toxicity Norms and Provider Communications Among Drinkers Currently Taking ART who are Non-Adherent and Adherent

	Non-adherent (N = 100)		Adherent (N = 233)		OR	95% CI
	N	%	N	%		
Perceived Norms						
People living with HIV skip taking medications when planning to drink alcohol.	76	76	124	54	2.74 ^{**}	1.60-4.68
People living with HIV refuse to drink alcohol after taking medications.	69	69	131	57	1.70 [*]	1.03-2.81
People living with HIV take medications with an alcohol drink.	61	61	117	52	1.55	0.95-2.51
People living with HIV take medications after drinking alcohol.	63	63	134	59	1.26	0.77-2.06
People living with HIV get sick if medications are mixed with alcohol.	68	68	150	66	1.14	0.68-1.91
Communication Experiences with Providers						
A doctor or other health care provider discussed the medications you are taking with you.	89	89	206	89	1.12	0.52-2.42
A doctor or other health care provider discussed alcohol use with you.	70	70	148	63	1.32	0.80-2.19
A doctor or other health care provider discussed other drug use with you.	67	67	140	60	1.33	0.81-2.18
My doctor has told me not to mix alcohol with my medications.	84	84	191	82	1.12	0.59-2.12
My doctor has told me not to mix any drugs with my medications.	86	86	191	82	1.31	0.68-2.54

Note. OR = odds ratio; CI = confidence interval

**
p < .01

*
p < .05

Table 4

Multivariable Model Predicting ART Non-Adherence/Adherence in the Previous Month

Characteristic	OR	95% CI
Age	0.97 [*]	0.93-1.00
History of incarceration	1.62	0.92-2.92
HIV symptoms	1.07	0.99-1.15
Alcohol use - AUDIT score	1.06 ^{**}	1.01-1.10
Number of drugs used	1.03	0.82-1.29
Perceived alcohol-ART norms	1.10	0.94-1.28
Provider communication about alcohol	0.98	0.74-1.28
Provider recommendation to not mix alcohol and ART	1.01	0.67-1.52
Interrupting treatment to avoid mixing alcohol and ART	1.11 ^{**}	1.02-1.22

Note. OR = odds ratio; CI = confidence interval; ART = antiretroviral therapy; AUDIT = Alcohol Use Disorders Identification Test

^{**}
 $p < .01$

^{*}
 $p < .05$

Table 5

Multivariable Model for Stopping ART Before Drinking

Characteristic	OR	95% CI
Age	1.00	0.97-1.03
HIV symptoms	1.10 *	1.01-1.18
Alcohol use - AUDIT score	1.04	0.99-1.08
Number of illicit drugs used	1.44 **	1.17-1.79
Perceived alcohol-ART norms	1.13	0.98-1.29
Provider recommendation to not mix alcohol and ART	1.41 *	1.01-1.98

Note. OR = odds ratio; CI = confidence interval; ART = antiretroviral therapy; AUDIT = Alcohol Use Disorders Identification Test

**
 $p < .01$

*
 $p < .05$