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ORIGINAL PAPER

Predictors of HIV Care Engagement, Antiretroviral Medication Adherence, and Viral Suppression Among People Living with HIV Infection in St. Petersburg, Russia

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Abstract Over 1 million HIV infections have been diagnosed in Russia, and HIV care uptake and viral suppression are very low. 241 HIV-positive individuals in St. Petersburg were enrolled through social networks, provided blood for viral load testing, and completed measures of medication-taking adherence, readiness, and self-efficacy; psychosocial well-being; and substance use. Outcomes included attending an HIV care appointment in the past 6 months, >90% ART adherence, and undetectable viral load. 26% of participants had no recent care appointment, 18% had suboptimal adherence, and 56% had detectable viral load. Alcohol use consistently predicted all adverse health outcomes. Having no recent care visit was additionally associated with being single and greater past-month drug injection frequency. Poor adherence was additionally predicted by lower medication-taking self-efficacy and lower anxiety. Detectable viral load was additionally related to younger age. Comprehensive interventions to improve HIV care in Russia must address substance abuse, anxiety, and medication-taking self-efficacy.

Keywords Russia · Persons living with HIV · HIV-positive · HIV medical care · HIV services · HIV care linkage and retention

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Introduction

In contrast to much of the world where HIV incidence has now leveled, the HIV epidemic in Russia continues to expand. Only about 1000 HIV infections were cumulatively diagnosed in Russia through 1995 [1]. Twenty years later, Russia's number of officially-recorded HIV infections exceeds 1 million, and the true number of infections is likely to be even greater [2]. The epidemiology of the disease in Russia is also changing. Once overwhelmingly associated with injection drug use, Russia's HIV epidemic now reflects increasing sexual transmission [3]. The growth of HIV in Russia has long been linked with widespread drug injection, especially in the late-1990s and 2000s, as well as with the limited availability of effective drug treatment, policies preventing opioid replacement therapy, and high prevalence of sexual and drug use risk behaviors [4–6]. However, the HIV epidemic in Russia and some other countries of the former Soviet Union is almost certainly now also being driven by low levels of antiretroviral therapy (ART) uptake, low levels of viral suppression, and therefore high continued disease transmission.

A large number of clinical trials established that people living with HIV infection (PLH) who are on ART regimens and who achieve viral suppression are less likely to transmit HIV infection to both sexual partners and also drug injection partners [7, 8]. This has led to the conceptualization of ART not only as treatment but also as a prevention strategy because viral suppression produced by treatment reduces infectivity, the likelihood of HIV transmission, and therefore downstream disease incidence [9]. Modeling analyses have demonstrated that widescale treatment-as-prevention (TasP) has the potential to avert large numbers of future infections [10], and—in world

regions that have scaled up treatment—HIV incidence has leveled [11, 12].

Antiretroviral treatment for PLH in many countries of the former Soviet Union lags behind levels found elsewhere. Only 21% of PLH in the region [13]—including 23% in Russia [14]—are on ART regimens, proportions that are lower than in Sub-Saharan Africa [13, 15]. Reductions in HIV-related morbidity and mortality—and the public health benefits of TasP—can only be achieved when persons who have contracted HIV infection are diagnosed early, are linked and remain in care, receive ART immediately following diagnosis, adhere to ART regimens, and reach and maintain viral suppression [16].

A number of studies, primarily carried out in the West, have identified factors associated with poor HIV medical care linkage, engagement, and retention. Some of these barriers are structural and include poor care access, health system barriers and policies, and poor treatment by providers [17–20], as well as housing instability and poverty [21–23]. Others are individual-level characteristics including substance abuse [18, 22, 24, 25]; younger age [25–27]; depression and mental distress [17, 20, 22]; having less advanced HIV disease [25, 28]; and misconceptions about HIV treatment [29]. However, little past research has examined factors associated with medical care engagement among PLH in Eastern Europe, few prior studies have examined factors predicting whether PLH achieve viral suppression, and almost all past studies have examined factors associated with care engagement and retention in clinic-based samples as opposed to community-based samples of HIV-positive persons.

The present research was conducted in St. Petersburg, the second largest city in Russia with a population of about 4.5 million. Over 50,000 HIV infections were officially recorded in the city by July, 2015, and the city's epidemiological profile reflects that of the country overall [30]. The aims of this study were: (1) to characterize the HIV medical care attendance, treatment adherence, and attainment of viral suppression in a large community sample of social networks of PLH in St. Petersburg and (2) to identify univariate and multivariate predictors of these health-related outcomes.

Methods

The study was undertaken during 2014–2015 and followed a protocol approved by the IRBs of the Medical College of Wisconsin, Milwaukee, USA and Botkin Hospital for Infectious Diseases, St. Petersburg. These data were collected as part of the baseline assessment of participants in "Stimulus," a randomized controlled trial of a network-level intervention designed to increase HIV medical care engagement among PLH in the community.

Settings and Participant Recruitment

The study enrolled a sample of PLH using a social network recruitment strategy designed to reach HIV-positive individuals by means of their social connections with other PLH in the community. The recruitment of each network began when study staff identified a "seed" to serve as an initial access point to a network. Seeds were recruited from PLH self-support groups, needle exchange sites, medical service settings, and online forums for HIV-positive persons, as well as through community announcements and recommendations made by key informants. We recruited seeds so as to represent drug users, men who have sex with men (MSM), and heterosexual men and women. Seed eligibility criteria were being HIV-positive verified by study testing and also: (1) reporting either not having an HIV medical care visit in the past 6 months or—if prescribed ART—taking medication doses on <90% of days in the past month; (2) being age 18 or older; and (3) having friends known to also be HIV-positive. After their recruitment, consented seeds were asked to provide the first names of these friends and to give each of them invitation packets with study information and a request that the recipient contact the study office. Interested and eligible friends were recruited into the study as members of the network of the seed who named them. Seeds unable to recruit HIV-positive friends were not excluded from the sample. Friends of seeds were eligible if they were HIV-positive (confirmed by study testing) and were age 18 or older regardless of their HIV medical care attendance or adherence. The circle of friends surrounding a seed constituted the first "ring" of network members. When first-ring members entered the study, they—in turn—invited the participation of their own HIV-positive friends. This constituted the second and final ring of each network. The study sample consisted of 43 networks of PLH composed of a total of 241 unique individuals (mean = 5.6 participants per network).

Assessment Measures

All participants provided informed consent, completed study measures during a single assessment visit at the Botkin Hospital study office, and received an incentive payment of approximately $15. The assessment consisted of an individually-administered interview and biological specimen collection.

Demographic Characteristics and HIV Treatment History

Included age, gender, education, relationship status, length of serostatus knowledge, HIV exposure history, and HIV treatment and ART history.

HIV Care Attendance, Appointment Keeping, and ART Adherence

To measure care attendance, participants were asked how many HIV-related medical treatment visits they had in the past year. They were then asked how many appointments were scheduled, and how many were missed, in the past 6 months. Participants presently on antiretroviral regimens completed the Visual Analog Scale (VAS), previously shown valid for measuring ART adherence [31], to indicate the percentage of medication doses taken as prescribed in the past month. Participants who reported taking <90% of prescribed doses were considered non-optimally adherent based on levels of adherence required for ART regimens used in Russia.

HIV Medication Readiness and HIV Medication-Taking Self-Efficacy Scales

Participants not presently on ART regimens were administered nine items of the HIV medication readiness scale [32] (sample item: "How ready would you be to accept the idea of taking these HIV pills for a long time?," scale range 9–36, Cronbach's $\alpha = 0.92$, current sample). Participants who were on ART regimens completed the HIV medication-taking self-efficacy scale [33] that consisted of 2 components. The self-efficacy beliefs (SEB) subscale consisted of 17 items (sample SEB item: "How confident are you in your ability to take HIV medication at correct intervals?," scale range 17–170, $\alpha = 0.93$) and the outcome expectancy (OE) subscale consisting of 9 items (sample OE item: "taking HIV medication will allow you to live a long life," scale range 9–90, $\alpha = 0.92$).

Scales of Psychosocial Well-Being

Participants were administered four scales assessing psychosocial well-being. The 24-item social provisions scale (SPS) [34] measures the adequacy and quality of the respondents' perceived social supports, scale range 24–96, $\alpha = 0.92$. The 20-item Beck Hopelessness Scale [35] has been widely used to measure depression, scale range 0–20, $\alpha = 0.87$. Finally, the 20-item state anxiety inventory scale (STAI) [36] assesses the individual's level of presently-experienced anxiety, scale range 20–80, $\alpha = 0.92$. We have employed Russian-language versions of most of these scales in our prior research with PLH, and they showed excellent psychometric characteristics and criterion validity [5, 6].

Substance Use and Needle Sharing Behavior

Participants indicated the number of alcohol drinks they consumed in the past 7 days. In addition, and to measure recent binge drinking, male participants specified the number of days in the past week when they consumed ≥5 (females ≥4) drinks. Participants indicated whether they used any kind of illicit drug in the past month. Participants reporting illicit drug use specified the number of times they used marijuana, hallucinogens, ecstasy, heroin, recreational psychotropic medications, and other drugs. Finally, participants indicated whether they ever injected drugs, and—if so—their frequency of injection and needle sharing in the past month. The past 30-day time frame for measuring substance use was based on the National Institute of drug abuse risk behavior assessment (RBA) previously found valid and reliable [37]. Because alcohol use in Russia is frequent and prevalent, alcohol use was measured in a method based on the RBA but with a past one-week time frame selected to yield more accurate data for high-frequency events.

Sexual Transmission Risk Behavior

Participants reported their number of different- and same-sex partners in the past year. For the past 3 months, participants reported whether or not they had main and non-main partners of either gender. Participants specified their number of partners of each type, their knowledge of partners' HIV serostatus, and the percentage of vaginal or anal intercourse acts when condoms were used with these partners.

HIV, Viral Load, and CD4+ Testing

During the same assessment visit, study nurses performed a blood draw. Samples were analyzed to verify participants' HIV-positive serostatus and to measure CD4+ count and viral load, expressed as number of copies per ml. Undetectable viral load was defined as <75 copies/mL, a cutoff based on laboratory test sensitivity at the time of the study. Laboratory procedures were performed by an infectious disease hospital experienced in HIV viral load testing.

Statistical Methods

Means and standard deviations (SD) were computed for numerical measures, and relative frequencies for categorical variables, in order to characterize the overall

sample and distributions within each outcome (HIV care engagement, ART adherence, or undetectable viral load). Univariate associations between single predictor variables and each outcome were analyzed by mixed-effects regression for binomial distributions. To control for the interdependence of responses among members recruited within the same network, social network was included as a random effect in each regression. Predictors that met a threshold p value <.20 in those analyses qualified for putative inclusion in multiple mixed-effects logistic regressions for each outcome. A backward stepwise procedure was used to select all fixed-effect covariates in each model. An alpha of .05 (two-sided) was set as our criterion for statistical significance. Social network was again entered as a random effect. All regression analyses conducted were generalized estimating equations (GEE) for mixed-effects and were performed using IBM SPSS Statistics, Version 21 software [38].

Results

Participant Background Characteristics

Table 1 summarizes demographic and background characteristics of the full sample (n = 241). Fifty-eight

Table 1 Background and demographic characteristics of the study sample (n = 241)

Variables	% (N) or mean (SD)
Gender	
Male	58% (138)
Female	42% (103)
Age (years)	34.16 (5.68)
Officially married	22% (52)
Highest education completed	
Less than high school	11% (26)
High school	32% (76)
Completed technical school or some university	48% (115)
Completed university	10% (24)
Presently employed	59% (141)
Sexual orientation identity	
Primarily/exclusively heterosexual	89% (214)
Bisexual	5% (12)
Primarily/mostly homosexual	6% (15)
Duration of HIV + serostatus knowledge in months	95.0 (57.35)
Belief about how HIV was contracted	
Sharing needles	62% (149)
Heterosexual exposure	29% (70)
Homosexual exposure	7% (5)
Other or unknown	2% (5)
Substance use	
Used any alcohol, past 7 days	48% (116)
Binge drinking, past 7 days[a]	16% (38)
Used any drug, past month	32% (78)
Number of opioid use occasions, past month[b]	8.83 (17.38)
Number of marijuana use occasions, past month[b]	4.03 (12.68)
Injection drug use, lifetime	76% (183)
Injected drugs, past month	24% (57)
Number of injection drug use occasions, past month[c]	4.64 (13.4)

n = 241 participants except for occasional missing data (≤5 participants) for some items

[a] Binge drinking was defined as ≥5 drinks/day for males and ≥4 drinks/day for females

[b] n = 78 participants (includes only participants who reported any use of opioid/marijuana in the past month)

[c] n = 183 participants (includes only participants who reported any lifetime drug injection)

percent of participants were men and 42% women, their mean age was 34 years, and most were not officially married. Most participants had completed technical school or some university but over 40% were unemployed. Eighty-nine percent of participants identified themselves as primarily or exclusively heterosexual. Of the 27 participants reporting gay or bisexual identity, 8 were males and 19 were females. Persons in the sample reported knowing of their positive HIV status for an average of nearly 8 years, and 62% believed they contracted HIV infection through needle sharing and over one-third through heterosexual or homosexual exposure. Substance abuse was common. Over three-fourths of study participants said they had injected drugs at some point in their lives and—among them—24% used injected drugs in the past month an average of 4.6 times. 48% of participants used alcohol in the past week, and 16% reported binge drinking days in that period. Among the third of participants (n = 78) who reported any drug use in the past month, opioids and marijuana were most often reported.

HIV Medical Care Attendance, ART Adherence, and HIV Viral Suppression

Seventeen percent (n = 41) of participants reported not visiting an HIV medical provider during the past year and 26% (n = 63) did not see a provider in the past 6 months. The mean length of time since participants' most recent HIV medical care visit was 5.13 (SD = 13.80) months. Although a majority of participants reported they had an HIV medical care visit in the past year, half (49%, n = 119) were not presently on an ART regimen. Fifty-six percent of participants not on ART (n = 66) reported that their medical provider had not offered it, while the another 37% (n = 44) said that they did not yet begin the regimen or that they declined or discontinued taking ART. Among 122 participants presently on ART regimens, 18% (n = 22) reported suboptimal adherence (<90% of doses in the past month). Participants on ART (n = 122) reported that they had been on the antiretroviral regimens for a mean of 22.4 (SD = 23.60) months. Laboratory testing data by routine venipuncture could not be obtained from 4 participants due to extensive vein scarring associated with drug injection. Among the remaining 237 participants, mean CD4+ count was 476.43 (SD = 266.22, range 58.6–1462.2). Forty-four percent of participants (n = 106) had undetectable viral load (<75 copies/mL). As one would expect, 93% (n = 99) of participants with undetectable viral load reported presently being on ART or having a recent HIV medical care visit.

Univariate Predictors of Primary Outcomes

Table 2 presents results of the univariate analyses for variables associated at $p < .20$ with each study outcome. As shown in Table 2, having an HIV care visit in the past 6 months was negatively associated in univariate analyses with all substance use variables including measures of alcohol use, illicit drug use of any kind, and drug injection in the past month. In addition, participants who did not have a recent care visit scored higher in state anxiety, were more often unmarried, and tended to be younger. Table 2 then shows that suboptimal (<90%) ART adherence was predicted in univariate analyses by lower scores on the medication taking self-efficacy scale, any use of alcohol in the past week, with a trend for nonadherence to be associated with greater number of alcohol drinks consumed in the past week. As also shown in Table 2, univariate predictors of detectable viral load were younger age, greater number of alcohol drinks consumed in the past week, and higher state anxiety scores. There were also trends for detectable viral load to be related to male gender, greater use of any kind of drug, injecting drugs in the past month, and having unprotected intercourse with casual partners in the past 3 months.

Multivariate Predictors of Primary Outcomes

Table 3 presents results of multiple mixed logistic regression models predicting HIV care engagement, ART adherence, and undetectable viral load. As the table shows, participants who visited an HIV medical care provider in the past 6 months were less likely to be single and never married, less likely to have consumed any alcohol in the past week, less often injected drugs in the past month, and tended to report lower state anxiety. Poorer ART medication adherence in the past month was predicted by greater number of alcohol drinks in the past week, lower medication-taking self-efficacy, and lower state anxiety. Detectable viral load was predicted by younger age and greater number of alcohol drinks in the past week. In addition, males tended to more often have detectable viral load.

Discussion

Russia is among the few countries in the world where HIV incidence continues to rise. While the scope of Russia's HIV epidemic is great, very little research has systematically examined patterns of HIV medical care engagement, treatment adherence, and viral suppression in community samples of PLH in Russia and other countries in Eastern Europe. While considerable research has identified

Table 2 Univariate logistic regression models predicting HIV care engagement, ART adherence, and undetectable viral load

Had an HIV medical care visit in the past 6 months[a]	Had no care visit n = 63	Had care visit n = 178	*p*-value	OR	95% CI
Demographic variables					
Age (years)—mean (SD)	33.0 (5.7)	34.6 (5.6)	.090	1.05	0.99, 1.12
Single and never married—% (n)	52.4% (33)	36.0% (64)	.015	0.41	0.20, 0.84
Substance use variables					
Used any alcohol, past 7 days—% (n)	74.6% (47)	38.8% (69)	<.001	0.24	0.11, 0.53
Number of alcohol drinks, past 7 days—mean (median)	15.7 (6.0)	3.4 (0.0)	.002	0.95	0.92, 0.98
Used any drug, past month—% (n)	57.1% (36)	23.6% (42)	.002	0.32	0.16, 0.65
Number of drug use occasions, past month—mean (median)	12.8 (1.0)	2.5 (0.0)	.014	0.97	0.93, 0.99
Injected drugs, past month—% (n)	49.2% (31)	14.6% (26)	<.001	0.23	0.11, 0.49
Number of injection drug use occasions, past month—mean (median)	9.9 (0.0)	1.3 (0.0)	.002	0.92	0.88, 0.97
Psychosocial scales					
STAI anxiety—mean (SD)	37.4 (10.8)	34.4 (11.0)	.030	0.97	0.94, 0.99

ART medication adherence over 90% in the past month[b]	<90% ART adherence n = 22	≥90% ART adherence n = 100	*p*-value	OR	95% CI
Demographic variables					
Single and never married—% (n)	36.4% (8)	39.0% (39)	.167	2.23	0.71, 6.94
Sexual behavior variables					
Had a casual partner, past 3 months—% (n)	36.4% (8)	15.0% (15)	.139	0.42	0.13, 1.33
Substance use variables					
Used any alcohol, past 7 days—% (n)	59.1% (13)	35.0% (35)	.037	0.28	0.09, 0.93
Number of alcohol drinks, past 7 days—mean (median)	6.4 (1.5)	2.2 (0.0)	.088	0.95	0.90, 1.01
Psychosocial scales					
STAI anxiety—mean (SD)	31.4 (9.0)	34.4 (11.0)	.196	1.04	0.98, 1.10
HAART beliefs scales					
Medication taking self-efficacy—mean (SD)	8.2 (1.4)	9.3 (0.9)	.003	2.11	1.30, 3.41

Undetectable HIV viral load (<75 copies/mL)[c]	Detectable VL (≥75 copies/mL) n = 131	Undetectable VL (<75 copies/mL) n = 106	*p*-value	OR	95% CI
Demographic variables					
Male gender—% (n)	64.1% (84)	49.1% (52)	.053	0.58	0.61, 1.74
Age (years)—mean (SD)	32.9 (5.3)	35.9 (5.8)	<.001	1.11	1.05, 1.17
Sexual behavior variables					
Had UI with casual partners—% (n)	12.2% (16)	5.7% (6)	.088	0.41	0.15, 1.15
Substance use variables					
Number of alcohol drinks, past 7 days—mean (median)	9.5 (1.0)	3.2 (0.0)	.014	0.96	0.93, 0.99
Used any drug, past month—% (n)	38.9% (51)	24.5% (26)	.074	0.56	0.30, 1.06
Injected drugs, past month—% (n)	30.5% (40)	16.0% (17)	.053	0.49	0.24, 1.01
Number of injection drug use occasions, past month—mean (median)	5.1 (0.0)	1.8 (0.0)	.110	0.97	0.93, 1.01
Psychosocial scales					
STAI anxiety—mean (SD)	37.4 (10.8)	34.4 (11.0)	.050	0.97	0.95, 1.00

[a] n = 241 participants within 43 social networks

[b] n = 122 participants within 23 social networks (includes only participants taking ART)

[c] n = 237 participants within 43 social networks (excludes four participants for whom blood samples could not be obtained)

predictors of HIV medical care engagement elsewhere, the present study is unique because it also examined factors that influence attainment of viral suppression among PLH in Russia. This study also demonstrated the feasibility of using a social network strategy to recruit PLH in the community, many of whom were out of medical care, did not regularly attend care appointments, were ART-nonadherent, or were not virally suppressed.

Participants in this sample knew of their positive HIV serostatus for an average of about 8 years, a considerable period of time, and most used injected drugs at some point of their lives. These patterns are consistent with Russia's HIV epidemiology. Alcohol use, binge drinking, and drug use (including drug injection) were prevalent in the sample. Further, the most consistent predictors of poor care engagement, treatment nonadherence, and unsuppressed viral load were recent substance use including drinking, drug injection, and the use of other illicit drugs. Relationships between alcohol and substance use with poor HIV treatment engagement have been reported in past research elsewhere [39–43]. Our findings establish that this is also the case in Russia and—in addition—establish that alcohol use is related to poor HIV viral suppression. Drinking and drug use often create life chaos, interfere with medical care appointment attendance and treatment adherence, and—consequently—with achieving viral suppression.

Apart from the close association of substance abuse with adverse HIV-related health indicators, other predictors were also identified. For example, persons who were single were less likely to regularly attend care appointments, probably because there may be fewer social supports and family care responsibilities to motivate HIV care engagement [44–48]. Men and younger participants of either gender were less likely to achieve undetectable viral load. Interventions need to focus on gender- and age-specific issues that interfere with care engagement and ART adherence. As expected, greater ART medication taking self-efficacy predicted higher ART adherence, indicating the benefits of interventions to develop skills and adopt practices to improve consistency in medication-taking. Participants with greater state anxiety tended to miss their care visits, but anxiety was positively associated with ART adherence. It is possible that greater state anxiety can lead to delaying care visits, but can also help persons to follow relatively strict ART regimens.

This study examined individual characteristics of PLH related to HIV health outcomes. However, systems-level factors in Russia also play a large role. Despite recent WHO guidelines [48] recommending immediate ART upon HIV diagnosis, early antiretroviral initiation has not been adopted in Russia. Consequently, PLH are often asked to repeatedly return to care settings for long periods of clinical monitoring alone without receiving antiretroviral treatment. This may discourage care engagement and also greatly limit the public health benefits of HIV treatment-as-prevention.

The findings of this study underscore the urgent need to develop integrated care systems in Russia so that persons receiving HIV care also receive effective substance abuse treatment. Russia's current substance abuse treatment infrastructure offers methods of limited effectiveness and does not address the care needs of HIV-positive patients. Similarly, AIDS treatment clinics in Russia do not provide substance abuse treatment. This contributes to HIV

Table 3 Multiple mixed logistic regression models predicting HIV care engagement, ART adherence, and undetectable viral load

Outcomes and their covariates	*p*-Value	OR	95% CI
Had an HIV medical care visit in the past 6 months[a]			
Single and never married	.038	0.46	0.22, 0.96
Drank any alcohol, past 7 days	.011	0.35	0.15, 0.78
Number of times drugs were injected, past month	.017	0.94	0.89, 0.99
STAI anxiety scale	.072	0.97	0.94, 1.00
ART medication adherence over 90% in the past month[b]			
Number of alcohol drinks, past 7 days	.031	0.92	0.85, 0.99
STAI anxiety scale	.011	1.12	1.03, 1.23
ART medication taking self-efficacy scale	.002	2.60	1.44, 4.67
Undetectable HIV viral load (<75 copies/mL)[c]			
Male gender	.060	0.56	0.31, 1.02
Age, in years	<.001	1.12	1.06, 1.18
Number of alcohol drinks, past 7 days	.033	0.97	0.93, 0.99

[a] n = 241 participants within 43 social networks

[b] n = 122 participants within 23 social networks (includes only participants taking ART)

[c] n = 237 participants within 43 social networks (excludes four participants for whom blood samples could not be obtained)

epidemic growth in the country. Opioid substitution therapy in Russia is illegal, further hindering prospects of effective integrated care for people who inject drugs, a group that still accounts for about half of all HIV infections in Russia. Beyond integrated care development, age- and gender-tailored behavioral and psychosocial interventions that address both substance use and HIV care are needed.

This study has several limitations. Although its network recruitment methods reached PLH who might otherwise be hidden in the community, this may not be a representative community sample even though networks were recruited so as to represent most exposure groups. Participants were recruited in St. Petersburg, a large urban area with better medical care than in many other areas of the country. Therefore, these findings probably underestimate the true extent of the problem in Russia. Although viral load was assessed using biological testing, care attendance and medication adherence were measured by self-report that is susceptible to social desirability and recall bias. If this bias was present, the true picture of care engagement would likely be worse than that found here. Finally, the study focused on individual predictors of care-related outcomes. As discussed earlier, structural and systems-level barriers are also related to poor HIV health outcomes but were outside of the scope of the current study.

HIV treatment cascade analyses for Russia show major gaps at all points in the care continuum including care linkage, retention, ART provision, adherence, and viral suppression [13]. The present study underscores the need to develop and implement comprehensive interventions to address substance abuse, psychosocial needs, and HIV treatment among PLH in Russia. Doing so will improve HIV care outcomes and could limit the scale of future HIV incidence in the country.

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Compliance with Ethical Standards

Conflict of interest All authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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