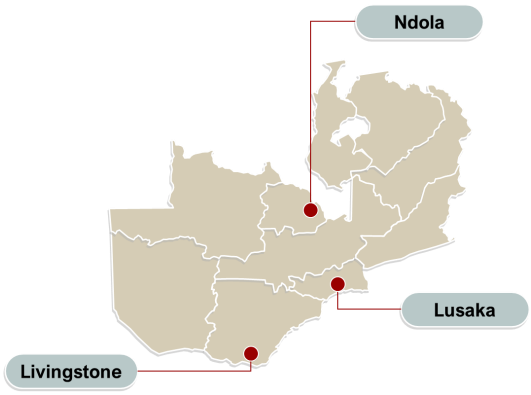
BIOBEHAVIORAL SURVEY AMONG PEOPLE WHO INJECT DRUGS IN THREE TOWNS IN ZAMBIA

BACKGROUND

The first biobehavioral survey (BBS) among people who inject drugs (PWID) was conducted in three towns in Zambia from November 2021 to February 2022. The BBS estimated the prevalence of HIV, recent HIV infection, active syphilis, hepatitis B (HBV), hepatitis C (HCV), HIV viral load suppression (VLS), and risk behaviors, as well as progress towards the UNAIDS 95-95-95 targets. The population size of PWID was also estimated. The BBS was led by ICAP at Columbia University, in collaboration with the Zambia National HIV/AIDS/STI/TB Council (NAC) and the Tropical Diseases Research Centre (TDRC), with support from the United States Centers for Disease Control and Prevention (CDC).

Figure 1. Survey sites in Zambia



Survey sites were selected based on those expected to have larger populations of PWID.[1]

SURVEY METHODS

Eligibility Criteria

- Self-reported drug injection for non-medical purposes in past 3 months
- Age ≥16 years
- Lived in surveyed town for past 3 months
- Speaks English, Bemba, Kaonde, Lozi, Nyanja, or Tonga
- Capable and willing to provide verbal informed consent
- In possession of valid survey coupon

Survey Components

- Interviewer-administered survey questionnaire
- Rapid testing for HIV, HBV, HCV, syphilis
- Laboratory-based testing for HIV viral load, recent HIV infection, active syphilis, and for confirmation of positive rapid assays for HIV, HCV, and syphilis

RECRUITMENT

Participants were recruited using respondent-driven sampling (RDS). Community mobilizers working with key population (KP) partners identified PWID who served as recruitment seeds. Seeds recruited potential participants by distributing three coded referral coupons; enrolled participants continued the recruitment process until achieving the target sample size.

SURVEY PROCEDURES

Verbal informed consent was obtained by staff trained in human subjects' protection and good clinical practice. Trained staff conducted tablet-based,[2] in-person interviews using an adapted standardized questionnaire.[3] Consenting participants received rapid testing for HIV, HBV, HCV, and syphilis with immediate return of results. Referral for care at KP-friendly clinics was provided for those testing positive for any infection or those reporting symptoms of sexually transmitted infections; HIV-negative individuals were referred for HIV pre-exposure prophylaxis (PrEP) services. Laboratory-based testing was conducted at TDRC in Ndola for active syphilis, HIV viral load, and HIV recency classification per the recent infection testing algorithm (RITA). Confirmation of positive rapid assays was conducted for HIV, HCV, and syphilis. HIV viral load results were returned to participants within two weeks of their first visit. HIV recency results were not returned as they do not inform diagnosis or clinical care.

ANALYSIS

Indicators were estimated using R (version 4.0.5, RDS package version 0.9-3) with bootstrap variance estimation of 95% confidence intervals. All indicators were weighted using Gile's sequential sampling weights. SAS (version 9.4) was used for indicator validation and sensitivity analyses using Taylor series variance estimation. Some estimates have wide confidence intervals due to small denominators. They are less reliable and should be interpreted with caution.

Population size estimation was conducted with R (version 4.0.5) using the three-source capture-recapture (3-SCRC) and successive sampling population size estimation (SS-PSE) methods. 3-SCRC estimates with 95% credible intervals were calculated using Bayesian nonparametric latent-class models in the shinyrecap app.[4] Size estimation was based on the number of participants overlapping across three capture events (each of two community-based events timed one week apart and the RDS survey sample). SS-PSE was computed with the Gile's estimator in the sspse package (version 0.6) using RDS recruitment histories and self-reported network sizes; self-reported network sizes were adjusted using the imputed visibility approach. Consensus population estimates with credible intervals were generated using a Bayesian synthesis model to combine the estimates and standard errors from each method.[4]

PARTICIPANT ENROLLMENT AND DEMOGRAPHICS

ENROLLMENT

Table 1. Recruitment and enrollment indicators, by site

Site	Seeds	Screened	Eligible	Enrolled	Tested for biomarkers	Coupon return rate
Livingstone	7	249	235	235	235	48.2%
Lusaka	12	479	349	349	349	51.5%
Ndola	8	303	259	259	259	53.8%

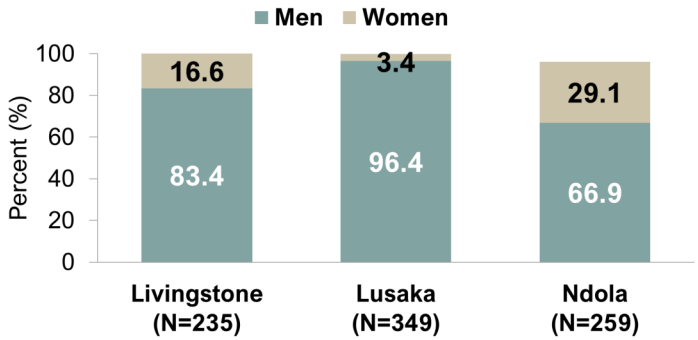
DEMOGRAPHICS

Most PWID were men (range: 66.9%–96.4%), and the percentage aged 16 to 24 years was highest in Livingstone (58.6%) followed by Lusaka (52.0%) and Ndola (30.3%) [Figures 2, 3]. The median age of women was higher than that of men in Livingstone (29.0 years versus 22.0 years) and in Ndola (29.0 years versus 27.0 years) [Table 2]. The majority of PWID completed secondary school education or higher (Livingstone: 56.5%; Lusaka: 62.1%; Ndola: 87.3%). Current unemployment was common (Livingstone: 57.6%; Lusaka: 77.5%; Ndola: 45.0%).

Table 2. Median age of PWID, by gender and site

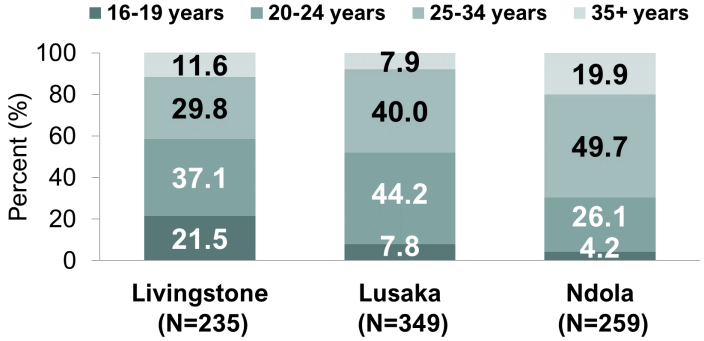
	Median age (years)	
	Men	**Women**
Livingstone	22.0	29.0
Lusaka	25.0	23.0
Ndola	27.0	29.0

Figure 2. Gender distribution of PWID, by site



N: denominator, total number of sampled PWID.
Non-binary genders were excluded due to small cell size.

Figure 3. Age group distribution of PWID, by site



N: denominator, total number of sampled PWID.

POPULATION SIZE ESTIMATES

Table 3. PWID consensus population size estimates, by site

Site	Estimate (median)	95% credible intervals	% of total 15–64 years district population[5, a]
Livingstone	1,200	900 – 1,900	0.9 (0.7 – 1.5)
Lusaka	3,700	1,500 – 7,500	0.2 (0.1 – 0.5)
Ndola	2,200	1,600 – 2,900	0.6 (0.4 – 0.7)

[a] District population estimates were used since estimates for smaller catchment areas were not available.
Estimates and credible intervals are rounded to the nearest fifty.
95% Credible Intervals indicate the interval where the true population parameter falls with 95% probability, given the observed data.

KEY FINDINGS

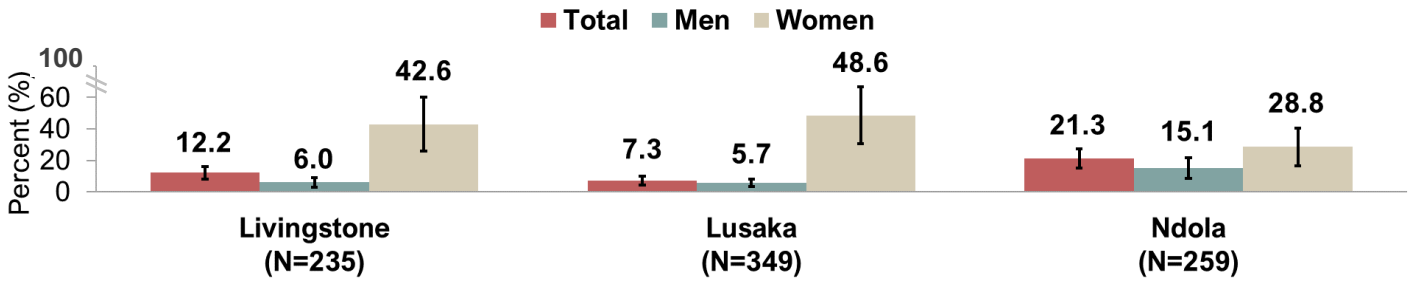
HIV PREVALENCE AND RECENT INFECTION

The prevalence of HIV among PWID was highest in Ndola (21.3%), followed by Livingstone (12.2%) and Lusaka (7.3%) [Figure 4]. HIV prevalence among PWID was substantially higher among women than among men (Livingstone: 42.6% versus 6.0%; Lusaka: 48.6% versus 5.7%; Ndola: 28.8% versus 15.1%). The prevalence of HIV was highest among PWID aged 35 years and older in Livingstone (51.4%) and Ndola (42.5%) and those aged 25-34 years in Lusaka (9.4%) [Figure 5].

Across all sites, two participants tested as recently infected with HIV. Participants were classified as having a recent HIV infection if they tested positive for a recent infection and had a HIV viral load ≥1000 copies/mL.

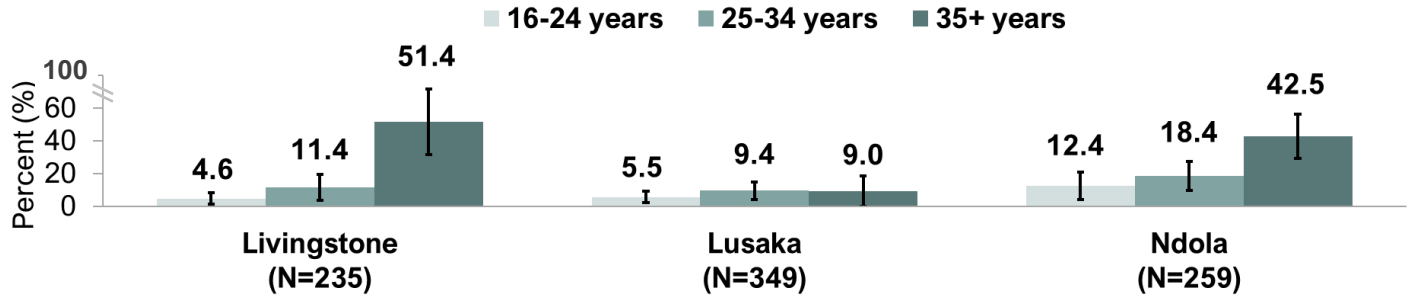
Estimates with wide confidence intervals (i.e., women [Figure 4], 35+ years [Figure 5]) are less reliable and should be interpreted with caution.

Figure 4. HIV prevalence among PWID, by gender and site



N: denominator, total number of sampled PWID who tested for HIV.
Error bars represent 95% confidence intervals (CI), the interval within which the true population parameter is expected to fall 95% of the time from repeated surveys with the same design.

Figure 5. HIV prevalence among PWID, by age group and site



N: denominator, total number of sampled PWID who tested for HIV.
Error bars represent 95% confidence intervals, the interval where the true population parameter is expected to fall 95% of the time from repeated surveys with the same design.

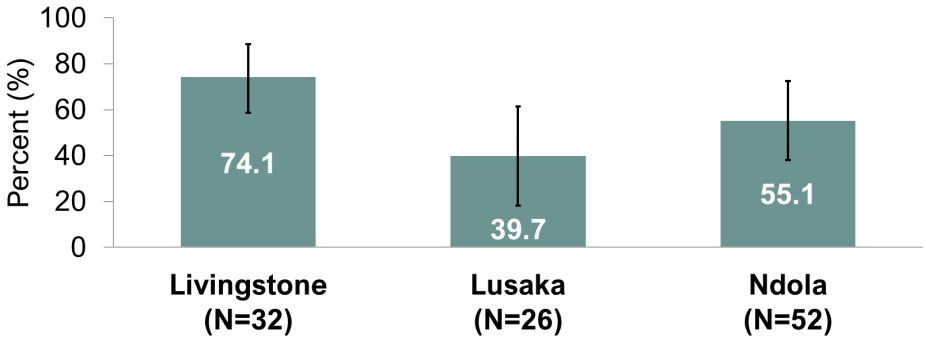
HIV VIRAL LOAD SUPPRESSION

VLS prevalence among all PWID living with HIV was highest in Livingstone (74.1%), followed by Ndola (55.1%) [Figure 6].

VLS is defined as HIV RNA at <1,000 copies per mL.

Estimates have wide confidence intervals and should be interpreted with caution.

Figure 6. VLS prevalence among all PWID living with HIV, by site



N: denominator, total number of sampled PWID who tested positive for HIV.
Error bars represent 95% confidence intervals, the interval where the true population parameter is expected to fall 95% of the time from repeated surveys with the same design.

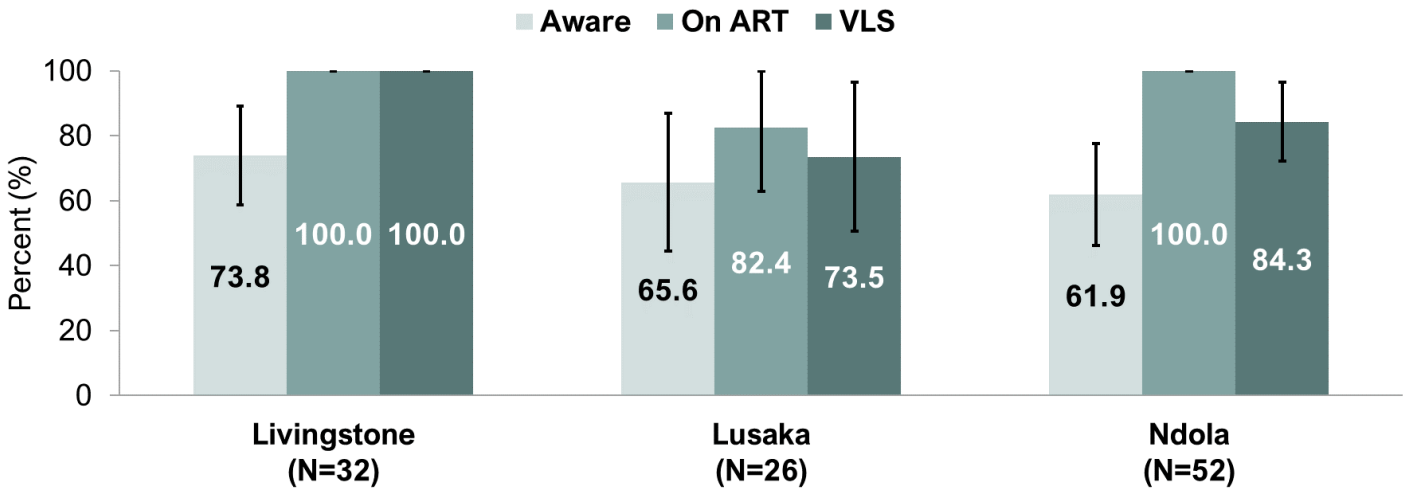
PROGRESS TOWARDS UNAIDS 95-95-95 TARGETS

The UNAIDS 2025 targets aim for 95% of all people living with HIV (PLHIV) to be aware of their HIV status; 95% of PLHIV who are aware of their HIV status to receive antiretroviral therapy (ART); and 95% of PLHIV who are on ART to achieve viral suppression.[6] Awareness of HIV-positive status and on ART status were based upon self-report or having a HIV viral load <200 copies/mL.

- **Aware of HIV Status:** Across the three sites, the percentages of PWID living with HIV who were aware of their HIV status ranged from 61.9% to 73.8% [Figure 7].
- **On ART:** In Livingstone and Ndola, all (100.0%) PWID who were aware of their HIV-positive status were on ART, compared to about four-fifths (82.4%) in Lusaka [Figure 7].
- **Virally Suppressed:** In Livingstone, all (100.0%) PWID who were on ART were virally suppressed, compared to 73.5% in Lusaka and 84.3% in Ndola.

Estimates with wide confidence intervals are less reliable and should be interpreted with caution.

Figure 7. 95-95-95 cascade for PWID living with HIV



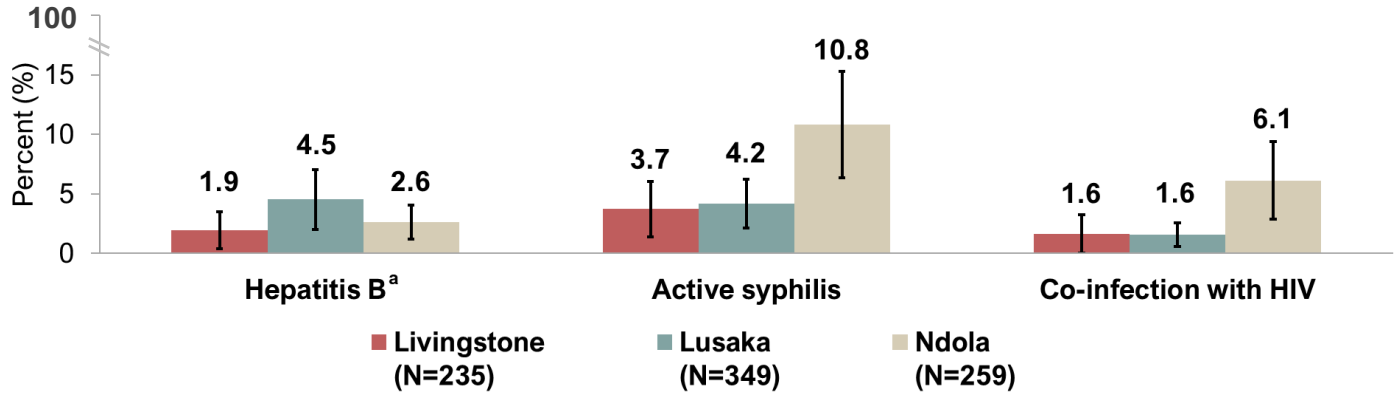
Conditional percentages are shown.
N: denominator, total number of sampled PWID who tested positive for HIV.
Error bars represent 95% confidence intervals, the interval where the true population parameter is expected to fall 95% of the time from repeated surveys with the same design.
Viral load suppression is defined as HIV viral load of <1,000 copies per mL.

HEPATITIS B, HEPATITIS C, ACTIVE SYPHILIS, AND CO-INFECTION WITH HIV

- **Hepatitis B:** The prevalence of hepatitis B among PWID was highest in Lusaka (4.5%) and lowest in Livingstone (1.9%) [Figure 8]. Hepatitis B infection was defined as testing positive for hepatitis B surface antigen (HBsAg), which indicates having either an acute or chronic infection.
- **Hepatitis C:** Among PWID across the sites, three individuals tested positive for hepatitis C. Hepatitis C infection was defined as detectable hepatitis C virus by polymerase chain reaction (PCR) testing.
- **Active syphilis:** The prevalence of active syphilis among PWID was highest in Ndola (10.8%) and lowest in Livingstone (3.7%) [Figure 8]. Active syphilis was defined as testing antibody-positive for both non-treponemal and *Treponema pallidum* antigens.
- **Co-infection with HIV:** The prevalence of co-infection with HIV among PWID was highest in Ndola (6.1%) compared to the other sites [Figure 8]. Co-infection with HIV was defined as testing HIV-positive and testing positive for either hepatitis B, hepatitis C, active syphilis, or two of these infections.

Estimates with wide confidence intervals are less reliable and should be interpreted with caution.

Figure 8. Prevalence of HBV, active syphilis, and co-infection with HIV among PWID, by site

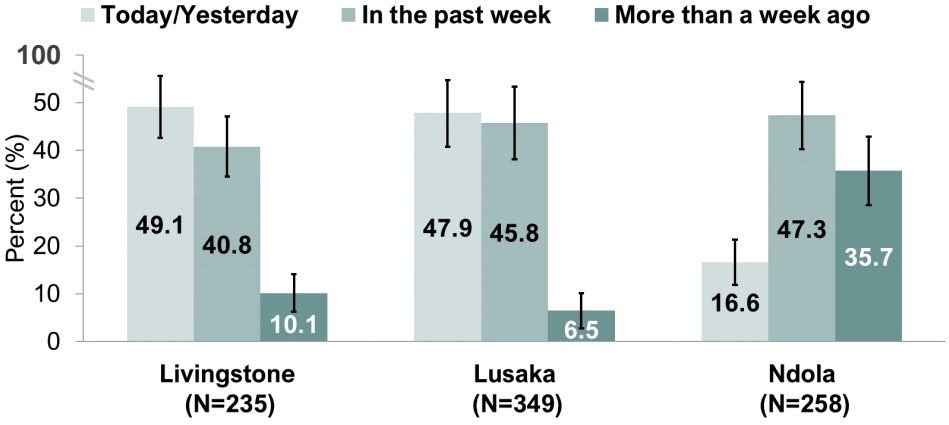


[a] Testing hepatitis B antigen.
N: denominator, total number of sampled PWID who tested for biomarkers.
Error bars represent 95% confidence intervals, the interval within which the true population parameter is expected to fall 95% of the time from repeated surveys with the same design.

INJECTION PRACTICES

LAST TIME INJECTED DRUGS

Figure 9. Last time injected drugs among PWID, by site

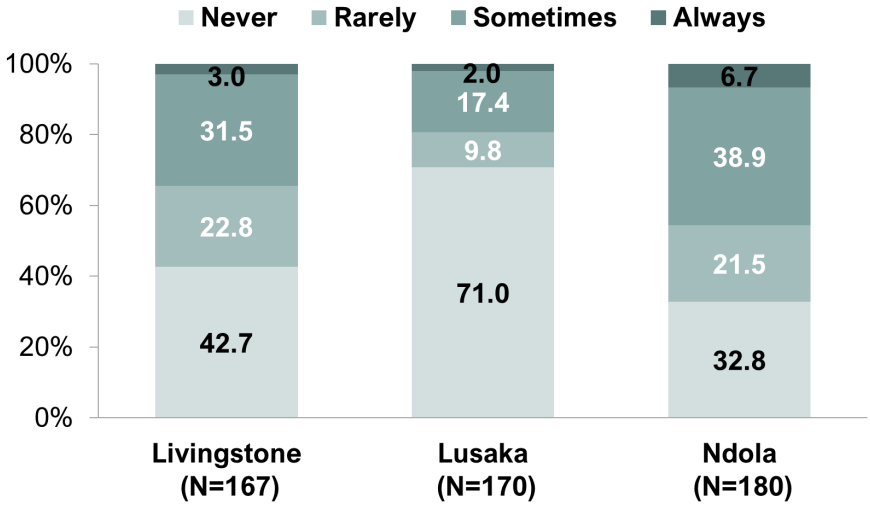


N: denominator, total number of sampled PWID.
Error bars represent 95% confidence intervals (CI), the interval within which the true population parameter is expected to fall 95% of the time from repeated surveys with the same design.

Having last injected drugs on the day of or day before the survey was most common among PWID in Livingstone (49.1%) and Lusaka (47.9%), yet was the least common in Ndola (16.6%) [Figure 9]. About a third of PWID had last injected drugs more than a week ago in Ndola (35.7%) versus a tenth or less in Livingstone (10.1%) and Lusaka (6.5%).

SAFER INJECTION PRACTICES

Figure 10. Sharing needles in last 6 months among PWID, by site



N: denominator, total number of sampled PWID who shared needles.

The majority of PWID in Lusaka (71.0%) had not shared a needle in the last 6 months. In contrast, less than half of PWID in Livingstone (42.7%) and in Ndola (32.8%) had not shared a needle in the last 6 months [Figure 10].

A higher percentage of PWID in Ndola had sometimes (38.9%) or always shared a needle (6.7%) in the last 6 months compared to PWID in Livingstone (sometimes: 31.5%; always: 3.0%) and Lusaka (sometimes: 17.4%; always: 2.0%).

PRIMARY INJECTABLE DRUG OF CHOICE

Tie White (heroin) was the primary injectable drug of choice among the vast majority (92.0%) of PWID in Livingstone [Table 4]. In Lusaka, approximately half (54.6%) of PWID reported Tie White (heroin), while the remaining (42.4%) reported Dirty Drug/Voloo (mixed heroin). In Ndola, about a third of PWID indicated Artane (36.2%) and Blue Marsh (Promethazine) (32.5%) as their primary drug of choice.

Table 4. Primary injectable drug of choice in last 6 months among PWID, by site

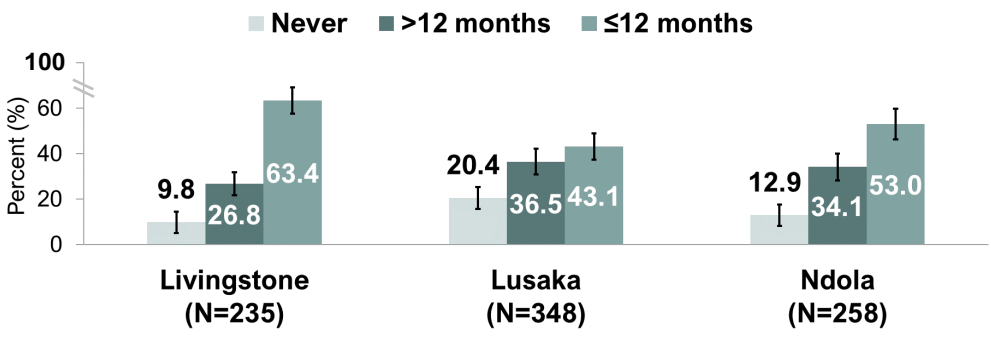
	Livingstone (N=235)	Lusaka (N=349)	Ndola (N=259)
	% (95% CI)	% (95% CI)	% (95% CI)
Tie White (Heroin)	92.0 (87.9 – 96.2)	54.6 (47.5 – 61.7)	13.7 (7.9 – 19.4)
Artane	2.1 (0.4 – 3.8)	0	36.2 (28.9 – 43.4)
Blue Marsh (Promethazine)	3.2 (0.0 – 6.3)	0	32.5 (25.0 – 39.9)
Dirty Drug/Voloo (Mixed Heroine)	0.4 (0.0 – 0.7)	42.4 (36.1 – 48.7)	1.8 (0.3 – 3.3)

95% CI (confidence interval): the interval within which the true population parameter is expected to fall 95% of the time from repeated surveys of the same design.

PREVENTION SERVICE UPTAKE

HIV TESTING

Figure 11. HIV testing among PWID, by site



N: denominator, total number of sampled PWID.
Error bars represent 95% confidence intervals, the interval within which the true population parameter is expected to fall 95% of the time from repeated surveys with the same design.

Across all sites, the largest percentages of PWID had tested for HIV in the last 12 months (Livingstone: 63.4%; Lusaka: 43.1%; Ndola: 53.0%) [Figure 11].

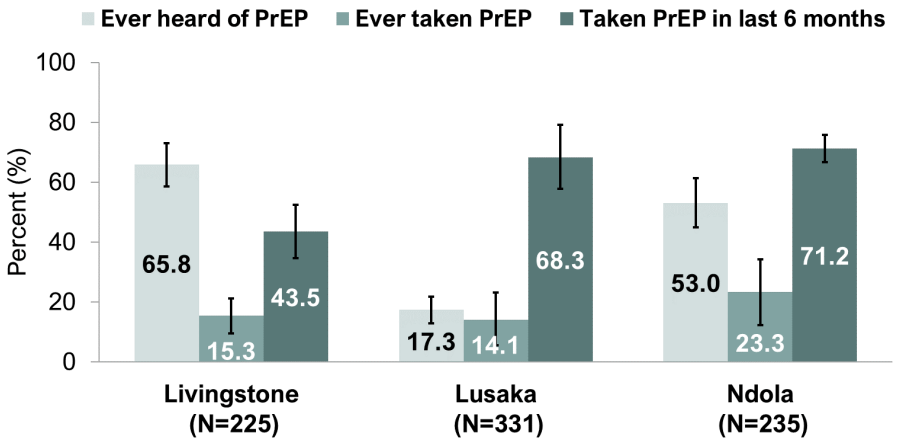
The percentage of PWID who had never tested for HIV was highest in Lusaka (20.4%) and lowest in Livingstone (9.8%).

HIV PRE-EXPOSURE PROPHYLAXIS (PrEP)

Among PWID reporting as HIV-negative across sites, 17.3% to 65.8% had ever heard of PrEP [Figure 12]. Among PWID who had heard of PrEP, 14.1% to 23.3% had ever taken PrEP. Among PWID who had ever taken PrEP, 43.5% to 71.2% had taken PrEP in the prior 6 months.

At each site, the most common reason for never taking PrEP was not feeling at risk (Livingstone: 37.1%; Lusaka: 24.8%) and not knowing where to get PrEP (Ndola 32.1%).

Figure 12. PrEP knowledge and uptake among PWID reporting as HIV-negative, by site

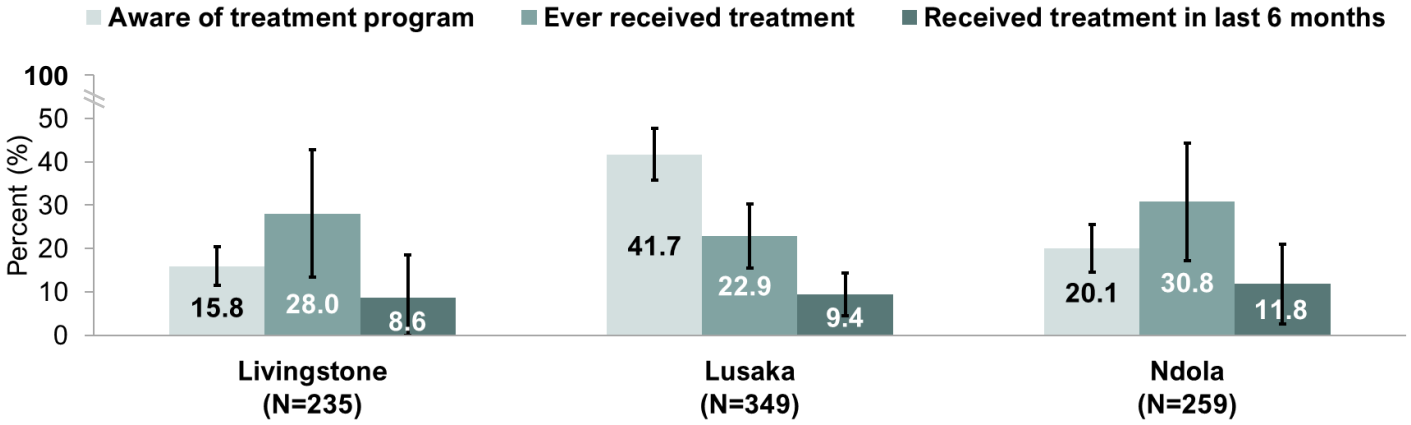


Conditional percentages are shown.
N: denominator, total number of sampled PWID reporting as HIV-negative.
Error bars represent 95% confidence intervals, the interval where the true population parameter is expected to fall 95% of the time from repeated surveys with the same design.

DRUG TREATMENT PROGRAM

Across sites, 15.8% to 41.7% of PWID were aware of a drug treatment program [Figure 13]. Among PWID who were aware of a drug treatment program, 22.9% to 30.8% had ever received drug treatment. Among PWID who had ever received drug treatment, 8.6% to 11.8% reported having received treatment in the prior 6 months.

Figure 13. Experience with drug treatment programs among PWID, by site



Conditional percentages are shown.
N: denominator, total number of sampled PWID.
Error bars represent 95% confidence intervals, the interval within which the true population parameter is expected to fall 95% of the time from repeated surveys with the same design.

OUTREACH AND PEER EDUCATOR CONTACT

Across all sites, close to two-thirds of PWID who had ever tested for HIV (range: 63.0%–65.0%) and who had ever heard of PrEP (range: 65.5%–68.5%) had spoken with a peer educator or outreach worker about HIV. In contrast, a minority of PWID who had never tested for HIV (range: 24.2%–31.2%) and only around half of PWID who had never heard of PrEP (range: 44.0%–55.5%) had spoken with a peer educator or outreach worker about HIV.

CONCLUSIONS

- The prevalence of HIV among all PWID was highest in Ndola (21.3%), compared to Livingstone (12.2%), and Lusaka (7.3%).
- Although small sample sizes limit the reliability of the 95-95-95 target estimation, findings suggest both successes and gaps in the progress towards the global targets.
  - ◊ The percentage of PWID living with HIV who were aware of their HIV status was less than 95% across the three sites (Livingstone:73.8%; Lusaka: 65.6%; Ndola: 61.9%).
  - ◊ Among PWID living with HIV who were aware of their HIV status, ART coverage was highest in Livingstone (100%) and Ndola (100%), compared to Lusaka (82.4%). These estimates should be interpreted with caution due to small denominators.
  - ◊ Among PWID living with HIV and on ART, the prevalence of viral load suppression was highest in Livingstone (100.0%), followed by Ndola (84.3%) and Lusaka (73.5%). These estimates should be interpreted with caution due to small denominators.
- Active syphilis prevalence was highest among PWID in Ndola (10.8%) compared to Livingstone (3.7%) and Lusaka (4.2%).
- The prevalence of HBV was lowest among PWID in Livingstone (1.9%) compared to Lusaka (4.5%) and Ndola (2.6%).
- Among HIV-negative PWID who had ever heard of PrEP, a minority had ever taken PrEP (range: 14.1%–23.3%).
- The majority of PWID in Livingstone (57.3%) and Ndola (67.2%) had shared needles in the last six months, compared to 29.0% in Lusaka.

REFERENCES

[1] Population Council, *Key Populations Formative Findings. Final Power Point*. 2016.
[2] SurveyCTO. Retrieved from https://www.surveycto.com. Accessed 1 October 2022.
[3] WHO, et al., *Biobehavioral survey guidelines for Populations at Risk for HIV*. Geneva: World Health Organization. 2017.
[4] Fellows, IE. Epi Apps. Retrieved from https://epiapps.com. Accessed 1 April 2022.
[5] ZamStat. *2021 Adjusted District Population Estimates.* 2021.
[6] UNAIDS. *2025 AIDS Targets*. Retrieved from https://aidstargets2025.unaids.org/#section-targets. Accessed 1 August 2022.

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