Published in final edited form as:

AIDS Behav. 2015 February ; 19(Suppl 1): S36–S45. doi:10.1007/s10461-014-0929-2.

HIV Prevalence and Risk Behaviors Among People Who Inject drugs in Two Serial Cross-Sectional Respondent-Driven Sampling Surveys, Zanzibar 2007 and 2012

Eva Matiko,
Division of Global HIV/AIDS, US Centers for Disease Control and Prevention, CDC Tanzania, c/o US Embassy, 686 Old Bagamoyo Road, PO Box 9123, Dar Es Salaam, Tanzaniag

Ahmed Khatib,
Zanzibar AIDS Control Program, Ministry of Health, Zanzibar, Tanzania, ahmedbenga@yahoo.com

Farhat Khalid,
Zanzibar AIDS Control Program, Ministry of Health, Zanzibar, Tanzania, farhat_jowhar@yahoo.com

Susie Welty,
Global Health Sciences, University of California, San Francisco, CA, USA, swelty@psg.ucsf.edu

Christen Said,
Global Health Sciences, University of California, San Francisco, CA, USA, cmullen@psg.ucsf.edu

Ameir Ali,
Zanzibar AIDS Control Program, Ministry of Health, Zanzibar, Tanzania, ameirali@yahoo.co.uk

Asha Othman,
Zanzibar AIDS Control Program, Ministry of Health, Zanzibar, Tanzania, ashaahmed26@yahoo.com

Shaaban Haji,
Zanzibar AIDS Control Program, Ministry of Health, Zanzibar, Tanzania, jechah3@yahoo.com

Mary Kibona,
Division of Global HIV/AIDS, US Centers for Disease Control and Prevention, CDC Tanzania, c/o US Embassy, 686 Old Bagamoyo Road, PO Box 9123, Dar Es Salaam, Tanzania, iys8@cdc.gov

Evelyn Kim,
Division of Global HIV/AIDS, US Centers for Disease Control and Prevention, Atlanta, GA, USA, gvh5@cdc.gov

Dita Broz, and
Division of Global HIV/AIDS, US Centers for Disease Control and Prevention, Atlanta, GA, USA, iga4@cdc.gov

iyt9@cdc.gov.

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

Mohammed Dahoma
Directorate of Preventive Services and Health Education, Ministry of Health, Zanzibar, Tanzania, mjudahoma@yahoo.com

Abstract

People who inject drugs (PWID) are at higher risk of acquiring HIV due to risky injection and sexual practices. We measured HIV prevalence and behaviors related to acquisition and transmission risk at two time points (2007 and 2012) in Zanzibar, Tanzania. We conducted two rounds of behavioral and biological surveillance among PWID using respondent-driven sampling, recruiting 499 and 408 PWID, respectively. Through faceto-face interviews, we collected information on demographics as well as sexual and injection practices. We obtained blood samples for biological testing. We analyzed data using RDSAT and exported weights into STATA for multivariate analysis. HIV prevalence among sampled PWID in Zanzibar was 16.0 % in 2007 and 11.3 % in 2012; 73.2 % had injected drugs for 7 years or more in 2007, while in the 2012 sample this proportion was 36.9 %. In 2007, 53.6 % reported having shared a needle in the past month, while in the 2012 sample, 29.1 % reported having done so. While 13.3 % of PWID in 2007 reported having been tested for HIV infection and received results in the past year, this proportion was 38.0 % in 2012. Duration of injection drug use for 5 years or more was associated with higher odds of HIV infection in both samples. HIV prevalence and indicators of risk and preventive behaviors among PWID in Zanzibar were generally more favorable in 2012 compared to 2007—a period marked by the scale-up of prevention programs focusing on PWID. While encouraging, causal interpretation needs to be cautious and consider possible sample differences in these two cross-sectional surveys. HIV prevalence and related risk behaviors persist at levels warranting sustained and enhanced efforts of primary prevention and harm reduction.

Keywords

HIV; Tanzania; Sexual behavior; Injection drug use; Respondent-driven sampling

Introduction

People who inject drugs (PWID) are at increased risk of HIV infection through unsafe sexual and injection behaviors. It is estimated that there are 16 million PWID worldwide, of whom 3 million are infected with HIV [1]. In 2005, injection drug use was demonstrated in 23 sub-Saharan Africa countries, and HIV infection was reported in PWID in 5 of these countries [2]. Some data suggest that heroin is the most common illicit drug used by PWID in sub-Saharan Africa [3]. Although data on HIV prevalence and risk among PWID in sub-Saharan Africa remain limited, published findings confirm that sharing needles and unprotected sex are common practices among African PWID and are associated with high prevalence of HIV infection [4–6].

Located along the drug trafficking routes from Asian heroin-producing countries to East Africa, Zanzibar has experienced an increase in local heroin consumption and injection drug use in recent years [7]. The first cases of HIV infection among PWID in Zanzibar were documented in 2005 in a convenience sample of people who used drugs [8]. In this study,

PWID had higher HIV prevalence (26.2 %) compared to people who used drugs through non-injecting methods (4.1 %) [8]. High-risk behaviors were also reported, including sharing of needles, the practice of ‘‘flashblood’’ (injecting blood from someone who had injected drugs [9]), multiple sexual partners, and unprotected sex. Given their elevated HIV prevalence and overlapping drug and sexual risk behaviors, PWID and their non-injecting partners are disproportionately affected by HIV in Zanzibar [10], where the general population prevalence of HIV is 1 % [11].

To better inform HIV prevention and care programs for PWID in Zanzibar and to estimate the burden of disease, the Zanzibar AIDS Control Program (ZACP), the Ministry of Health, and its academic and non-governmental partners conducted 2 rounds of integrated behavioral and biological surveillance surveys in 2007 and 2012 using respondent-driven sampling (RDS). Between the 2 rounds of surveillance, a number of interventions addressing sexual and injection HIV risk behaviors among PWID were introduced and scaled up in Zanzibar. The objectives of this analysis are to estimate population-based prevalence of HIV infection and risk behaviors among PWID at 2 time points, 2007 and 2012, and to gauge related risk and preventive behaviors.

Methods

Overall Study Design

We conducted 2 cross-sectional surveys of the prevalence of HIV infection and associated risk behaviors among PWID on the island of Zanzibar in 2007 and in 2012 using RDS. We used a standardized protocol across both time periods.

Setting

Zanzibar Island, also known locally as Unguja, is the main island of the Zanzibar archipelago, a semiautonomous part of the United Republic of Tanzania with an adult population of 793,298. The estimated size of the PWID population in Unguja is 3,000 [12].

Eligibility

We recruited PWID between August and September in 2007 and between March and May in 2012 using RDS. In both surveys, individuals were eligible to participate if they were aged 15 years and above, had been living in Zanzibar for the past 3 months, had injected illicit drugs in the preceding 3 months and were able to provide informed consent. Participants aged 15–17 years who reported currently living under the direction or auspices of a parent or guardian and were supported by a parent or guardian were not considered liberated minors and were not eligible. We confirmed injection drug use in the past 3 months by assessing participants’ knowledge of injection drug use (i.e., questions determined during the formative assessment) and by observing stigmata of injection (e.g., track marks).

Sampling and Study Procedures

PWID were recruited using RDS, a social network-based recruitment methodology that allows weighted adjustment to produce unbiased representative results for hard to reach populations [13, 14]. Prior to carrying out the studies, we conducted formative assessments

[15] consisting of 1 focus group discussion with active and former PWID and 5 key informant interviews with local authorities and local non-governmental organizations (NGOs) working with PWID. The formative research confirmed (1) RDS was an appropriate sampling method, (2) the acceptability of the study site, (3) the appropriate compensation, (4) the best times for the site to be open to recruits, (5) identification of initial recruits (‘‘seeds’’), (6) strategies to prevent recruitment of persons who were not eligible, and (7) clarity of the language used in the questionnaire.

RDS recruitment began with purposefully selected seeds, whom we asked to recruit 3 PWID within his/her social network. If eligible, these participants were in turn asked to recruit others using a system of coded coupons. This recruitment process continued until we reached the calculated sample size. Equilibrium (i.e., as the sample grows, the composition of the sample does not change) was reached on all key variables of interest such as age, education, gender, income, most frequent drug used, and whether they had sold sex. Trained project staff assessed candidates’ eligibility for enrolment, which included ensuring that the recruits possessed a valid referral coupon from a previous survey participant. The 2007 survey participants received compensation valued at US $3.20 for completing the survey, $1.60 for each successful female recruit referred, and $0.80 for each successful male recruit referred. The increased incentive for females was added a few weeks into the study in order to encourage female PWID to participate; however, very few female PWID participated even with increased incentives. In 2012, all participants received $3.90 for completing the survey and providing a blood specimen and $1.30 for each successful recruit regardless of sex.

Measurements

We collected demographic information and self-reported sexual and injection risk behavior data through face-to-face interviews using a structured questionnaire delivered by gender-matched interviewers at the same location in 2007 and 2012. Study staff drew venous blood from consenting participants and transported whole blood samples in cold boxes daily to the Mnazi Mmoja Hospital laboratory, 500 meters away from the study site. The network size was assessed by asking, ‘‘How many PWID do you know personally (i.e., who are living in Unguja, are aged 15 years and above, you know their name, you know who they are, and they know you)?’’ This was followed by a question asking how many of those they had seen in the past month, so the network size was based on the number they had seen in the past month.

Time from first injection was calculated by subtracting age at first injection from the participant’s current age, and this was assumed to be equivalent to their duration of injection drug use. However, because PWID can transition in and out of injecting, it is possible that this is not a true indication of duration of injection drug use. We explored duration of injection use as less than 5 years since time of first injection or greater than or equal to 5 years since first injection.

Laboratory

We tested serum for HIV antibodies using a serial algorithm in accordance with the national testing guidelines for HIV [16]. We screened all specimens using Determine HIV1/2 test

(Abbott Diagnostic Division, Hoofddorp, The Netherlands) and retested reactive specimens using Unigold (Trinity Biotech, Bray, Ireland). We conducted external quality assessment (EQA) for HIV testing by retesting 10 % of the non-reactive samples and all HIV reactive samples. Retesting was done with the last test used in the field (e.g., for a non-reactive specimen screened only with Determine, the test used was Determine; for a reactive sample screened first with Determine and then with Unigold, the test used was Unigold), followed by enzyme-linked immunosorbent assay (ELISA). All ELISAs were conducted at the National Health Laboratory Quality Assurance and Training Centre, the national reference laboratory in Dar es Salaam, Tanzania.

Data Analysis

We based power and sample size estimates on achieving desired precision around point estimates for HIV infection in PWID. In 2007, we assumed HIV prevalence to be around 30 %, with expected precision of 5 %, a 95 % confidence interval of 25–30 %, and a design effect of 1.5. This gave us a sample size of 490. In 2012, we based the HIV prevalence at 16 %, with a 95 % confidence interval of 11.6–21.6 % leading to a sample size of 407, after correction for an expected design effect of 1.8, based on the literature available at the time of planning the study [17].

We used the Respondent Driven Sampling Analysis Tool (RDSAT) 6.0.1, an open-source software package available at www.respondentdrivensampling.org, to analyze data on prevalence of HIV infection, sexual and drug-related risk behaviors, demographic characteristics, and other variables adjusted for social network sizes and recruitment patterns. We calculated estimators and 95 % confidence intervals for risk factors associated with HIV infection using partition and prevalence analysis. Data from the seeds were also included in the analysis. Additionally, we used RDSAT to produce individualized weights for the dependent variable and exported these to STATA (STATA Corporation, College Station, Texas, USA) for multivariable analysis. To test statistical differences between the 2 samples, we used point estimates and their 95 % confidence intervals to calculate a proxy z-score.

We explored the interaction of multiple factors of HIV infection in the 2 studies using logistic regression modeling for each study independently. We selected variables that were associated with HIV infection in bivariate analysis at the level of $p < 0.2$. We then used backwards stepwise regression to find the best fit model as the one that included variables associated with HIV at or near the $p < 0.05$ level.

Ethical Considerations

Prior to enrolling in the survey, eligible participants received an explanation of the survey and were asked to provide written informed consent if they wished to participate in the survey. Only consenting participants were enrolled. Adolescents aged 15–17 years whose circumstances allowed them to consent for themselves were considered liberated minors and eligible for this study. A liberated minor was defined as one not currently living under the direction or auspices of a parent or guardian and not otherwise supported by a parent or guardian. We did not collect any identifying information apart from the written informed

consent forms, which were stored separately from all other study information. The study received approvals from the Zanzibar Medical Research Ethical Committee; the Committee on Human Research of the University of California, San Francisco; and non-research determination from the Office of the Associate Director for Science of the U. S. Centers for Disease Control and Prevention.

Results

In 2007, we recruited 7 seeds, and the longest recruitment chain was 14 waves. In 2012, 6 seeds began recruitment initially, and an additional 3 seeds were added in the fourth study week. The longest chain in the 2012 survey was 21 waves. We had 499 and 408 PWID participants in the surveys in 2007 and 2012, respectively. Despite efforts to encourage female participation by planting female seeds, the samples remained predominately male (i.e., 96.9 % in 2007 and 98.5 % in 2012).

Table 1 shows RDSAT-weighted population-based estimates for socio-demographic characteristics, risk behaviors, and HIV prevalence of PWID. In 2007, the median age was 31 years (interquartile range [IQR] 27–37); in 2012, the median age was 32 years (IQR 28–38). In 2007, 8.3 % (95 % CI 5.7–11.6) of PWID earned a monthly income of more than 200,000 Tanzanian shillings (TZS) (~$125 USD) compared to 76.5 % (95 % CI 67.8–83.5) in 2012 ($p < 0.01$). In 2007, about 73 % (73.2 %, 95 % CI 68.6–78.5) of PWID had injected drugs for 7 years or more, while in 2012 this proportion was 36.9 % (95 % CI 31.5–42.5) ($p < 0.01$). In 2007, 53.6 % (95 % CI 47.7–59.0) of PWID reported having shared a needle in the past month, while in 2012, 29.1 % (95 % CI 23.6–36.2) reported needle sharing in the past month ($p < 0.01$). In 2007, 53.1 % (95 % CI 47.5–58.7) of PWID reported ever having shared a needle, while in 2012, 54.8 % (95 % CI 48.5–61.0) reported ever having shared a needle ($p = 0.70$). We found 16.5 % (96 % CI 12.7–20.6) of PWID had received money for sex in 2007, while in 2012 this proportion was 8.4 % (95 % CI 5.3–12.5) ($p < 0.01$). Among those who were paid for sex, 15.3 % (95 % CI 1.8–33.3) reported always using condoms in 2007, while 51.0 % (95 % CI 30.6–71.5) did so in 2012 ($p < 0.01$). Nearly one-third of PWID (32.4 %, 95 % CI 27.2–38.0) in 2007 reported having two or more sexual partners in the past month compared to 20.9 % (95 % CI 16.1–26.5) in 2012 ($p < 0.01$). A total of 13.3 % (95 % CI 9.6–17.3) of PWID in 2007 had been tested for HIV and received results in the past year, while this proportion was 38.0 % (95 % CI 31.2–45.2) in 2012 ($p < 0.01$). In 2007, 16 % of PWID (16.0 %, 95 % CI 11.4–21.2) were HIV-positive and 11.3 % (95 % CI 7.7–15.2) in 2012 ($p = 0.14$).

Weight-adjusted associations between socio-demographic characteristics and risk behaviors and HIV infection in the 2 surveys are listed in Table 2. Among PWID earning TZS 200,000 or more per month, HIV prevalence was 31.5 % (95 % CI 11.1–54.1) in 2007 compared to 9.2 % (95 % CI 6.0–14.6) in 2012 ($p = 0.04$). Of PWID who had tested for HIV in the past year, 20.3 % (95 % CI 0.0–31.4) tested positive in 2007 and 4.6 % (95 % CI 1.9–12.5) in 2012 ($p = 0.06$).

Duration of injection drug use for 5 years or more was associated with 2.5 (95 % CI 1.0–6.3) higher adjusted odds of HIV infection in 2007 and 5.4 (95 % CI 2.5–11.6) higher adjusted

odds of HIV infection in 2012. We found using condoms at last paid sexual encounter was of borderline significance in 2007 (adjusted odds ratio [AOR] 1.9, 95 % CI 1.0–3.5), but it was not an independent predictor of HIV infection in 2012 (Table 3). Ever sharing a needle was associated with HIV infection (AOR 3.4, 95 % CI 1.7–6.9) in 2012, but not in 2007.

Discussion

This study is the first to report estimates for HIV prevalence and related behaviors among PWID in Zanzibar using a rigorous probability-based sampling method. HIV prevalence was 16.0 % in 2007 and 11.3 % in 2012, although this difference was only of borderline significance. Several indicators also provide encouraging news when comparing the results of 2007 to 2012. We found that self-reported receptive needle sharing (i.e., used a needle previously used by someone else) in the past month was lower in 2012 compared to 2007. Moreover, indicators of sexual risk (e.g., reported having 2 or more sexual partners in the past month and never using a condom during paid sex) were also lower in the 2012 sample. A larger proportion of PWID had tested for HIV and received results in the past year in 2012 than in 2007, though we found lower HIV prevalence among those who had tested in the past year in 2012 than in 2007. This may be attributed to increased HIV testing and counseling coverage while the number of those infected with HIV remained relatively the same. Longer time since first injection, which likely reflects a longer cumulative exposure to injection-related risk [18], was highly associated with HIV prevalence. We also noted that personal income increased substantially between 2007 and 2012. This could be either due to inflation between the two rounds or possibly a different subset of the PWID population being sampled in the two rounds, which would help explain some of the other differences noted.

There are some important limitations to this study. The first is the use of RDS as our sampling method. RDS, while widely used for estimating burden of disease in hidden populations at high risk for HIV infection, remains controversial, and the external validity of estimates derived from RDS is not fully known [19, 20]. In addition, the assumptions of RDS are difficult to fulfill and validate. For instance, RDS is conducted under the assumption that the population is networked; if this is violated, the study may oversample or omit subgroups of the population. We cannot rule out the possibility of this having occurred in our sample given the differences we found in education, income, and duration of injection among PWID between 2007 and 2012. Results of a study of PWID comparing 2 rounds of RDS in Seattle suggested that the 2 waves may have accessed very different sub-samples of the population [21].

Also in our study, less than half of the recruitment coupons distributed were brought by recruits to the study site. Also, recruitment stalled during the second round, necessitating deployment of additional seeds. We were unable to recruit females even in 2007 when a higher incentive was offered, despite the network sizes of male and female PWID being almost the same in both 2007 and 2012. A differential incentive may lead to a violation of the RDS assumption that participants recruit randomly from their networks. However, this strategy did not result in the recruitment of more women and therefore it did not affect our

ability to calculate unbiased estimates. Other studies have found similar challenges recruiting female PWID [22].

In addition, the questionnaires differed slightly from 2007 to 2012. Specifically, the 2007 questionnaire did not ask about ever sharing a needle, and the 2012 questionnaire included a module on access to services that had been rolled out by ZACP after the 2007 survey. RDS surveys are cross-sectional studies with the inherent limitations of being unable to establish temporality of associations. Therefore, we acknowledge uncertainties in interpreting the data as causally demonstrating the impact of prevention scale-up for PWID over the 5 year period. Differences in the samples, fidelity to protocol, and the role of chance or external factors need to be carefully considered.

Nonetheless, several factors bolster confidence that the differences in indicators between the 2 rounds may in part be related to increased prevention efforts specifically scaled up for PWID in Zanzibar. First is the consistency of multiple risk and prevention indicators showing improvement. Second, age, sex, and other key characteristics of the samples were comparable in the 2 survey waves. Third, the intervening period was characterized by the scale-up of programs that specifically targeted sexual risk, clean needle use, and HIV testing for PWID. Thus, findings of our surveys coincide temporally, in the specific targets, and in magnitude with the program response in Zanzibar.

Consecutive rounds of surveys help us to understand whether services were accessed and if they impacted risk behaviors in the target population. The Ministry of Health of Zanzibar, through the ZACP and in collaboration with development partners and local agencies, has been spear-heading interventions to address these behaviors. Interventions include targeted information and communication through trained peer educators and health care providers, mobile HIV testing and counseling outreach, condom promotion, screening and referral for sexually transmitted infections and tuberculosis, harm reduction through distribution of hypochlorite disinfection kits, and peer-supported residential drug addiction recovery initiatives known as sober houses. While we did not directly measure exposure to these programs and were unable to ascribe causal associations, we did find an increase in HIV testing, a decrease in self-reported needle sharing in the past month, and decreases in risky sexual behaviors such as number of partners and condom use during paid sex between the two rounds. The successful scale-up of services to PWID may be contributing to a decrease in transmission and may partially explain the slight decline of HIV prevalence across these two rounds of surveillance. We suggest continued efforts to provide biological and behavioral prevention interventions to this vulnerable population and to provide them access to diagnostic and clinical care services to encourage testing and treatment. ZACP will open a Medication-Assisted Treatment (MAT) center in 2014.

Conclusions

In conclusion, we found encouraging differences in HIV prevalence and related risk and preventive behaviors among PWID in Zanzibar, coincident with new public health intervention programs targeting this population. We want to emphasize the importance of conducting behavioral surveillance surveys among PWID in Zanzibar, in order to effectively

monitor HIV prevalence in this highly vulnerable population and to provide information to guide effective prevention programs. We recommend detailed qualitative work to give context to findings and help offset the limitations we found. Future surveys should include questions regarding antiretroviral therapy and measures of community viral load to fully characterize the course of the HIV epidemic among PWID in Zanzibar and to identify sub-groups of PWID that are most at risk.

Acknowledgments

We thank the numerous members of the research design and data collection team as well as the men and women who participated in this study. This research has been supported by the President's Emergency Plan for AIDS Relief (PEPFAR) through the Centers for Disease Control and Prevention (CDC) under the terms of cooperative agreement 5UGPS002039-02. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the CDC.

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AIDS Behav. Author manuscript; available in PMC 2019 March 14.

Table 1

HIV prevalence, socio-demographic characteristics, and risk behaviors among PWID in Zanzibar, 2007 and 2012

	2007 n = 499		2012 n = 408		*p* value[≠]
	Crude N	%[a] [95 % CI]	Crude N	%[a] [95 % CI]	
Age (years)					
15–19	5	0.7 [0.1–1.5]	1	3.0 [0.0–10.0]	0.38
20–24	62	14.3 [10.1–18.3]	38	11.0 [7.1–15.7]	0.28
25–29	130	28.6 [23.8–34.1]	100	28.9 [22.7–35.5]	0.94
30–34	126	24.0 [19.0–29.1]	103	23.9 [18.8–30.4]	0.98
≥35	176	32.4 [27.0–38.0]	166	35.8 [28.9–41.7]	0.42
Median age in years (IQR)	31 years (IQR 27–37)		32 years (IQR 28–38)		
Range, years	Min. 15–Max. 66		Min. 18–Max. 54		
Sex					
Male	483	96.9 [94.2–98.7]	401	98.5 [97.6–99.8]	0.22
Female	16	3.1 [1.3–5.8]	7	1.5 [2.0–2.4]	0.16
Education					
No education (years)	6	1.1 [0.1–2.6]	14	3.2 [1.2–5.9]	0.12
2–7	147	34.1 [28.3–40.4]	211	55.7 [50.3–62.5]	0.00
8–10	188	38.2 [32.2–43.9]	179	39.2 [32.3–44.8]	0.82
>11	149	26.6 [21.5–31.8]	4	1.8 [0.2–3.9]	0.00
Personal income in last 30 days TZS					
<50,000	68	22.4 [17.2–28.9]	1	0.6 [0.0–2.0]	<0.01
50,000–120,000	170	47.4 [40.1–54.2]	17	12.4 [7.1–18.3]	<0.01
120,001–200,000	103	21.9 [16.8–26.9]	18	10.6 [6.1–16.7]	0.02
≥200,001	44	8.3 [5.7–11.6]	187	76.5 [67.8–83.5]	<0.01
Median income	100,000 TZS (IQR 50,000–180,000)		450,000 TZS (IQR 300,000–600,000)		
	Min. 6,000–Max. 600,000		Min. 3,500–Max. 12,000,000		
Duration of injection drug use					
3 years or less	31	7.2 [4.3–10.2]	167	48.0 [41.7–53.8]	<0.01
4–6 years	85	19.6 [14.9–24.0]	76	15.1 [11.9–19.0]	0.12

	2007		2012		*p* value ≠
	n = 499		n = 408		
	Crude N	%[a] [95 % CI]	Crude N	%[a] [95 % CI]	
7 years or more	381	73.2 [68.6–78.5]	165	36.9 [31.5–42.5]	<0.01
Median duration	10 Years (IQR 7–15)		5 years (IQR 2–9)		
Median age at first injection	20 years (IQR 17–25)		26 years (IQR 21–30)		
	Min. 8–Max. 50		Min. 12–Max. 51		
Ever shared a needle	260	53.1 [47.5–58.7]	224	54.8 [48.5–61.0]	0.70
Receptively shared needles, past month	252	53.6 [47.7–59.0]	122	29.1 [23.6–36.2]	<0.01
Injected flashblood, past month	22	3.3 [1.5–6.0]	19	4.8 [2.4–7.6]	0.40
Condom use at last sex with a non-paying partner among those who had a non-paying partner	93	17.5 [13.3–21.9]	68	14.4 [10.2–18.2]	0.85
Number of non-paid partners in past month among those who had a non-paid partner					
1 partner	108	60.9 [49.5–73.7]	117	86.4 [74.6–92.7]	<0.01
2 or more partners	104	39.1 [26.3–50.5]	29	13.6 [7.3–25.4]	<0.01
Median number of past month non-paid sex partners	1 partner (IQR 1–2) Min. 1–Max. 8		1 partner (IQR 1–1) Min. 1–Max. 5		
Frequency of condom use with non-paid partners in past month among those who had a non-paid partner					
Always	18	9.6 [3.3–22.7]	23	15.9 [8.3–23.0]	0.16
Inconsistently	34	18.7 [8.5–25.8]	24	13.1 [7.4–20.3]	0.85
Never	144	71.6 [60.1–82.1]	100	71.0 [62.4–80.0]	0.53
Frequency of condom use with paid partners among those who paid to have sex in past month					
Always	19	15.6 [7.6–26.0]	26	23.0 [5.5–35.3]	0.40
Inconsistently	17	17.7 [7.8–29.4]	24	31.8 [10.8–43.6]	0.16
Never	65	66.7 [53.4–78.4]	42	45.2 [34.2–73.2]	0.06
Received money from a man or woman for sex in past month	96	16.5 [12.7–20.6]	44	8.4 [5.3–12.5]	<0.01
Frequency of condom use with paying sex partners among those					

	2007 n = 499		2012 n = 408		*p* value‡
	Crude N	%[a] [95 % CI]	Crude N	%[a] [95 % CI]	
who received money for sex in the past month					
Always	20	15.3 [1.8–33.3]	17	51.0 [30.6–71.5]	<0.01
Inconsistently	13	11.4 [0.0–18.0]	10	14.6 [3.6–26.6]	0.66
Never	60	73.3 [59.1–93.2]	17	34.4 [18.5–53.2]	0.00
Total number of partners in past month paid and non-paid					
0	246	48.4 [42.3–54.6]	193	47.3 [39.7–54.4]	0.59
1 partner	78	19.2 [14.4–24.3]	117	31.8 [39.7–54.4]	<0.01
2 or more partners	175	32.4 [27.2–38.0]	97	20.9 [16.1–26.5]	<0.01
Ever tested for HIV prior to the survey	120	22.0 [17.5–26.4]	293	68.3 [61.3–74.3]	<0.01
Received an HIV test and results in the past one year among all respondents	72	13.3 [9.6–17.3]	149	38.0 [31.2–45.2]	<0.01
STI symptoms in the past 6 months	91	19.9 [15.3–24.7]	64	16.8 [12.5–21.8]	0.36
HIV Positive	79	16.0 [11.4–21.2]	67	11.3 [7.7–15.2]	0.14

CI confidence interval, IQR interquartile range, TZS Tanzanian shillings

[a]RDSAT weighted

‡ Z test To test statistical differences between the two samples we used point estimates and their 95 % confidence intervals to calculate a proxy z-score

Table 2

HIV prevalence by socio-demographic characteristics and risk behaviors among PWID in Zanzibar, 2007 and 2012

	2007		2012		
	2007 N HIV+	2007 (%) HIV Prevalence[a] [95 % CI]	2012 N HIV+	2012 % HIV Prevalence[a] [95 % CI]	*p* value[b]
Age groups (years)					
15–19	0	0.0 [0.0–0.0]	0	–	–
20–24	9	14.7 [3.7–27.2]	4	6.2 [0.8–14.4]	0.22
25–29	17	9.7 [4.8–23.1]	9	6.7 [2.2–13.3]	0.58
30–34	29	22.4 [14.2–35.6]	19	10.5 [4.9–19.3]	0.08
≥35	24	15.4 [8.3–22.8]	35	16.1 [9.1–21.8]	0.88
Sex					
Male	70	14.1 [9.8–18.7]	65	10.8 [7.6–15.2]	0.26
Female	9	74.0 [36.3–93.1]	2	29.8 [0.0–64.3]	0.04
Education					
No education	1	3.3 [0.0–29.6]	4	21.2 [1.7–58.5]	0.28
2–7 years	36	24.0 [14.8–33.7]	38	11.5 [7.6–16.7]	0.02
8–10 years	26	12.1 [6.7–19.4]	25	10.0 [4.8–15.0]	0.62
>11 years	16	13.0 [5.3–21.4]	0	–	–
Income TZS among those who knew their income					
<50,000	14	20.1 [7.3–33.3]	1	10.9 [0.0–26.6]	0.34
50,000–120,000	27	18.3 [9.6–29.0]	8	11.8 [3.7–22.7]	0.34
120,001–200,000	11	19.9 [7.6–34.1]	15	8.1 [3.2–15.2]	0.12
≥200,001	7	31.5 [11.1–54.1]	39	9.2 [6.0–14.6]	0.04
Duration of injection drug use					
3 years or less	3	5.5 [0.0–13.8]	14	6.3 [2.5–10.1]	0.84
4–6 years	12	16.2 [6.1–28.0]	15	15.6 [7.0–26.9]	0.94
7 years or more	64	16.7 [11.2–22.1]	38	15.9 [9.7–23.2]	0.86
Ever shared a needle	36	8.1 [4.9–12.1]	48	8.7 [6.2–12.1]	.80
Receptively shared needles, past month	43	15.6 [10.1–21.7]	27	14.4 [8.2–24.0]	0.82
Injected flashblood	3	10.4 [0.0–28.1]	4	22.6 [1.7–49.7]	0.38

AIDS Behav. Author manuscript; available in PMC 2019 March 14.

	2007		2012		
	2007 N HIV+	2007 (%) HIV Prevalence[a] [95 % CI]	2012 N HIV+	2012 % HIV Prevalence[a] [95 % CI]	*p* value[b]
Frequency of condom use with non-paid partners in past month among those who had a non-paid partner					
Always	0	0.0 [0.0–0.0]	6	20.6 [2.5–33.1]	–
Inconsistently	4	8.4 [0.7–20.3]	1	not calculable	–
Never	16	12.5 [5.4–21.8]	14	13.4 [6.9–20.8]	0.86
Number of non-paid partners in past month among those who had a non-paid partner					
1 partner	10	11.3 [2.8–15.0]	7	7.5 [1.1–13.7]	0.40
2 or more partners	12	10.9 [1.6–15.9]	38	8.6 [5.2–17.2]	0.62
Frequency of condom use with paid partners among those who paid to have sex in past month					
Always	3	12.9 [0.0–30.2]	1	3.2 [0.0–4.0]	0.22
Inconsistently	4	35.6 [2.2–68.9]	4	18.3 [0.0–38.1]	0.38
Never	10	17.6 [4.7–33.2]	7	18.8 [5.2–30.4]	0.90
Frequency of condom use with paying sex partners among those who received money for sex in the past month					
Always	2	5.8 [0.0–8.4]	3	13.1 [0.0–31.0]	0.38
Inconsistently	4	18.7 [0.0–50.0]	1	0 [0.0–0.0]	–
Never	5	11.0 [0.0–44.6]	0	0 [0.0–0.0]	–
Total number of partners in past month, paid and non-paid					
None	46	19.5 [12.3–27.0]	41	12.0 [7.3–17.7]	0.10
1 partner	9	13.0 [3.9–24.3]	13	8.7 [3.3–13.0]	0.46
2 or more partners	24	13.9 [7.5–22.5]	13	13.1 [5.8–22.9]	0.90
Ever had an HIV test	18	16.0 [7.0–25.7]	47	11.2 [6.9–15.5]	0.36
Tested for HIV in past 1 year	10	20.3 [0.0–31.4]	19	4.6 [1.9–12.5]	0.06
STI Symptom in past 6 months	23	22.4 [12.4–36.7]	13	15.4 [7.1–27.5]	0.38

CI confidence interval, TZS tanzanian shillings

[a] RDSAT weighted

[b] Z test: To test statistical differences between the two samples we used point estimates and their 95 % confidence intervals to calculate a proxy z-score

Table 3

Multivariable model of factors associated with HIV infection, Zanzibar, Tanzania, 2007 and 2012

	OR[a]	95 % CI	*p* value
2007			
Duration injecting drugs >5 years	1.00	1.00	1.00
Duration injecting drugs ≤5 years	2.46	0.96–6.32	0.06
No condom at last sex with paid partner	1.00	1.00	1.00
Used a condom at last sex with paid partner	1.92	1.04–3.54	0.04
2012			
Duration injecting drugs >5 years	1.00	1.00	1.00
Duration injecting drugs ≤5 years	5.43	2.53–11.64	<0.01
Never shared a needle	1.00	1.00	1.00
Shared a needle	3.37	1.65–6.89	<0.01

CI confidence interval, *OR* odds ratio

[a]OR adjusted odds ratio are adjusted for variables in the table, the adjustments are for the 2007 and 2012 samples independently