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# Hazardous alcohol use, antiretroviral therapy receipt, and viral suppression in people living with HIV who inject drugs in the United States, India, Russia, and Vietnam

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## Abstract

**Objectives:** In high-income countries, hazardous alcohol use is associated with reduced receipt of antiretroviral therapy (ART) and viral suppression among people living with HIV (PLHIV) who inject drugs. These associations are less understood in lower middle-income countries (LMIC) and upper middle-income countries.

**Design:** We examined associations between hazardous alcohol use, ART receipt, and viral suppression among PLHIV who reported current or former injection drug use. Participants were from nine studies in the United States (high-income country), India (LMIC), Russia (upper middle-income country), and Vietnam (LMIC).

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Conflicts of interest

There are no conflicts of interest.

**Methods:** Hazardous alcohol use was measured via Alcohol Use Disorders Identification Test. Outcomes were HIV viral suppression (viral load of <1000 RNA copies/ml) and self-reported ART receipt. Logistic regression assessed associations between hazardous alcohol use and both outcome variables, controlling for age and sex, among participants with current and former injection drug use.

**Results:** Among 2790 participants, 16% were women, mean age was 37.1 ± 9.5 years. Mean Alcohol Use Disorders Identification Test scores were 4.6 ± 8.1 (women) and 6.2 ± 8.3 (men); 42% reported ART receipt; 40% had viral suppression. Hazardous alcohol use was significantly associated with reduced ART receipt in India (adjusted odds ratio = 0.59, 95% confidence interval: 0.45–0.77, $P < 0.001$); and lower rates of viral suppression in Vietnam (adjusted odds ratio = 0.51, 95% confidence interval: 0.31–0.82, $P = 0.006$).

**Conclusion:** Associations between hazardous alcohol use, ART receipt, and viral suppression varied across settings and were strongest in LMICs. Addressing hazardous alcohol use holds promise for improving HIV continuum of care outcomes among PLHIV who inject drugs. Specific impact and intervention needs may differ by setting.

### Keywords

antiretroviral receipt; hazardous alcohol use; high-income country; HIV infection; middle-income country; people living with HIV; people who inject drugs; viral suppression

## Introduction

Global estimates suggest 15.6 million people inject drugs and almost one-fifth (18%) of these persons are living with HIV [1]. People who inject drugs (PWID) living with HIV face unique barriers to accessing and engaging in HIV treatment and achieving and maintaining viral suppression. These barriers include restrictions on being offered treatment among persons actively using drugs, hidden, or collateral fees for HIV services, discrimination in healthcare settings, multiple requirements for treatment initiation or modification, police harassment, higher rates of detention, and incarceration and lack of access to HIV prevention services including preexposure prophylaxis and syringe exchange [2]. Although hazardous alcohol use is known to be common among PWID [3], its association with HIV care, treatment, and clinical outcomes has been understudied. While the current literature suggests PWID experience unique risks related to alcohol use, additional investigation is needed to deepen our understanding of associations between alcohol use and HIV outcomes among PWID living with HIV in diverse settings according to healthcare provider availability, physical, and managerial infrastructure, human resources for health and availability of medical supplies.

Findings from multiple sites suggest any alcohol use (compared with no alcohol use) in PWID living with HIV is independently associated with higher rates of nonadherence to antiretroviral therapy (ART) [4,5], an association that reflects both unintentional nonadherence, caused by impaired cognition, and intentional missed doses due to concerns of potential harmful interactions between alcohol and ART [6]. For example, one study of PWID living with HIV found alcohol increased the risk of nonadherence by 20% for each

additional 25 drinks consumed per month [7]. Heavy alcohol use has also been correlated with poor clinical HIV outcomes, including $CD4^+$ cell count and HIV viral load [8]. Alcohol use by PWID has been independently associated with needle-sharing, engagement in various HIV transmission risk behaviors (e.g. no or inconsistent condom use and having multiple sex partners) and history of sexually transmitted infection [9,10]. Hepatitis C virus infection is highly prevalent among PWID compared with persons who use other substance, and many PWID report drinking alcohol despite risks for accelerated liver disease [11].

Alcohol consumption, particularly at hazardous levels, is clearly associated with a range of adverse health outcomes and there is mounting evidence that concurrent alcohol and injection drug use negatively impact HIV care outcomes, including reduced linkage to HIV care, initiation of ART, and achievement of viral suppression [12]. Most of this evidence has been generated from high-income countries (HICs) such as the United States and Canada [13]. Thus, little is known about these relationships in lower resource settings. The effects of alcohol use and concurrent injection of drugs may differ in middle-income countries due to distinct individual, systemic and structural barriers to HIV care and ART access [12]. Addressing this gap in evidence is particularly important given recent estimates that global HIV prevalence among PWID is highest in Eastern Europe (25%) and Latin America (36%), two regions with many lower and middle-income countries (LMICs) [1].

The National Institute on Drug Abuse-funded 'Seek, Test, Treat, Retain' (STTR) cohort collaboration project (https://sttr-hiv.org/) provides an ideal set of data for examining the effect of alcohol use on PWID living with HIV from a diverse range of global settings. The STTR consortium consists of 22 observational studies and randomized controlled trials implementing and testing the STTR paradigm [14]. The current study aims to build on prior research that suggests concurrent hazardous alcohol and injection drug use have a negative impact on HIV outcomes. For this analysis we examined former or current PWID living with HIV who were ART eligible and provided information on alcohol use, ART receipt and/or viral load status from nine STTR studies in the United States (HIC), India (LMIC), Russia (an upper middle-income country), and Vietnam (LMIC). We describe patterns of alcohol use among participants and examine associations among hazardous alcohol use, ART receipt, and viral suppression, by country.

## Methods

### Study settings

We conducted a cross-sectional analysis of associations among alcohol use, ART receipt and viral suppression in male and female PWID living with HIV who participated in the STTR cohort collaboration project. This STTR collaboration aims to increase the comparability, collaboration, and scientific yield of clinical research on HIV and drug use by promoting the utilization of common measures across studies and by harmonizing data across studies to address important questions that may be difficult to address in individual studies and cohorts [14].

For the current study, data were analyzed from nine STTR studies conducted in the United States, India, Russia, and Vietnam (Table 1). Two of the cohorts did not enroll heterosexual

women participants: VISTA (Vietnam) only enrolled men and STAR (New York) only enrolled men and transgender persons. Studies were eligible for inclusion in the current analysis if they met the following criteria: enrolled people living with HIV (PLHIV) who were eligible for ART; enrolled former and/or current PWID; collected self-reported data on alcohol use; collected self-reported data on ART treatment and/or laboratory data on HIV viral load. ART eligibility varied according to the study location. In the United States, all participants were ART eligible at the time of the study. Participants enrolled in India and Russia were considered eligible for ART if their $CD4^+$ cell count was less than 350 cells/$\mu$l (the national standard at the time of data collection) or if they reported current ART receipt. Participants enrolled in Vietnam were considered ART eligible if $CD4^+$ cell count was less than 350 cells/$\mu$l through May 2015 and $CD4^+$ cell count less than 500 cells/$\mu$l after May 2015 or if they reported current ART receipt.

Data from the six STTR cohorts in the United States (including Puerto Rico) were pooled. Viral load data were not available from participants enrolled in Russia. ART receipt data were not available from participants enrolled in the STAR study in New York.

## Measurements

All studies administered structured questionnaires to collect data on self-reported demographic characteristics, including age and sex (women, men, other). Participants who identified as transgender were not included in the analyses as the sample size was too small. In the six US-based studies only, data were collected on race and ethnicity and organized in the following categories: Caucasian/White, African American/Black, Hispanic/Latino, or other. In all studies except VISTA (Vietnam), participants self-reported their living/housing status and data were organized in three categories: single-family household, living in group quarters (i.e. living or staying in a group living arrangement, typically owned or managed by a third party), or other type of housing (e.g. homeless and living on the streets/in a park, staying at someone else's house, living in a shelter, etc.). Each participant was asked to report on their current and former injection drug use. Current use was defined as having injected within the 90 days prior to admission to a drug treatment center in Vietnam among VISTA participants, within the past 6 months among ICC-IDU participants (India), and within the past 30 days for all other studies. Former injection drug use was defined as having injected drugs but not meeting criteria for current use. Participants in each study were asked to indicate all types of drugs they used (including opioids, cocaine, stimulants, and other drugs) in the past 30 days or the past 6 months. Due to a problem with baseline data collection in the LINC Study, accurate information on the type of drugs used by participants in the Russia cohort were not available and are not presented in our article.

The main exposure variable was hazardous alcohol use, measured via the Alcohol Use Disorders Identification Test (AUDIT) [15] over the past 6–12 months. The alcohol use behavior variable was modeled dichotomously as nonalcohol user or low-level alcohol user (based on AUDIT scores of 0–6 for women and 0–7 for men); and hazardous alcohol user (based on AUDIT scores of ≥7 for women and ≥8 for men) [15]. Outcome variables included recent ART receipt and HIV viral suppression. Recent ART receipt was defined as ART receipt within the past 30 days. HIV viral suppression was defined as a viral load of

less than 1000 RNA copies/ml including those whose viral load was lower than limit of detection.

### Statistical analysis

Descriptive statistics were calculated for all PWID, as well as for current vs. former PWID by viral suppression status. Logistic regression analyses were used to assess associations between hazardous alcohol use and ART receipt and viral suppression, controlling for age, sex, and injection drug use status (current/former) within country. We tested for interactions between hazardous alcohol use and country setting and the interaction terms were significant for all non-US sites (i.e. India, Russia, and Vietnam) thus we decided to stratify the analysis by country. Since age is measured as a continuous variable its impact on the outcome of interest is for a 1-year increase in age, controlling for all other model variables. We conducted random effects meta-analyses, using restricted maximum likelihood, to estimate the overall effect of hazardous alcohol use on both ART receipt and viral suppression. The $I^2$ statistic was used to check heterogeneity among the three or four included study regions. The $I^2$ of 53% for viral suppression indicates significant heterogeneity between studies and thus suggests that pooling is not a good option. The $I^2$ of 0% for ART receipt indicates no statistical heterogeneity between studies, but pooling is not advisable due to the diverse populations. All analyses were conducted in R 3.4.4 (R Foundation for Statistical Computing, Vienna, Austria) [16]. We conducted analyses on participants with complete data for the variables and either of the outcomes (ART receipt or viral suppression) of interest.

## Results

This study included data from 2790 participants from the nine STTR studies detailed in Table 1. Study participants included the following: the United States ($n = 608$); Russia ($n = 136$); India ($n = 1706$); and Vietnam ($n = 340$). Most participants (60%; $n = 1687$) reported current injection drug use and 40% ($n = 1103$) reported former use. Most participants were men (84%), the mean age was 37 ± 9.5 years, 42% reported recent ART receipt and 40% were virally suppressed. Alcohol use patterns were as follows: 70% no and low-level users, and 31% hazardous drinkers.

Table 2 shows estimates for main study variables among the different cohorts, as well as other factors that may have affected ART receipt and viral suppression in PWID living with HIV (e.g. types of drugs used, housing status). Compared with the non-US studies, the mean age was higher in all US-based cohorts. Also noteworthy is that while most participants (from all sites) reported single-family household living, 36% of men and women from the PACTo study in Puerto Rico indicated ‘other’ living arrangements. The majority of participants from all sites reported no and low-level drinking, except among LINC participants in Russia, where 63% reported hazardous alcohol use. Similarly, the majority of participants reported former injection drug use, except in India where 75% of ICC-IDU participants were current PWID. In Russia, 51% were current PWID.

The demographic and alcohol use characteristics of all participants are described by current or former PWID status, recent ART receipt (Table 3), and viral suppression status (Table 4).

Table 3 shows that, former PWID had a larger percentage (64%) of participants who reported recent ART receipt compared with current PWID (28%). Among both former and current PWID, the mean age was higher, the proportion of women was higher, and the proportion of hazardous alcohol use was lower among those who reported recent ART receipt. Similarly, the mean age was higher, the proportion of women was higher, and the proportion of hazardous alcohol use was lower among those who had evidence of viral suppression (Table 4).

In the multivariable analysis (Table 5), after controlling for age, sex (excluding data from STAR in New York and VISTA in Vietnam because both studies excluded female participants) and prior vs. former injection drug use status, hazardous alcohol use was associated with lower odds of recent ART receipt in all settings. This relationship, however, was only statistically significant in India [adjusted odds ratio (aOR) = 0.59; 95% confidence interval (CI): 0.45–0.77, $P < 0.001$] and marginally statistically significant in Russia (aOR 0.47; 95% CI: 0.22–1.01, $P = 0.053$). A 1 year increase in age was associated with increased odds of recent ART receipt in the United States (aOR = 1.05; 95% CI: 1.03–1.07, $P < 0.001$) and in India (aOR = 1.06, 95% CI: 1.04–1.07, $P < 0.001$). Being male was associated with lower odds of recent ART receipt in India (aOR = 0.26, 95% CI: 0.2–0.35, $P < 0.001$) only. Being a current PWID was associated with lower odds of recent ART receipt across all settings (Table 5).

After controlling for covariates, (i.e. age, sex, and injection status), hazardous alcohol use was associated with lower odds of viral suppression in India and Vietnam. However, this association was only statistically significant in Vietnam (aOR = 0.51, 95% CI: 0.31–0.82, $P = 0.006$) and marginally statistically significant in India (aOR = 0.8; 95% CI: 0.63–1.01, $P = 0.057$) (Table 5). Older age was associated with increased odds of viral suppression in the United States (aOR = 1.07; 95% CI: 1.05–1.09, $P < 0.001$) and India (aOR = 1.06, 95% CI: 1.05–1.08, $P < 0.001$), and being male was only associated with lower odds of viral suppression in India (aOR = 0.34, 95% CI: 0.26–0.46, $P < 0.001$). Being a current PWID was associated with lower odds of viral suppression across all sites (Table 6).

## Discussion

To comprehensively improve linkage to HIV care, ART initiation, and achievement of viral suppression among PWID living with HIV who use alcohol, worldwide, it is essential to understand and tailor interventions to address the barriers and risk factors that exist in different environments. The current multicohort study offers an unusual opportunity to provide insight on the associations among hazardous alcohol use and ART receipt and viral suppression among PWID living with HIV in diverse countries. Participants reporting active injection drug use also commonly reported concurrent alcohol use across all sites. The trends in our findings supported the hypotheses that alcohol use and being a current PWID (compared with former PWID) are inversely associated with ART receipt and viral suppression among PWID living with HIV. We found hazardous alcohol use to be associated with reduced odds of past 30-day ART receipt in all settings, and reduced viral suppression in Vietnam and India. These relationships, however, were only fully statistically significant

in India (recent ART receipt) and Vietnam (viral suppression), both of which are LMIC settings.

With regard to injection status, we found current PWID living with HIV were statistically significantly less likely to both report recent ART receipt and achieve viral suppression, compared with former PWID living with HIV. These findings, taken together, suggest that alcohol reduction interventions might improve HIV care and treatment outcomes, particularly in LMIC settings. These findings further suggest that HIV care and treatment programs in all of these countries might have improved effectiveness if tailored to meet the needs of PWID based on their injection status (i.e. if they reported current or former use with the potential for relapse).

Approximately one third of all participants from our nine-cohort sample reported hazardous alcohol use. Similar to other studies, with both HIV-positive [17] and HIV-negative PWID [10], that found alcohol use to be linked with high-risk sexual behaviors and negative health consequences, our results suggest high-risk drinking was associated with decreased odds of recent ART receipt and viral suppression. Select sociodemographic factors influenced this relationship differentially by location. In both the United States and India, for instance, we found increasing age to be associated with improved HIV outcomes among PWID living with HIV. Specifically, the odds of both reporting recent ART receipt and of being virally suppressed increased by 5 and 6% for each additional year of age in the United States and India, respectively. Multiple studies from HIC settings have also found that, relative to younger persons, older individuals living with HIV were more likely to engage in and adhere to HIV treatment and care and achieve viral suppression [18–21]. Prior studies suggest younger individuals may experience more barriers to HIV care than older adults. One study conducted in several United States cities found that, among adolescents and young adults (aged 16–29) living with HIV, almost all (89%) reported some type of HIV-related stigma in their lifetime [22]. Other studies found younger adults were more likely to fear losing their job because of their HIV status compared with older adults [23] and to experience social isolation [24].

Interventions are urgently needed to reduce alcohol consumption, particularly at hazardous levels, among PWID living with HIV to improve morbidity and mortality from alcohol and HIV/AIDS globally, as well as reduce transmission to the uninfected, for example, the Undetectable = Untransmittable or U = U campaign [25,26]. One intervention found to be successful is medication treatment for alcohol use disorders. Currently, daily oral naltrexone and once monthly injectable extended-release naltrexone are Food and Drug Administration approved medication treatments found to efficaciously reduce alcohol and opioid use and improve rates of achieving and maintaining viral suppression among PLHIV, people with alcohol use disorders and opioid use disorders [26–28].

Our research has limitations. This is a cross-sectional study and the relationships between hazardous alcohol use, ART receipt and viral suppression cannot be interpreted as causal. Further, we did not include all sociodemographic factors that may be important for understanding how alcohol use impacts HIV care outcomes, such as individual levels of income or household poverty. Findings from the PWID included in our study may not be

generalizable to PWID who were not reached or consented into the nine STTR studies from which our data are drawn. Two important and related issues pertain to how gender and sexual identity were accounted for in our analytic sample. First, the cohort in Vietnam only included male participants, precluding our ability to understand how alcohol use impacts female PWID living with HIV in this Southeast Asian LMIC setting. Research with Vietnamese women who inject drugs suggests they have unique needs (not, or less, commonly experienced by Vietnamese men) for improved HIV prevention outcomes, such as single parenting, high rates of intimate partner violence and selling sex for drugs [29]. Second, with the exception of the STAR cohort in New York, which involved transgender women and men, participants who identified as transgender in any of the other cohorts were excluded from our analyses because the sample size was too small to produce reliable estimates. To respond to the diverse health needs of people of all gender and sexual identities, greater investment should be placed on exploring the impact of alcohol use on ART receipt and viral suppression among men, women and individuals who identify as sex nonbinary and are living with HIV. Another limitation of our study is that viral load data were not available from the Russia cohort so we were unable to look at associations between alcohol use and viral suppression in this country, the only upper middle income setting in our study. The binary modeling of alcohol use data prevented deeper understanding of how more nuanced levels of alcohol consumption impacted ART receipt and viral suppression among PWID living with HIV. However, categorizing alcohol use data into more than two groups led to small analytic cell sizes that precluded our ability to precisely estimate associations between more stratified drinking patterns and key HIV outcomes. Another limitation is that injection drug use behaviors and receipt of ART were self-reported and may have been influenced by social desirability bias. Research has found, however, that self-reported ART receipt has high specificity and moderate sensitivity, providing a conservative estimate of true behavior [30]. Finally, we lacked harmonized data (across the nine cohorts) on several key factors that could have affected our HIV outcomes of interest, including the proportion and frequency of recent injection drug use, recent incarceration, and the percentage of participants in and out of treatment for injection drug use.

## Conclusion

In our cohort of PWID living with HIV in the United States, Russia, India, and Vietnam, we found associations between hazardous alcohol use and ART receipt and achievement of viral suppression varied by country. This effect was strongest in India and Vietnam suggesting a possibility that alcohol reduction interventions among PWID are particularly important in LMIC settings. Given the persistently high incidence of HIV infection among PWID globally [31], concentrated efforts to treat hazardous drinking and moderate-to-severe alcohol use disorders may enhance ART uptake and rates of viral suppression. Direct medication treatment, combined with behavior change interventions, has been found to reduce morbidity and mortality related to HIV infection and alcohol use, and reduced HIV transmission to those uninfected in HIC settings [26–28] (U = U). Such approaches should be considered for implementation in middle-income countries as well, given the promise they hold for improving HIV continuum of care outcomes among PLHIV who inject drugs in those settings.

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**Table 1.**

Participating studies, study location, number of enrolled women and men people who inject drugs living with HIV, study population, and recruitment methods used in the 9 included Seek, Test, Treat, Retain cohorts in the United States, India, Russia, and Vietnam.

| Study | Study location | Women/Men, *n*[a] | Study population | Recruitment methods |
|---|---|---|---|---|
| US studies | | | | |
| RETAIN | Miami & Atlanta | 24/44 | PLHIV who use cocaine | Recruited from neighborhoods |
| PACTo | Puerto Rico | 42/231 | Substance users living with HIV | Recruited from neighborhoods |
| FIRST | New York | 14/38 | PLHIV receiving suboptimal substance use and HIV treatment | Active (i.e. via medical staff, letters) and passive (i.e. flyers, advertisements, word-of-mouth) recruitment |
| STAR | New York | 0/22 | Black substance-using TGW/MSM | Respondent-driven sampling, community-based recruitment, and online advertising |
| C4C | San Francisco | 13/99 | PLHIV who were new to clinic or with a history of poor retention in clinic care | Recruited from HIV clinics |
| STRIDE | Washington, DC | 29/52 | PLHIV with opioid use dependence | Recruited through street outreach, HIV clinics, word of mouth and local advertising |
| NON-US studies | | | | |
| ICC-IDU | India | 282/1424 | PWID living with HIV | Respondent-driven sampling |
| LINC | Russia | 38/98 | PLHIV with opioid use disorders | Recruited from Inpatient wards |
| VISTA | Vietnam | 0/340 | Community-dwelling PWID released from substance use treatment | Recruited through peer outreach and peer referrals |

C4C, The UCSF Connect4Care Study; FIRST, Financial Incentives to Reduce Substance use and improve Treatment; ICC-IDU, Integrated Care Clinics for IDUs in India; LINC, Linking Infection and Narcology Care; PACTo, Enhanced HIV Care Access and Retention for Drug Users in San Juan, Puerto Rico; PLHIV, people living with HIV; PWID, people who inject drugs; RETAIN, Providing Integrated Care for HIV-Infected Crack Cocaine Users; STAR, Seek, Test, And Retain. Linkages for Black HIV+, Substance-Using MSM; STRIDE, Seek/Test/Treat: HIV, Buprenorphine, and Criminal Justice; TGW, transgender women; VISTA, Vietnam's Seek, Test, and ART.

[a]The sample sizes presented in this table do not reflect the full sample size of each cohort. They reflect the number of PWID in each study.

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**Table 2.**

Estimates for main study variables and factors that may have affected antiretroviral therapy receipt and viral suppression in people who inject drugs living with HIV, by Seek, Test, Treat, Retain cohort in the United States, India, Russia, and Vietnam.

| Country | RETAIN The United States | PACTo The United States | FIRST The United States | STAR The United States | C4C The United States | STRIDE The United States | ICC-IDU India | LINC Russia | VISTA Vietnam |
|---|---|---|---|---|---|---|---|---|---|
| Sample size[a] | 68 | 273 | 52 | 22 | 112 | 81 | 1706 | 136 | 340 |
| Mean age (SD) | 48.4 (9.3) | 46.3 (8.7) | 49.5 (8.6) | 39.0 (10.2) | 43.4 (9.4) | 54.5 (6.5) | 34.1 (7.7) | 33.7 (4.8) | 35.8 (6.1) |
| Sex/gender | *n* (%) | *n* (%) | *n* (%) | *n* (%) | *n* (%) | *n* (%) | *n* (%) | *n* (%) | *n* (%) |
| Women | 24 (35%) | 42 (15%) | 14 (27%) | 0 (0%) | 13 (12%) | 29 (36%) | 282 (17%) | 38 (28%) | 0 (0%) |
| Men | 44 (65%) | 231 (85%) | 38 (73%) | 22 (100%) | 99 (88%) | 52 (64%) | 1424 (83%) | 98 (72%) | 340 (100%) |
| Race/ethnicity | | | | | | | | | |
| White | 9 (13%) | 1 (0%) | 4 (8%) | 0 (0%) | 49 (44%) | 0 (0%) | *b* | *b* | *b* |
| African American/ Black | 40 (59%) | 0 (0%) | 17 (35%) | 5 (23%) | 22 (20%) | 80 (99%) | *b* | *b* | *b* |
| Hispanic/Latino | 16 (24%) | 272 (100%) | 25 (52%) | 17 (77%) | 26 (23%) | 0 (0%) | *b* | *b* | *b* |
| Other | 3 (4%) | 0 (0%) | 2 (4%) | 0 (0%) | 15 (13%) | 1 (1%) | *b* | *b* | *b* |
| Alcohol use level | | | | | | | | | |
| No and low-level use | 45 (66%) | 234 (86%) | 36 (69%) | 15 (68%) | 90 (80%) | 56 (69%) | 1192 (70%) | 50 (37%) | 218 (64%) |
| Hazardous use | 23 (34%) | 39 (14%) | 16 (31%) | 7 (32%) | 22 (20%) | 25 (31%) | 514 (30%) | 86 (63%) | 122 (36%) |
| Recent ART use | | | | | | | | | |
| No | 34 (52%) | 96 (35%) | 32 (62%) | *b* | 70 (62%) | 15 (21%) | 1225 (72%) | 78 (57%) | 31 (10%) |
| Yes | 31 (48%) | 177 (65%) | 20 (38%) | *b* | 42 (38%) | 56 (79%) | 481 (28%) | 58 (43%) | 289 (90%) |
| Viral suppression | | | | | | | | | |
| No | 59 (89%) | 118 (45%) | 10 (28%) | 18 (82%) | 87 (78%) | 17 (25%) | 1053 (62%) | *b* | 207 (61%) |
| Yes | 7 (11%) | 142 (55%) | 26 (72%) | 4 (18%) | 25 (22%) | 52 (75%) | 653 (38%) | *b* | 133 (39%) |
| PWID status | | | | | | | | | |
| Former | 48 (71%) | 155 (57%) | 31 (60%) | 16 (73%) | 61 (54%) | 52 (64%) | 432 (25%) | 66 (49%) | 242 (71%) |
| Current | 20 (29%) | 118 (43%) | 21 (40%) | 6 (27%) | 51 (46%) | 29 (36%) | 1274 (75%) | 70 (51%) | 98 (29%) |
| Drugs used | | | | | | | | | |

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| Country | RETAIN The United States | PACTo The United States | FIRST The United States | STAR The United States | C4C The United States | STRIDE The United States | ICC-IDU India | LINC Russia | VISTA Vietnam |
|---|---|---|---|---|---|---|---|---|---|
| Any opioids | 14[c] (21%) | 179[d] (66%) | 45[c] (87%) | 7[c] (32%) | 43[d] (38%) | 74[c] (91%) | 1384[d] (81%) | [e] | 20[c] (11%) |
| Cocaine | 49[c] (72%) | 187[d] (68%) | 39[c] (75%) | 11[c] (50%) | 34[d] (30%) | 27[c] (33%) | 9[d] (1%) | [e] | 1[c] (1%) |
| Any stimulants | 1[c] (1%) | 4[d] (1%) | 3[c] (6%) | 6[c] (27%) | 84[d] (75%) | 2[c] (2%) | 77[d] (5%) | [e] | 38[c] (21%) |
| Any other drugs | 3[c] (6%) | 70[d] (26%) | 11[c] (21%) | 6[c] (27%) | 43[d] (38%) | 8[c] (10%) | 947[d] (56%) | [e] | 125[c] (68%) |
| Housing status | | | | | | | | | |
| Single-family household | 44 (65%) | 139 (51%) | 35 (81%) | 14 (64%) | 41 (65%) | 65 (86%) | 1564 (92%) | 123 (90%) | [b] |
| Group quarter | 13 (19%) | 36 (13%) | 8 (19%) | 8 (36%) | 14 (22%) | 11 (14%) | 41 (2%) | 12 (9%) | [b] |
| Other | 11 (16%) | 97 (36%) | 0 (0%) | 0 (0%) | 8 (13%) | 0 (0%) | 101 (6%) | 1 (1%) | [b] |

ART, antiretroviral therapy; C4C, The UCSF Connect4Care Study; FIRST, Financial Incentives to Reduce Substance use and improve Treatment; ICC-IDU, Integrated Care Clinics for IDUs in India; LINC, Linking Infection and Narcology Care; PACTo, Enhanced HIV Care Access and Retention for Drug Users in San Juan, Puerto Rico; PWID, people who inject drugs; RETAIN, Providing Integrated Care for HIV-Infected Crack Cocaine Users; STAR, Seek, Test, And Retain. Linkages for Black HIV+, Substance-Using MSM; STRIDE, Seek/Test/Treat: HIV, Buprenorphine, and Criminal Justice; VISTA, Vietnam's Seek, Test, and ART.

[a] The sample sizes presented in this table do not reflect the full sample size of each cohort. They reflect the number of PWID in each study.

[b] Information not collected in this study.

[c] Drug use for past 30 days.

[d] Drug use for past 6 months.

[e] Accurate information unavailable for this variable.

**Table 3.**

Demographic and alcohol use characteristics of antiretroviral therapy-eligible people who inject drugs living with HIV ($N = 2735$), stratified by recent antiretroviral therapy receipt and former vs. current injection drug use status from the Seek, Test, Treat, Retain cohorts in the United States, India, Russia, and Vietnam.

| | **Total, $N = 2735$** | | | | **Former PWID, $N = 1070$** | | | | **Current PWID, $N = 1665$** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Recent ART receipt** | **No** | | **Yes** | | **No** | | **Yes** | | **No** | | **Yes** | |
| *N* | 1581 | | 1154 | | 380 | | 690 | | 1201 | | 464 | |
| Mean age (SD) | 35.1 (9) | | 39.6 (9.4) | | 38.2 (10) | | 40.3 (9.7) | | 34.1 (8.2) | | 38.6 (8.8) | |
| Sex/gender | *n* | % | *N* | % | *N* | % | *N* | % | *n* | % | *n* | % |
| Women | 200 | 13 | 236 | 21 | 71 | 19 | 132 | 19 | 129 | 11 | 104 | 22 |
| Men | 1381 | 87 | 918 | 80 | 309 | 81 | 558 | 81 | 1072 | 89 | 360 | 78 |
| Race/ethnicity[a] | | | | | | | | | | | | |
| White | 38 | 15 | 25 | 8 | 15 | 12 | 18 | 8 | 23 | 19 | 7 | 7 |
| African American/Black | 61 | 25 | 86 | 26 | 40 | 33 | 63 | 29 | 21 | 17 | 23 | 22 |
| Hispanic/Latino | 131 | 53 | 207 | 64 | 56 | 46 | 132 | 61 | 75 | 61 | 75 | 70 |
| Other | 15 | 6 | 6 | 2 | 10 | 8 | 4 | 2 | 5 | 4 | 2 | 2 |
| Alcohol use level | | | | | | | | | | | | |
| No and low-level use | 1034 | 65 | 868 | 75 | 257 | 68 | 513 | 74 | 777 | 65 | 355 | 76.5 |
| Hazardous use | 547 | 35 | 286 | 25 | 123 | 32 | 177 | 26 | 424 | 35 | 109 | 23.5 |

ART, antiretroviral therapy.

[a]Race/ethnicity information only collected in US-based studies.

**Table 4.**

Demographic and alcohol use characteristics of antiretroviral therapy-eligible people who inject drugs living with HIV (2611), stratified by viral suppression status[a] and former vs. current injection drug use status from the Seek, Test, Treat, Retain cohorts in the United States, India, Russia, and Vietnam.

| | Total, $N = 2611$[b] | | | | Former PWID, $N = 1014$ | | | | Current PWID, $N = 1597$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Not suppressed | | Suppressed | | Not suppressed | | Suppressed | | Not suppressed | | Suppressed | |
| *N* | 1569 | | 1042 | | 480 | | 534 | | 1089 | | 508 | |
| Mean age (SD) | 35.5 (9.1) | | 39.4 (9.6) | | 38.6 (9.6) | | 40.7 (10) | | 34.2 (8.5) | | 38.1 (8.9) | |
| Sex/gender | *n* | % | *n* | % | *N* | % | *n* | % | *n* | % | *n* | % |
| Women | 175 | 11 | 218 | 21 | 66 | 14 | 117 | 22 | 109 | 10 | 101 | 20 |
| Men | 1394 | 89 | 824 | 79 | 414 | 86 | 417 | 78 | 980 | 90 | 407 | 80 |
| Race/ethnicity[c] | | | | | | | | | | | | |
| White | 51 | 17 | 12 | 5 | 26 | 16 | 7 | 4 | 25 | 17 | 5 | 6 |
| African American/Black | 76 | 25 | 68 | 27 | 53 | 32 | 47 | 27 | 23 | 16 | 21 | 27 |
| Hispanic/Latino | 168 | 55 | 167 | 66 | 76 | 46 | 117 | 67 | 92 | 64 | 50 | 63 |
| Other | 13 | 4 | 8 | 3 | 9 | 6 | 5 | 3 | 4 | 3 | 3 | 4 |
| Alcohol use level | | | | | | | | | | | | |
| No and low-level use | 1068 | 68 | 785 | 75 | 321 | 67 | 420 | 79 | 747 | 69 | 365 | 72 |
| Hazardous use | 501 | 32 | 257 | 25 | 159 | 33 | 114 | 21 | 342 | 31 | 143 | 28 |

ART, antiretroviral therapy; PWID, people who inject drugs; VL, viral load.

[a]Viral suppression defined as VL of less than 1000 RNA copies/ml. Those not suppressed had a VL at least 1000 copies/ml.

[b]The numbers included in this table represent participants from each study who had no missing information for the variables in the regression model for each outcome (ART receipt or viral suppression).

[c]Race/ethnicity information only collected in US-based studies.

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**Table 5.**

Associations between recent hazardous alcohol use and antiretroviral therapy receipt among current and former people who inject drugs living with HIV who were antiretroviral therapy eligible in the United States ($n = 573$), Russia ($n = 136$), India ($n = 1706$), and Vietnam ($n = 320$).

| | All 6 US sites, $n = 573$[a] | | Russia, $n = 136$[a] | | India, $n = 1706$[a] | | Vietnam, $n = 320$[a] | |
|---|---|---|---|---|---|---|---|---|
| **Variable** | **OR (95% CI)**[b,c] | ***P* value** | **OR (95% CI)** | ***P* value** | **OR (95% CI)** | ***P* value** | **OR (95% CI)** | ***P* value** |
| Hazardous alcohol use | 0.7 (0.46–1.07) | 0.1 | 0.47 (0.22–1.01) | 0.053 | 0.59 (0.45–0.77) | <0.001 | 0.6 (0.28–1.34) | 0.206 |
| Age | 1.05 (1.03–1.07) | <0.001 | 1.04 (0.96–1.13) | 0.342 | 1.06 (1.04–1.07) | <0.001 | 0.97 (0.9–1.03) | 0.288 |
| Sex (male) | 1.13 (0.73–1.73)[d] | 0.584 | 0.52 (0.22–1.19) | 0.125 | 0.26 (0.2–0.35) | <0.001 | [e] | [e] |
| PWID (current) | 0.51 (0.36–0.72) | <0.001 | 0.35 (0.16–0.72) | 0.005 | 0.31 (0.24–0.39) | <0.001 | 0.28 (0.13–0.6) | 0.001 |

ART, antiretroviral therapy; PWID, People who inject drugs.

[a] The numbers included in this table represent participants from each cohort who had complete information on ART receipt.

[b] CI, confidence interval; OR, odds ratio.

[c] Logistic regression analyses adjusted for age, sex, and injection drug use status (current/former).

[d] This estimate excludes data from the STAR study in New York which only included male participants.

[e] Estimate not shown because VISTA study in Vietnam only included male participants.

**Table 6.**

Associations between hazardous alcohol use and viral suppression among current and former people who inject drugs living with HIV who were antiretroviral therapy eligible in the United States ($n = 565$), India ($n = 1706$), and Vietnam ($n = 340$).

| | All 6 US sites, $n = 565$[a] | | India, $n = 1706$[a] | | Vietnam, $n = 340$[a] | |
|---|---|---|---|---|---|---|
| **Variable** | **OR (95% CI)[b]** | ***P* value** | **OR (95% CI)** | ***P* value** | **OR (95% CI)** | ***P* value** |
| Hazardous alcohol use | 0.99 (0.65–1.52) | 0.978 | 0.8 (0.63–1.01) | 0.057 | 0.51 (0.31–0.82) | 0.006 |
| Age | 1.07 (1.05–1.09) | <0.001 | 1.06 (1.05–1.08) | <0.001 | 0.98 (0.94–1.02) | 0.317 |
| Sex (male) | 1.11 (0.71–1.73)[c] | 0.652 | 0.34 (0.26–0.46) | <0.001 | [d] | [d] |
| PWID (current) | 0.56 (0.39–0.8) | 0.002 | 0.38 (0.3–0.49) | <0.001 | 0.44 (0.26–0.73) | 0.002 |

CI, confidence interval; OR, odds ratio; PWID, People who inject drugs.

[a]The numbers included in this table represent participants from each cohort who had viral load data.

[b]Logistic regression analyses adjusted for age, sex, and injection drug use status (current/former).

[c]This estimate excludes data from the STAR study in New York which only included male participants.

[d]Estimate not shown because VISTA study in Vietnam only included male participants.