ABSTRACT

Objective To quantify the proportion of people living with HIV (PLWH) with other tuberculosis (TB) risk factors that completed the latent tuberculosis infection (LTBI) care cascade and describe factors associated with attrition. The care cascade was defined as follows: (1) receipt of an LTBI test and result, (2) initiation of LTBI treatment and (3) completion of LTBI treatment.

Setting Reactivation of LTBI remains a large source of active TB disease in the USA. PLWH and those who use substances are at greater risk and are harder to engage and retain in care.

Participants Participants enrolled in a Boston cohort of PLWH from 2012 to 2014.

Primary and secondary outcome measures Our primary outcome was the number and proportion of participants who completed each stage of the cascade and the factors associated with completing each stage. Our secondary outcomes were differences between participants tested with an interferon gamma release assay (IGRA) versus tuberculin skin test and differences between participants who tested positive versus negative for LTBI.

Results Only 189 of 219 (86.3%) participants completed their LTBI test and result, (2) initiation of LTBI treatment and (3) completion of LTBI treatment.

Conclusions Although the majority completed LTBI testing, our findings warrant further investigation in a larger cohort to better understand factors that lead to suboptimal treatment initiation and completion in a low-burden country.

INTRODUCTION

Reactivation of tuberculosis (TB) infection remains a source of active TB disease in the USA. An estimated 15 million people in the USA have latent TB infection (LTBI). To reduce TB disease incidence and mortality, TB testing and treatment is prioritised for individuals at increased risk for progression to active disease, including persons living with HIV (PLWH) and people who inject drugs (PWID).

In PLWH, TB preventive therapy has been shown to reduce the risk of progression to active disease by up to 62%. HIV is one of the greatest risk factors for active TB development; PLWH are 20–30 times more likely to develop TB than individuals without HIV. Injection drug use (IDU) has also

To cite: Runels T, Ragan EJ, Ventura AS, et al. Testing and treatment for latent tuberculosis infection in people living with HIV and substance dependence: a prospective cohort study. BMJ Open 2022;12:e058751. doi:10.1136/bmjopen-2021-058751.
been associated with higher LTBI risk, with an estimated 10%-59% of PWID to be infected with TB. Alcohol use is also a risk factor for TB disease, with individuals who consume ≥40 g of alcohol daily having a nearly threefold increased risk. For these reasons, PLWH and individuals who use drugs and alcohol have been prioritised for LTBI testing and TB preventive therapy.

PLWH are a particularly high priority group for TB testing because those with LTBI, TB preventive therapy decreases their risk of progressing to active TB, development of immune reactivation inflammatory syndrome and overall HIV-associated morbidity and mortality. The reduced risk of TB disease and mortality attributable to TB preventive therapy among PLWH is independent of whether an individual is on antiretroviral therapy (ART).

The two main diagnostic tests for LTBI are the Mantoux tuberculin skin test (TST) and the interferon-gamma release assay (IGRA), the former an intradermal hypersensitivity test and the latter a whole blood immune sensitivity test and the latter a whole blood immune sensitivity test. The care cascade for TB testing includes: (1) being successfully tested for TB (ie, receiving a result), (2) initiating TB preventive therapy and (3) completing treatment. Currently, 3 months of weekly isoniazid (INH) plus rifapentine, 4 months of daily rifampin or 3 months of daily INH plus rifampin are standard regimens in the USA. Six or 9 months of daily INH can also be offered, the latter which was standard at the time of this study. A meta-analysis on the LTBI cascade found that among individuals intended for screening in high-income countries, 76% received a test result, 65% accepted and started treatment and 23% completed treatment. Another meta-analysis of the LTBI cascade among PLWH found treatment completion to be 37.9% in high-income countries. Populations at higher risk for LTBI and HIV, including people who are foreign-born, homeless, have a history of incarceration and who use substances, are often harder to engage and retain in care. US-based studies report that between 54% and 79% of eligible PLWH receive TB testing which, although greater than the general population, falls short of the 100% goal.

We conducted a secondary analysis of the prospective Boston Alcohol Research Collaboration on HIV/AIDS (ARCH) cohort, a study of individuals with multiple risk factors for both LTBI and poor completion of the LTBI cascade of care. All cohort participants were recruited from the Boston Medical Center infectious disease and HIV clinic or the Boston Healthcare for the Homeless Programme’s HIV primary care clinic between September 2012 and November 2014. All participants were actively receiving HIV care at the time of cohort enrolment, enabling us to identify dropout from the LTBI cascade among those already engaged in care. Eligibility criteria for the cohort have been described previously. Additionally for our analysis, participants were excluded if they had past active TB disease or documentation of previous TB preventive therapy, as these individuals would no longer be eligible for repeat testing or treatment. TB testing and treatment were conducted by participants’ routine care providers and were not done as part of ARCH cohort participation. Those who test positive were offered 9 months INH with vitamin B6 and, if they agreed to start treatment, were seen monthly by clinical nurses to confirm medication tolerance. One participant received experimental LTBI treatment as part of a trial. TB testing was either by TST or QuantiFERON TB-Gold In-Tube.

**Data collection**

Demographic characteristics of study participants were obtained through research assistant administered interviews and medical record review. Alcohol and other drug use were assessed using validated questionnaires by Boston ARCH study personnel. Information on TB testing and treatment and history of active TB was abstracted from the electronic medical record.

**Definitions**

The Mini-International Neuropsychiatric Interview V.6.0 was used to assess current alcohol use disorder (past 12 months) as well as current alcohol and drug dependence using DSM-IV criteria. History of IDU, current use of ART, time on ART, country of birth and smoking status were ascertained via self-report. Past 30-day IDU was measured using questions from the Addiction Severity Index (ASI) while current prescription of methadone or buprenorphine (treatment for opioid addiction) was measured using the ASI in conjunction with the medical record. Current alcohol use was measured using a 30-day Timeline Followback assessment with drinking behaviour categorised as abstinent, not heavy (not exceeding the National Institute on Alcohol Abuse and Alcoholism (NIAAA) daily or weekly limits by gender), heavy (exceeding NIAAA daily or weekly limits by gender, but <5 heavy days in past month) or frequent heavy (≥5 heavy days in past month). Lifetime alcohol consumption was ascertained using the lifetime drinking history instrument.

**METHODS**

**Study setting and population**

US-based cohort of PLWH with substance dependence (Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) history, we aimed to quantify the percentage that completed each stage of the LTBI cascade and to describe factors associated with failure to complete each stage.
Homelessness was defined as self-reported one or more nights on the street or in a shelter in the past 6 months. History of incarceration was abstracted from the medical record. Diabetes without chronic complications was measured according to the Charlson Comorbidity Index. Being foreign-born was defined as being born outside of the USA. Each participant’s medical record was reviewed at the time of enrolment and, if available, within the past 3 months for HIV viral load. An undetectable viral load was defined as ≤50 copies/mL. If the medical record lacked documentation, HIV viral load was tested at the time of enrolment. Adherence to ART was defined as self-reported adherence of ≥95% of doses in the last month using a Visual Analogue Scale. Viral hepatitis was defined as having either a positive hepatitis C virus (HCV) antibody result, an HCV viral load of greater than zero, or a positive hepatitis B virus antigen test. Variables collected as part of this study, as defined above, that were comparable to US Centers for Disease Control and Prevention (CDC)-defined risk factors for LTBI were summed to create a final cumulative count, and included: being foreign born; ever IDU; alcohol or drug dependence in the past 12 months; HIV; homelessness; ever incarceration; diabetes; and liver disease. All study participants had a minimum of two risk factors (ie, HIV infection and substance dependence).

The LTBI care cascade included the following: (1) completed TB testing in the 10 years prior to enrolment in the Boston ARCH cohort or up to 12 months thereafter; (2) initiation of TB preventive therapy; and (3) treatment completion (figure 1). TST was interpreted as negative if induration was <5 mm and positive if ≥5 mm, per guidelines. IGRA was recorded as positive, negative or unsuccessful based on standard cut-off of Nil ≥0.35 IU/mL. TB testing completion was defined as receiving a valid TST or IGRA result. Initiation of TB preventive therapy was defined as having a physician visit where TB preventive therapy was prescribed. Information on adherence was not available. Treatment completion was defined as documented completion of a TB preventive therapy regimen in the medical record.

**Data analysis**

We quantified participants who completed each stage of the cascade, and, when sample size allowed, compared factors associated with completing each stage. We assessed differences in demographics, including number of CDC-defined risk factors, cascade completion and test positivity.

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**Figure 1** Flowchart of the latent tuberculosis infection (LTBI) cascade of care: (1) completion of tuberculosis (TB) testing; (2) initiation of TB preventive therapy; and (3) completion of TB preventive therapy.
between participants tested with an IGRA versus TST. Lastly, we looking at differences between participants who tested positive versus negative for LTBI. Measures of central tendency were used to describe the distribution of continuous variables. We employed $\chi^2$ and Fisher’s exact tests for categorical variables and t-tests for continuous variables to assess the association between cohort characteristics and completion of each stage of the cascade. Wilcoxon rank-sum tests were used for non-normal data. SAS University Edition was used for all statistical analyses with two-tailed significance defined at $p<0.05$. We report ORs with 95% CIs.

**Patient and public involvement**

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

**RESULTS**

**Cohort characteristics**

Of the 250 Boston ARCH cohort participants, 1 had a previous history of active TB and 30 had already been treated with TB preventive therapy, leaving 219 eligible for TB testing (table 1). More than half (51.6%) reported concurrent alcohol and drug dependence in the past 12 months, with 11.4% reporting IDU and 53% reporting heavy or frequent heavy alcohol drinking in the 30 days prior to assessment. Including HIV-infection and substance use, half (50.7%) had four or more CDC-defined risk factors for LTBI.

**Completion of the cascade of care**

Of the 219 participants eligible for this analysis, 203 (92.7%) were tested for LTBI and 189 (86.3%) completed testing (figure 2). Participants tested with IGRA (n=100, 49.3%) were four times more likely to complete testing than those tested with TST (OR=3.87, 95% CI 1.05 to 14.30). Of those who completed testing, more of those tested with TST compared with those tested with IGRA required more than one test (8.8% vs 1.0%, $p=0.02$). Cumulative number of CDC-defined TB risk factors was not associated with whether a participant was tested for LTBI (table 2), nor was it associated with which test was used (online supplemental additional file 1). Substance dependence was also not associated with lack of TB test completion (OR=1.11, 0.37–3.51). Individuals with alcohol dependence were more likely to be tested with TST (OR=2.15, 1.16–4.00) (online supplemental additional file 1).

Eleven (5.8%) individuals tested positive for LTBI. Among participants successfully tested (n=189), being foreign-born (OR=3.95; 1.13–13.77) was associated with having a positive test result (table 3). Of the 11 participants who tested positive for LTBI, 5 received a TST and 6 received an IGRA. Of those who received a TST, three had information on their induration ranging from 10 mm to 30 mm while one participant originally tested with IGRA

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**Table 1 Characteristics of study participants eligible for TB testing (n=219)**

| Demographics | n (%) or mean (SD) |
|--------------|--------------------|
| Mean age, years | 48.7 (9.5) |
| Female | 82 (37.4) |
| Race/ethnicity | |
| White | 44 (20.1) |
| Black | 108 (49.3) |
| Hispanic/other | 67 (30.6) |
| Employed | 35 (16.0) |
| Foreign-born | 38 (17.4) |
| Completed high school | 140 (63.9) |
| Married/live with partner | 56 (25.6) |
| Ever incarceration | 106 (48.4) |
| Homeless* | 58 (26.5) |
| Number of CDC-defined TB risk factors | |
| 2 risk factors | 47 (21.5) |
| 3 risk factors | 61 (27.9) |
| 4 or more | 111 (50.7) |
| Substance use | |
| Current smoking, n=217 | 175 (80.7) |
| Lifetime alcohol use, n=215 | |
| <150 kg of alcohol | 68 (31.6) |
| 150–600 kg of alcohol | 66 (30.7) |
| >600 kg of alcohol | 81 (37.7) |
| Lifetime IDU, n=218 | 122 (56.0) |
| Current IDU† | 25 (11.4) |
| Currently prescribed methadone or buprenorphine, n=199 | 47 (23.6) |
| Current alcohol and drug dependence‡ | |
| No dependence | 37 (16.9) |
| Alcohol dependence only | 21 (9.6) |
| Drug dependence only | 48 (21.9) |
| Both alcohol and drug dependence | 113 (51.6) |
| Current alcohol use disorder§ | |
| Neither | 76 (34.7) |
| Alcohol abuse | 9 (4.1) |
| Alcohol dependence | 134 (61.2) |
| Current alcohol use† | |
| Abstinent | 71 (32.4) |
| Low risk | 32 (14.6) |
| Heavy | 55 (25.1) |
| Frequent heavy | 61 (27.9) |

**Health characteristics**

| Health insurance¶ | 218 (99.5) |
| Medicaid/Masshealth | 211 (96.4) |
| Medicare | 99 (45.2) |

Continued
was retested with TST and had a recorded TST induration of 25 mm. Five individuals initiated TB preventive therapy even though two patient records detailed a history of liver disease or the need to abstain from drinking. Four participants initiated the standard 9-month INH regimen and one initiated a 1-month short course of a rifamycin and INH as part of a clinical trial. Three individuals completed treatment. Of those that discontinued treatment, one participant cited abdomen cramping and seizures while the other did not have details other than the provider noting that stopping treatment was safest in light of chronic liver disease.

**DISCUSSION**

For this cohort of PLWH and substance dependence engaged in clinical care, we found a high proportion were successfully tested for LTBI, higher than previously reported by two studies of HIV-infected populations with lower levels of substance use, which may reflect that our cohort was more engaged in HIV care (ie, all on ART, median CD4 count >500). 28 29 Substance dependence was not predictive of whether an individual successfully completed testing. However, our findings show that even with successful engagement in the beginning of the cascade, retention through the treatment phase of the LTBI cascade was poor. All participants should have been tested for LTBI, and all those who tested positive should have initiated and completed TB preventive therapy. 1 2 Only a quarter of participants eligible completed the full cascade. No known risk factors nor the cumulative number of risk factors were associated with attrition from TB testing. Trends in LTBI and TB disease in the USA continue to support the prioritisation of the testing and treatment of populations such as our cohort. A review of TB outbreaks in the USA from 2002 to 2011 reported that substance use disorder, homelessness and incarceration were significant drivers in outbreak development. 30

**Table 1  Continued**

| Demographics | n (% or mean (SD)) |
|--------------|-------------------|
| Diabetes mellitus | 49 (22.4) |
| Undetectable HIV viral load**, n=218 | 139 (63.8) |
| Mean length of HIV infection, years n=214 | 15.7 (8.3) |
| Viral hepatitis (B and/or C) | 125 (57.1) |
| Median CD4 count, n=218 (IQR) | 549 (328-769) |
| Time using ART, years n=206 | 11.7 (8.2) |
| Current use of ART, n=218 | 191 (87.6) |
| ART adherence 95% or greater††, n=190 | 111 (58.4) |

*1+ nights on street or in shelter past 6 months.
††More than 60 days.
‡‡From MINI combined alcohol and drug DSM-IV 12-month dependence.
§§From MINI 12-month DSM-IV alcohol dependence/abuse.
¶¶Non-cumulative.
**50 copies/mL or less.
††Self-report on Visual Analogue Scale.
ART, antiretroviral therapy; CDC, Centers for Disease Control and Prevention; DSM-IV, Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition; IDU, injection drug use; MINI, Mini-International Neuropsychiatric Interview; TB, tuberculosis.

Figure 2 Flowchart of study participants who were eligible for TB testing, received a test (IGRA or TST), were successfully tested (ie, received a valid result), tested positive for TB infection, initiated treatment and completed treatment (N=250). ARCH, Alcohol Research Collaboration on HIV; IGRA, interferon-gamma release assay; LTBI, latent TB infection; TB, tuberculosis; TST, tuberculin skin test.
Table 2  Comparison of participants who completed testing* versus those who did not (n=219)

|                                    | Completed testing (n=189) | Did not complete testing (n=30) | OR (95% CI) |
|------------------------------------|--------------------------|--------------------------------|-------------|
| **Demographics**                   |                          |                                |             |
| Mean age, years†‡                 | 48.5 (9.4)               | 49.9 (9.9)                     | 0.86 (0.56 to 1.30) |
| Received TST, n=203              | 92 (48.7)                | 11 (78.6)                      | 0.26 (0.07 to 0.96)‡ |
| Female                             | 69 (36.5)                | 13 (43.3)                      | 0.75 (0.34 to 1.64) |
| **Race/ethnicity**                |                          |                                |             |
| White                              | 38 (20.1)                | 6 (20.0)                       | ref —       |
| Black                              | 89 (47.1)                | 19 (63.3)                      | 0.74 (0.27 to 2.00) |
| Hispanic/other                    | 62 (32.8)                | 5 (16.7)                       | 1.96 (0.56 to 6.86) |
| Employed                           | 33 (17.5)                | 2 (6.7)                        | 2.96 (0.67 to 13.05) |
| Foreign-born                       | 36 (19.1)                | 2 (6.7)                        | 3.29 (0.75 to 14.47)¶ |
| Completed high school             | 125 (66.1)               | 15 (50.0)                      | 1.95 (0.90 to 4.25)§ |
| Ever incarceration                 | 93 (49.2)                | 13 (43.3)                      | 1.27 (0.58 to 2.75) |
| Homeless**                         | 52 (27.5)                | 6 (20.0)                       | 1.52 (0.59 to 3.93) |
| **Number of CDC-defined TB risk factors** |                      |                                |             |
| 2 risk factors                     | 38 (20.1)                | 9 (30.0)                       | ref —       |
| 3 risk factors                     | 55 (29.1)                | 6 (20.0)                       | 2.17 (0.71 to 6.61) |
| 4 or more                          | 96 (50.8)                | 15 (50.0)                      | 1.52 (0.61 to 3.76) |
| **Substance use**                 |                          |                                |             |
| Current smoking, n=217            | 153 (81.8)               | 22 (73.3)                      | 1.64 (0.67 to 3.99) |
| Lifetime IDU, n=218               | 107 (56.9)               | 15 (50.0)                      | 1.32 (0.61 to 2.86) |
| Current IDU††                     | 19 (10.1)                | 6 (20.0)                       | 0.45 (0.16 to 1.23) |
| **Current alcohol and drug dependence§§** |                    |                                |             |
| No dependence                      | 32 (16.9)                | 5 (16.7)                       | ref —       |
| Alcohol dependence only           | 15 (7.9)                 | 6 (20.0)                       | 0.39 (0.10 to 1.49) |
| Drug dependence only              | 43 (22.8)                | 5 (16.7)                       | 1.34 (0.36 to 5.04) |
| Both                               | 99 (52.4)                | 14 (46.7)                      | 1.11 (0.37 to 3.31) |
| **Current alcohol use disorder††** |                          |                                |             |
| Neither                            | 67 (35.5)                | 9 (30.0)                       | ref —       |
| Alcohol abuse                      | 8 (4.2)                  | 1 (3.3)                        | 0.80 (0.11 to 5.62) |
| Alcohol dependence                 | 114 (60.3)               | 20 (66.7)                      | 0.79 (0.34 to 1.80) |
| **Current alcohol use**            |                          |                                |             |
| Abstinent                          | 64 (33.9)                | 7 (23.3)                       | ref —       |
| Low risk                           | 28 (14.8)                | 4 (13.3)                       | 0.77 (0.21 to 2.83) |
| Heavy                              | 46 (24.3)                | 9 (30.0)                       | 0.56 (0.19 to 1.61) |
| Frequent heavy                     | 51 (27.0)                | 10 (33.3)                      | 0.56 (0.20 to 1.57) |
| **Health characteristics**        |                          |                                |             |
| Health insurance†¶¶               | 188 (99.5)               | 30 (100)                       | — —        |
| Medicaid/Masshealth                | 181 (95.8)               | 30 (100)                       | — —        |
| Medicare                           | 90 (47.6)                | 9 (30.0)                       | 2.12 (0.92 to 4.87)§ |
| Diabetes mellitus                  | 40 (21.2)                | 9 (30.0)                       | 0.63 (0.27 to 1.47) |
| Undetectable HIV viral load†++†+, n=218 | 119 (63.3)               | 20 (66.7)                      | 0.86 (0.38 to 1.95) |
| Mean length of HIV infection, years†+++ n=214 | 15.6 (8.4)               | 16.3 (7.5)                     | 0.95 (0.75 to 1.20) |
| Median CD4 count†+++†, n=218 (IQR) | 544 (331.5–777.5)        | 565 (258–684)                  | 1.05 (0.92 to 1.20) |

Continued
Among the study participants, 5.8% of those successfully tested had a positive result. A 2010–2012 analysis of a representative nationwide US database of PLWH showed 6.9% had evidence of LTBI. Consistent with both national and state trends and a well-recognised risk factor for LTBI, foreign-born participants were more likely to test positive. Substance dependence did not increase individual risk for LTBI in our study population.

LTBI diagnostics may have an impact on cascade retention. Participants tested with TST were less likely to be successfully tested, reflecting the challenges associated with this test. TST is susceptible to operator performance variability and requires a second visit to obtain a result. IGRAs are more specific and require only one visit, but are costly and discordance with TST and higher frequency of positive results raises concerns about interpretation. Current guidelines suggest the two tests can be used interchangeably, but that IGRAs is preferred for individuals unlikely to return for TST reading. A previous study found that patients at an urban HIV clinic were 1.5 times more likely to receive care adherent to TB treatment guidelines after the clinic transitioned to using an IGRA. Another study found being tested with an IGRAS to be significantly associated with treatment initiation and completion.

The length of the standard regimen for treating LTBI in PLWH is another barrier to retention. New shorter rifapentine-containing regimens have shown similar efficacy to and higher completion rates than 9 months of INH, providing a treatment alternative for groups difficult to retain in care. However, rifamycin-containing regimens require coordination with HIV medications to avoid drug interactions and recent studies may suggest needs for alternate dosing for PLWH. Directly observed therapy, patient incentives and social interventions during treatment, such as education, adherence coaching and peer counselling, have been shown to improve adherence and could also improve completion rates.

The overwhelming summary is that successful interventions depend on the target population, and further research is required to inform strategies for high-risk populations.

Our study has limitations. First, the sample size was too small to assess risk factors along the entire cascade of LTBI care. This limited our ability to draw conclusions about who begins and completes treatment for LTBI. Second, our study is limited in its generalisability: our participants were all engaged in care at the time of enrolment, potentially increasing the likelihood that they received LTBI testing compared with the broader population of PLWH.

Even with our smaller sample size and focus on those engaged in care, we did not find 100% LTBI testing and our low treatment initiation and completion numbers demonstrate a persistent gap.

**CONCLUSIONS**

Our study demonstrates that high testing coverage for LTBI is possible among PLWH with numerous other TB risk factors, including high rates of substance use, incarceration and homelessness. However, we also demonstrate persistent challenges in retaining patients through treatment completion. Our findings reaffirm that high-risk populations, such as PLWH and PWID, can be successfully tested, but reasons for attrition from
Table 3  Participants with a positive result on TST/IGRA compared with participants with a negative test result (n=189)

| Participant characteristics | Positive (n=11) | Negative (n=178) | OR | 95% CI |
|----------------------------|----------------|-----------------|----|--------|
| Mean age at time of TB test, years* | 44.4 (12.4) | 47.1 (9.4) | 0.75 | (0.41 to 1.38) |
| Received TST | 5 (45.5) | 87 (48.8) | 0.87 | (0.26 to 2.96) |
| Female | 4 (36.4) | 65 (36.5) | 0.99 | (0.28 to 3.52) |
| Mean time between test and ARCH enrolment†‡, months | 14.9 (34.1) | 12.9 (22.4) | 1.04 | (0.78 to 1.40) |

Race/ethnicity

| | Positive (n=11) | Negative (n=178) | OR | 95% CI |
|----------------------------|----------------|-----------------|----|--------|
| White | 2 (18.2) | 36 (20.3) | ref | — |
| Black | 3 (27.3) | 86 (48.3) | 0.63 | (0.10 to 3.92) |
| Hispanic/other | 6 (54.6) | 56 (31.5) | 1.93 | (0.37 to 10.08) |
| Employed | 0 (0.0) | 33 (18.5) | — | — |
| Foreign-born | 5 (45.5) | 31 (17.4) | 3.95 | (1.13 to 13.77)§ |
| Ever incarceration | 4 (36.4) | 89 (50.0) | 0.57 | (0.16 to 2.02) |
| Homeless¶ | 4 (36.4) | 48 (27.0) | 1.55 | (0.43 to 5.52) |

Number of CDC-defined TB risk factors

| | Positive (n=11) | Negative (n=178) | OR | 95% CI |
|----------------------------|----------------|-----------------|----|--------|
| 2 risk factors | 3 (27.3) | 35 (19.7) | ref | — |
| 3 risk factors | 1 (9.1) | 54 (30.3) | 0.22 | (0.02 to 2.16) |
| 4 or more | 7 (63.6) | 89 (50.0) | 0.92 | (0.22 to 3.75) |

Substance use

| | Positive (n=11) | Negative (n=178) | OR | 95% CI |
|----------------------------|----------------|-----------------|----|--------|
| Current smoking, n=187 | 11 (100) | 142 (80.7) | — | — |
| Lifetime IDU, n=188 | 8 (72.7) | 99 (55.9) | 2.10 | (0.54 to 8.18) |
| Current IDU** | 2 (18.2) | 17 (9.6) | 2.10 | (0.42 to 10.55) |
| No dependence | 3 (27.3) | 29 (16.3) | ref | — |
| Alcohol dependence only | 0 (0.0) | 15 (8.4) | 0.27 | (0.01 to 6.15) |
| Drug dependence only | 1 (9.1) | 42 (23.6) | 0.30 | (0.04 to 2.19) |
| Both | 7 (63.6) | 92 (51.7) | 0.68 | (0.18 to 2.64) |
| Current alcohol use disorder†† | | | | |
| Neither | 3 (27.3) | 64 (36.0) | ref | — |
| Alcohol abuse | 1 (9.1) | 7 (3.9) | 3.05 | (0.28 to 33.4) |
| Alcohol dependence | 7 (63.6) | 107 (60.1) | 1.40 | (0.35 to 5.59) |
| Current alcohol use§§ | | | | |
| Abstinent | 3 (27.3) | 61 (34.3) | ref | — |
| Low risk | 2 (18.2) | 26 (14.6) | 1.56 | (0.25 to 9.92) |
| Heavy | 2 (18.2) | 44 (24.7) | 0.92 | (0.15 to 5.77) |
| Frequent heavy | 4 (36.4) | 47 (26.4) | 1.73 | (0.37 to 8.11) |

Health characteristics

| | Positive (n=11) | Negative (n=178) | OR | 95% CI |
|----------------------------|----------------|-----------------|----|--------|
| Health insurance¶¶ | 11 (100) | 177 (99.4) | — | — |
| Medicaid/Masshealth | 10 (90.9) | 171 (96.1) | 0.41 | (0.05 to 3.66) |
| Medicare | 5 (45.5) | 85 (47.8) | 0.91 | (0.27 to 3.10) |
| Diabetes mellitus | 2 (18.2) | 38 (21.4) | 0.82 | (0.17 to 3.95) |
| Undetectable HIV viral load***, n=188 | 10 (90.9) | 109 (61.6) | 6.24 | (0.78 to 49.83)§§ |
| Mean length of HIV infection, years†††† n=185 | 14.5 (7.0) | 15.6 (8.5) | 0.93 | (0.65 to 1.33) |
| Median CD4 count‡‡‡‡, n=188 (IQR) | 389 (274–570) | 552 (343–780) | 0.85 | (0.68 to 1.07) |

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initiation and completion of preventive therapy need further investigation.

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**Acknowledgements** The authors would like to thank the Boston ARCH Cohort study participants for their time and contributions. We want to acknowledge Margo Godersky, Kate Haworth, Keshia Toussaint and Laura Vercammen for their work in recruitment, data collection and participant retention, Seville Melt for her oversight of study operations and Carolina Geadas for her assistance in formatting.

**Contributors** TR contributed to the study design and methods, aspects of data collection, data analysis, interpretation of results and drafting and editing the manuscript. EJR contributed to the study design and methods, data analysis, interpretation of results and drafting and editing the manuscript. ASV contributed to the study design and methods, aspects of data collection, data analysis, interpretation of results and drafting and editing the manuscript. CRH contributed to the study design and methods, aspects of data collection, data analysis and drafting and editing the manuscript. LW contributed to the study design and methods, aspects of data collection, data analysis and drafting and editing the manuscript. KRJ contributed to the study design and methods, aspects of data collection, data analysis, interpretation of results and drafting and editing the manuscript. RS contributed to the study design and methods, interpretation of results and drafting and editing the manuscript. JHS contributed to the study design and methods, data analysis, interpretation of results and drafting and editing the manuscript. KRJ contributed to the study design and methods, aspects of data collection, data analysis, interpretation of results and drafting and editing the manuscript.

**Funding** RS, JHS, ASV and MRW were funded by the National Institute on Alcohol Abuse and Alcoholism (award numbers U01AA020784, U24AA020779, U24AA020778) and by the National Center for Advancing Translational Sciences (UL1TR001430). KRJ, CRH and LW were supported by the National Institute of Allergy and Infectious Diseases (NIAID) through the Providence/Boston Center for AIDS Research (P30AI042853) and KRI, CRH and LW were supported by the NIAID through the Boston University/Rutgers Tuberculosis Research Unit (U19AI111276). KRJ, CRH and EJR were supported by the NIAID (RO1AI119037).

**Competing interests** RS reports that Alkermes provides medication for a comparative effectiveness study funded by NIAAA/NIH for which he is the principal investigator. Authors report no other conflicts.

**Patient consent for publication** Not applicable.

**Ethics approval** The study protocol was approved by the Boston University Medical Campus’ Institutional Review Board (application #H-31295) and written informed consent was obtained from all individual participants included in the study. The NIAAA provided a Certificate of Confidentiality to further protect participants. All data collection methods were done in conformance with Good Clinical Practice (GCP) standards, including automated validation and quality control checks in the electronic database. Participants gave informed consent to participate in the study before taking part.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** Data are available upon reasonable request. Data collected for the study are available to interested investigators in the URBAN ARCH Repository: www.urbanarch.org.

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