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Progress toward the 90-90-90 HIV targets in Zimbabwe and identifying those left behind

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Abstract

Objective: We present findings from the nationally representative Zimbabwe Population-based HIV Impact Assessment (ZIMPHIA) that characterize Zimbabwe's progress toward the Joint United Nations Programme on HIV/AIDS 90-90-90 targets.

Design: We conducted a cross-sectional household survey.

Methods: Consenting adults and children in the household were eligible to participate in ZIMPHIA (October 2015–August 2016). Participants completed face-to-face interviews and provided blood for HIV, CD4, viral load, and syphilis testing. VLS was defined as HIV RNA <1,000 copies/mL. HIV-positive specimens were tested for the presence of selected antiretroviral drugs. Data were weighted. Analysis was restricted to HIV-positive adults aged 15–64 years.

Results: We enrolled 11,098 men and 14,033 women aged 15–64 years. HIV prevalence was 14.1%. Of those living with HIV, 76.8% (95% confidence interval [CI]: 74.9–78.7) were aware of their HIV status or had detectable antiretroviral levels. Of these, 88.4% (95% CI: 87.1–89.7)

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were receiving ART, and of these people, 85.3% (95% CI: 83.4–87.1) had VLS. Male sex age 15–34 years and having one or more sexual partners were associated with being unaware of one's HIV-positive status. Age <50 years and not taking cotrimoxazole were associated with being less likely to be being both aware and taking ART. Male sex, age <50 years, and taking cotrimoxazole were associated with being on ART but not having VLS.

Conclusions: Zimbabwe has made great strides toward epidemic control. Focusing resources on case finding, particularly among men, people aged <35 years, and sexually active individuals can help Zimbabwe attain 90-90-90 targets.

Keywords

Zimbabwe; 90-90-90; awareness; treatment coverage; viral suppression

INTRODUCTION

In 2014, the Joint United National Programme on HIV and AIDS (UNAIDS) introduced the 90-90-90 targets to help end the global HIV epidemic¹. These targets, which refer to the HIV care continuum, call for 90% of people living with HIV (PLHIV) to know their status; of these, 90% are receiving antiretroviral therapy (ART); and of these, 90% have viral load suppression (VLS) by 2020. Once achieved, these percentages must be sustained for 10 years to decrease the annual number of new HIV infections and AIDS-related deaths by 90% and 80%, respectively¹. The targets serve as both a call to action and a roadmap to end the AIDS public health crisis.

With 1.3 million PLHIV and an adult (age 15–64) HIV prevalence of 12.7% in 2018, Zimbabwe is one of the countries most deeply affected by the HIV epidemic². Meeting the 90-90-90 targets for epidemic control is a national priority, exemplified by the government of Zimbabwe's commitment to the HIV response and the adoption in 2016 of the test and start policy for HIV treatment^{3,4}. Accordingly, in partnership with global partners including the U.S. President's Emergency Plan for AIDS Relief, HIV treatment and prevention activities have been scaled up rapidly in the last decade. Programmatic data from public health facilities suggest that both the number of HIV tests performed and the coverage of HIV treatment have increased steadily over the last 10 years with 2.8 million tests performed and 1.1 million people receiving ART as of 2017⁵.

However, health facility data are insufficient to quantify progress toward the 90-90-90 targets because they do not include PLHIV who are not engaged with the health system⁶. Without knowing the total denominator of people at each step of the cascade, it is impossible to estimate progress toward the 90-90-90 targets. Furthermore, developing programs to reach those currently not accessing HIV services requires identifying factors associated with being unaware of HIV status, not receiving ART, or not having VLS.

Several analyses have explored factors associated with HIV testing in Zimbabwe using data from the Demographic and Health Surveys (DHS); however, because these analyses lack general population data on the second and third targets, they cannot identify factors associated with receiving ART and/or having VLS^{7,8}. Other analyses use a combination

of DHS and program data to model data relevant to the 90-90-90 targets and unreached populations^{9,10}.

Tafuma et al. used qualitative methods to identify several barriers to HIV service utilization in two provinces of Zimbabwe: health system-related barriers, such as user fees and wait times, and community factors, such as stigma, counterproductive religious messaging, and food insecurity¹¹. They note that men are inadequately engaged in HIV services. The authors also captured participants' concern that some patients may discontinue treatment once symptoms improve, suggesting a potential gap in services.

To our knowledge, no previous studies have directly estimated progress toward the 90-90-90 targets and the factors associated with each of the targets at a nationally representative level in Zimbabwe. This is most likely because representative population-level data on both the numerator and denominator for each pillar of the 90-90-90 targets have not previously been available. The Zimbabwe Population-based HIV Impact Assessment (ZIMPHIA; October 2015–August 2016) was the first nationally representative household survey to measure the indicators required to benchmark Zimbabwe's progress toward the 90-90-90 goals and characterize the population that still needs to be reached. We analyzed ZIMPHIA data to identify the sociodemographic and biological correlates of meeting each of the 90-90-90 targets.

METHODS

Sampling

ZIMPHIA used a two-stage stratified cluster sampling design to select participants. In the first stage, 499 enumeration areas (EA) were selected from 10 strata using the 2012 Zimbabwe Population Census with probability proportional to size. In the second stage, an average of 30 households (range, 15–60) were randomly selected with equal probability from each EA. The sample of households was selected to provide representative provincial estimates of VLS among PLHIV aged 15–64 years with 95% confidence intervals (CI) \pm 0.068. The target sample size was 21,257 men and women aged 15 years selected from 15,000 households.

Eligibility

The heads of selected households were asked to provide written informed consent to participate in a household interview and list household members. Individuals living in the household and visitors who slept there the night before the survey were eligible to participate in the survey if they were aged 16 years or were a 15-year-old emancipated minor and provided written informed consent in English, Shona, or Ndebele. Non-emancipated minors who were similarly staying in the household were required to provide written assent in one of the three languages and obtain written permission from a parent or guardian. Consent was obtained electronically on tablet computers for participation in a face-to-face interview. Following the interview, consent was obtained for blood collection and biomarker testing.

Survey procedures

Participants were interviewed by a trained interviewer using an electronic questionnaire programmed in Open Data Kit. Interview domains included demographics, alcohol use, sexual behaviors, HIV knowledge and attitudes, reproductive health, and uptake of HIV services. After the interview, participants provided written informed consent for biomarker testing. Consenting participants received HIV pre-test counseling according to national guidelines before staff collected 14 mL of venous blood for testing. HIV testing was conducted in the household according to the national serial algorithm of Determine (Alere, Waltham, MA), First Response (Premier Medical Corporation, Maharashtra, India), and Stat-Pak (Chembio, Medford, NY). The DPP Syphilis Screen & Confirm Assay (Chembio, Medford, NY) was used to test for syphilis. HIV and syphilis results were provided the same day to participants. Individuals testing HIV-positive also received same-day CD4 testing and results using the Pima Analyzer and CD4 test (Alere, Waltham, MA). Additionally, a random sample of 5% of HIV-negative participants also received CD4 measurement to mask HIV status from household members.

HIV viral load quantification was conducted at a central laboratory using the COBAS AmpliPrep/COBAS TaqMan System (CAP/CTM) platform and the COBAS AmpliPrep/COBAS TaqMan HIV-1 Test, version 2.0 assay (Indianapolis, IN) using primarily plasma samples. In cases where plasma was not available, dried blood spots (DBS) were tested using a validated protocol. Viral load results were returned to the participant's health facility where they could be accessed using the participant's study ID. Participants were notified by SMS when their results were available.

HIV-positive DBS specimens also were tested for the presence of antiretroviral medicines, and qualitative screening for detectable concentrations of antiretrovirals (limit of detection of 20 ng/mL) was conducted on all HIV-positive adult and child samples by means of high-resolution liquid chromatography coupled with tandem mass spectrometry. The method used for antiretroviral drug detection was a modified version of the methodology described by Koal et al. and was carried out by the Division of Clinical Pharmacology of the Department of Medicine at the University of Cape Town in South Africa¹². Three antiretroviral medicines were selected as markers for the most commonly prescribed first- and second-line regimens: efavirenz, nevirapine, and lopinavir. These medicines also were selected based on their relatively long half-lives, allowing for a longer period of detection following intake.

Survey staff were trained to identify and refer all sexually exploited persons younger than 18 years to partner organizations experienced in providing counseling, health, social, and other protective services to these populations.

Data analysis

We restricted this analysis to PLHIV aged 15–64 years. The primary endpoints of interest were the proportion of those with HIV who were unaware of their status, the proportion of those diagnosed who were not receiving ART, and the proportion of those receiving ART who did not have VLS (defined as $> 1,000$ copies/mL). Self-reported awareness of HIV status and ART status were modified based on results of testing for the presence of

antiretroviral medicines. Individuals were considered aware of their HIV status if they self-reported having an HIV diagnosis, having tested positive for the presence of antiretroviral medicines, or had VLS. Individuals were considered aware and receiving ART if they self-reported receiving ART, tested positive for the presence of antiretroviral medicines, or had VLS.

Data were weighted for survey methods and non-response. We used jackknife replication to estimate variance, and analysis was conducted in SAS (version 9.4; Cary, NC). Variables associated with being outside the 90-90-90 cascade on bivariate analysis at $p < 0.1$ were included in the multivariate model.

Ethical approval

This survey was approved by the Institutional Review Boards (IRB) of the Research Council of Zimbabwe, the Medical Research Council of Zimbabwe (A/1914), WESTAT (IRB# 6317), Columbia University Medical Center (IRB# 6882), and the US Centers for Disease Control and Prevention (CDC; IRB# Y06M00).

Role of the funding source

ZIMPHIA was a PEPFAR initiative. The US Office of the Global AIDS Coordinator and CDC shaped the objectives of our survey. CDC investigators contributed to designing the survey, monitoring data collection, conducting data analysis, and writing this manuscript for publication.

RESULTS

We included data from 11,098 men and 14,033 women aged 15–64 years from 15,009 sampled households. Of these, 83.5% and 94.2% consented to and completed an interview, respectively. Of those who completed an interview, 90.6% of men and 92.2% of women consented to HIV testing. HIV prevalence was estimated at 14.1% and 1,153 men and 2,230 women tested positive for HIV (Table 1). Of those living with HIV, 76.8% (95% CI: 74.9–78.7, $n=2,699$) were aware of their HIV status (Figure 1). Among those aware of their status, 88.4% (95% CI: 87.1–89.7, $n=2,407$) were receiving ART, and of these people, 85.3% (95% CI: 83.4–87.1, $n=2,085$) had VLS. Overall, 42.1% of PLHIV did not have VLS. Geometric mean viral load was 362 (95% CI: 311–422). Among all adults in Zimbabwe, regardless of HIV status, 5.9% (95% CI: 5.5–6.4) have VL $\geq 1,000$ copies/mL.

The first 90: Awareness of HIV-positive status

A higher proportion of HIV-positive women were aware of their status (80.1%) than men (72.1%; Table 1). Awareness of HIV-positive status was lowest among those aged 15–24 years (60.3%). In contrast, 70.0% of PLHIV aged 25–34 years and 82.8% of PLHIV aged 35–49 years were aware of their HIV-positive status. Awareness of HIV-positive status did not differ by urban or rural residence or wealth quintile. In terms of sexual behavior, 82.1% of those who had not had sex in the last 12 months were aware of their HIV-positive status compared to 66.3% of those who had ≥ 2 partners.

More women who gave birth in the last 12 months (89.7%) were aware of their HIV-positive status than those who had not (77.9%). Similarly, a higher proportion of people who had been diagnosed with a sexually transmitted disease (STD) in the last 12 months were aware of their HIV-positive status (89.5%) than those who had not (76.4%). Awareness was higher among those with CD4 \geq 500 (84.4%) than those with CD4 of 200–499 (74.3%) or $<$ 200 (70.0%).

Among people who were unaware of their HIV-positive status, 37.0% had seen a healthcare provider in the last 12 months, and of them, 47.6% were offered an HIV test (Table 2). People who have never tested for HIV (41.7%) or last tested $>$ 2 years ago (35.9%) accounted for three-quarters of those unaware of their HIV status.

On multivariable analysis, those least likely to be aware of their HIV-positive status included men (adjusted odds ratio [aOR], 0.6 [95% confidence interval (CI): 0.5–0.8]) and those aged 15–24 years (aOR, 0.2 [95% CI: 0.2–0.4]) or 25–34 years (aOR, 0.5 [95% CI: 0.4–0.8]) compared to individuals aged 50–64 years (Table 3). People with one (aOR, 0.7 [95% CI: 0.5–0.9]) or 2 sexual partners (aOR, 0.5 [95% CI: 0.3–0.7]) in the last 12 months were less likely to know their HIV status than those who had no sexual partners.

The second 90: Aware of HIV-positive status and receiving ART

Among people who were aware of their HIV-positive status, ART status was similar across sex, age, urban or rural residence, and wealth quintiles (Table 1). More individuals who did not have an STD diagnosis in the last 12 months (88.7%) were receiving ART than those who had an STD (76.9%).

Nearly three-quarters (73.1%) of people who were aware of their HIV-positive status but were not on ART were diagnosed $>$ 1 year ago (Table 2). Approximately one-third (33.6%) of those aware but not receiving ART had not received HIV care, and 14.9% had stopped ART. Main reasons for never taking ART included not being eligible (44.4%) and not being prescribed ART (26.9%). Half (53.7%) of those not on ART were receiving cotrimoxazole, while 34.7% of those who were not receiving cotrimoxazole had not been prescribed it.

On bivariate analysis, the odds of receiving ART were higher among women who had not been forced to have sex than among those who had (OR, 2.3 [95% CI: 1.1–4.6]; Table 3). On multivariable analysis, those who were aware of their HIV-positive status and younger than 50–64 years were least likely to be receiving ART. Compared to people aged 50–64 years, the adjusted odds of receiving ART among those who were aware of their HIV-positive status was 0.2 (95% CI: 0.1–0.4) for those aged 15–24 years, 0.2 (95% CI: 0.1–0.4) for those aged 35–34 years, and 0.3 (95% CI: 0.2–0.6) for those aged 35–49 years. People who were not taking cotrimoxazole were 70% less likely to be receiving ART than those taking cotrimoxazole (aOR, 0.3 [95% CI: 0.2–0.5]).

The third 90: Receiving ART and having VLS

Among those receiving ART, VLS was similar across sex, age, urban or rural residence, and wealth quintiles. Among women who gave birth in the last 12 months and were receiving ART, 84.8% had VLS. Though not statistically significant, a smaller proportion of those

with an STD diagnosis in the last 12 months (76.4%) had VLS than those who did not have an STD (85.9%).

On multivariable analysis, among those receiving ART, men (aOR, 0.7 [95% CI: 0.5–0.9]) were less likely than women to have VLS. Compared to people aged 50–64 years, the adjusted odds of having VLS were lower for those aged 15–24 years (aOR, 0.4 [95% CI: 0.2–0.7]), those aged 25–34 years (aOR, 0.3 [95% CI: 0.2–0.5]), and those aged 35–49 years (aOR, 0.4 [95% CI: 0.3–0.6]). People who were not taking cotrimoxazole were more likely to have VLS than those who were (aOR, 1.7 [95% CI: 1.1–2.5]).

DISCUSSION

ZIMPHIA was the first nationally representative survey conducted to estimate progress toward the UNAIDS 90-90-90 targets. Our findings reveal that Zimbabwe has the potential to achieve the 90-90-90 targets by the end of 2020. With 76.8% of PLHIV aware of their HIV status and 88.4% of them receiving ART in 2016, our findings are consistent with the hypothesis that retention may be better than anticipated in many countries, allowing HIV service providers to prioritize case-finding efforts¹³. On the basis of the estimated number of PLHIV in Zimbabwe in 2015, we estimate that 282,000 people in Zimbabwe were unaware of their HIV-positive status, 390,000 people were not receiving ART, and 512,000 people did not have VLS¹⁴.

We found that men and adults younger than 35 years were most likely to be unaware of their HIV-positive status. These populations are also the least likely to access healthcare services where they may be reached by provider-initiated testing and counseling services. Case-finding strategies that extend beyond health facilities could increase awareness of HIV-positive status among these populations¹⁵. These strategies also can support HIV diagnosis among people with a higher CD4 count. Strategies are also needed to identify the larger share of PLHIV who are unaware of their HIV status and have CD4 < 500 cells/ μ L.

Service integration including mother-to-child transmission prevention and provider-initiated HIV testing and counseling help increase HIV case finding^{16–18}. Our findings suggest the same may be true in Zimbabwe as women who gave birth >12 months ago were more likely to be unaware of their HIV-positive status than those who gave birth in the last year. Similarly, awareness was lower among people who did not have an STD diagnosis in the last 12 months than those who had an STD. Better risk screening, including the use of screening tools that do not indicate the client's HIV risk behaviors to the provider but inform the client that they should undergo HIV testing, could help identify individuals who may not otherwise receive testing services in the health facility.

People who had sex in the last 12 months were less likely to be aware of their HIV-positive status than those who had not, possibly indicating that people change their sexual behaviors upon learning they have HIV^{19–21}. The larger number of sexual partners among people who were unaware of their HIV-positive status reflects a higher transmission potential. As people with no sexual partners theoretically have no transmission potential, diagnosing them would facilitate reaching 90-90-90 targets but may have a limited impact on epidemic control^{22,23}.

Case-finding efforts including index testing may have more impact if they prioritize people with the most sexual partners in a defined period.

Although men were more likely than women to be unaware of their HIV-positive status, ART initiation did not differ by sex, reflecting improvements in Zimbabwe's ART program. A retrospective analysis of ART retention among people who were initiated on ART (2007–2009) found that the adjusted hazards ratio (aHR) for attrition risk was greater for men than women (aHR, 1.2 [95% CI: 1.1–1.4])²⁴. A similar analysis of those initiated on ART from 2012–2015 did not find sex to be a predictor of retention¹⁶ but found age 15–24 years (compared to age ≥25 years) to be a negative predictor (aHR, 0.6 [95% CI: 0.5–0.9]) of retention. We found the odds of receiving ART were lower for all age groups compared to those aged 50–64 years, reflecting the importance of disaggregating data to the finest level possible.

Though decentralizing ART to primary health clinics and male involvement in mother-to-child transmission prevention programs may have helped increase ART uptake among men, we found gender differences in VLS among those receiving ART^{16,25}. Men receiving ART were less likely than women to have VLS. Compared to those aged 50–64 years, younger age groups were also less likely to have VLS. This may be because those in the oldest age group have been receiving ART the longest and consequently had the most time to find the most appropriate regimen. This interpretation is borne out in a recent meta-analysis that found no difference in the relative risk (RR) of VLS between those aged ≥50 years and those aged 13–49 years at 6, 12, and 24 months after ART initiation but found a small increase in the RR of VLS among those aged ≥50 years 36 months after initiation (RR, 1.04 [95% CI: 1.01–1.08])²⁶.

Taken together, the treatment as prevention trials highlighted the need for earlier diagnosis and rapid linkage to treatment²⁷. Our findings reveal the importance of focusing on earlier diagnosis in Zimbabwe. Where TasP/ANRS 12249 revealed the challenges of ART initiation and retention in rural Africa, we found no difference in ART status or viral suppression by urban or rural residence²⁸. Efforts to initiate treatment appear to be effective as approximately 90% of PLHIV with CD4 > 200 copies/μL were on ART and had achieved viral suppression. Zimbabwe's transition to test and start could further improve ART coverage and achievement of viral suppression.

One strength of our study was including self-reported HIV-positive status, self-reported ART status, and antiretroviral biomarkers to inform 90-90-90 results. Although we were unable to test for all antiretroviral medicines used in Zimbabwe, testing accounted for antiretroviral medicines used by >90% of PLHIV receiving ART.

Our study has several limitations. Our results are limited by the cross-sectional nature of ZIMPHIA, the self-reported nature of data collected through face-to-face interviews, and our inability to collect reliable data for all key populations. We were also unable to determine if participants with known HIV-positive status but who were not prescribed ART were not prescribed it because they were ineligible at their last clinic visit or for another reason. Together with those who were ineligible, this group comprised 71.3% of people

not receiving ART. Because Zimbabwe broadened ART eligibility criteria to include all HIV-positive individuals by adopting the *Test and Start* policy just after ZIMPHIA, ART coverage has likely increased since our survey was conducted. Finally, we did not include CD4 in our models because we did not know CD4 at diagnosis for participants with a previous HIV diagnosis.

Additionally, viral load was measured for all PLHIV, regardless of ART duration. VLS correlates were assessed on this broader population, and some people may have newly initiated ART and not had adequate time for VLS. We expect this to have had a minimal effect on findings.

Our findings reveal awareness of HIV-positive status is a critical gap in Zimbabwe's HIV response. Furthermore, with one in seven PLHIV having CD4<200, late diagnosis remains a problem. Reaching people who are not aware of their HIV-positive status requires innovative testing strategies, such as index testing, outside health facilities. However, case finding will become more difficult as awareness of HIV status increases among PLHIV. Characterizing those who are outside the 90-90-90 cascade (i.e., people who are not aware of their HIV-positive status, those not receiving ART, those who do not have VLS) will remain essential for targeting interventions to these groups.

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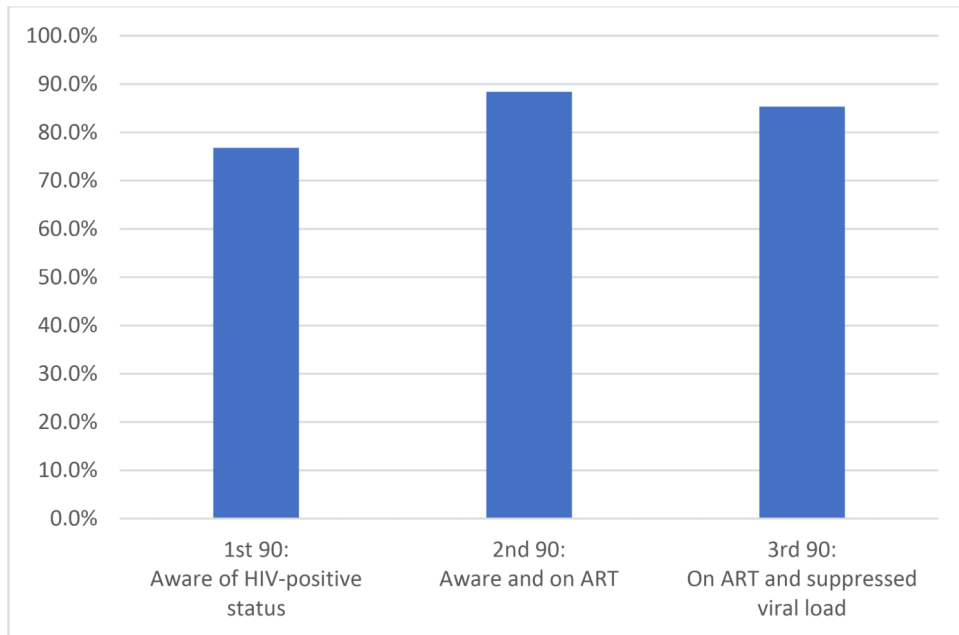


Figure 1: Zimbabwe's achievements toward 90-90-90 targets

*1st and 2nd 90s are based on self-report or detection of the presence of antiretroviral drugs.

Table 1.

Background characteristics of HIV-positive adults aged 15–64 years in Zimbabwe, 2015–2016

Characteristic	HIV Positive (N=3,383)	Aware of HIV-positive status (N=2,699)	Aware and on ART (N=2,407)	On ART and have suppressed viral load (N=2,085)
	n (%)	n (%; 95% CI)	n (%; 95% CI)	n (%; 95% CI)
Total	3383	2699 (76.8; 74.9–78.7)	2407 (88.4; 87.1–89.7)	2085 (85.3; 83.4–87.1)
Sex				
Male	1153 (40.4)	866 (72.1; 68.9–75.3)	770 (88.0; 85.5–90.5)	647 (82.5; 79.1–85.8)
Female	2230 (59.6)	1833 (80.1; 78.1–82.0)	1637 (88.6; 87.0–90.3)	1438 (87.0; 85.1–88.8)
Age, years				
15–24	345 (11.5)	210 (60.3; 54.2–66.4)	185 (86.9; 81.5–92.4)	150 (82.4; 76.4–88.5)
25–34	849 (27.3)	627 (70.0; 66.6–73.4)	521 (82.1; 79.0–85.3)	432 (81.5; 77.3–85.6)
35–49	1535 (45.3)	1304 (82.8; 80.5–85.2)	1164 (89.0; 87.2–90.7)	1005 (84.8; 81.9–87.6)
50–64	654 (16.0)	558 (83.4; 79.8–87.0)	537 (96.7; 94.9–98.4)	498 (92.6; 90.1–95.1)
Residence				
Urban	1049 (36.8)	819 (74.9; 71.2–78.6)	719 (87.4; 85.3–89.4)	629 (85.6; 82.2–89.1)
Rural	2334 (63.2)	1880 (78.0; 75.9–80.0)	1688 (89.0; 87.3–90.7)	1456 (85.1; 83.0–87.2)
Highest level of education completed				
No education	116 (2.8)	94 (80.4; 72.6–88.2)	89 (94.7; 89.8–99.6)	79 (89.2; 82.3–96.0)
Primary	1285 (34.1)	1065 (79.9; 77.3–82.6)	958 (89.8; 87.7–91.9)	828 (84.3; 81.2–87.3)
Secondary	1857 (58.5)	1446 (75.4; 72.9–78.0)	1275 (87.3; 85.6–89.0)	1106 (85.8; 83.6–88.1)
<Secondary	124 (4.5)	93 (69.2; 57.5–80.9)	84 (87.8; 77.4–98.2)	72 (83.7; 73.6–93.8)
Marital status				
Never married	342 (10.7)	244 (69.0; 63.4–74.6)	224 (90.7; 86.3–95.2)	186 (80.9; 74.9–86.9)
Married or living together	2008 (61.3)	1597 (76.3; 73.7–78.8)	1413 (87.8; 86.2–89.5)	1218 (84.7; 82.2–87.2)
Divorced or separated	435 (12.7)	337 (74.7; 69.8–79.6)	289 (85.4; 81.1–89.7)	247 (85.3; 80.5–90.0)
Widowed	591 (15.4)	515 (86.2; 83.0–89.4)	476 (91.5; 88.8–94.2)	430 (89.7; 86.7–92.7)
Lives together with partner				
Yes	1636 (69.8)	1312 (77.6; 74.9–80.2)	1163 (88.4; 86.5–90.2)	1005 (85.1; 82.5–87.8)
No	690 (30.2)	507 (69.7; 65.0–74.4)	429 (83.3; 79.4–87.1)	366 (84.0; 79.8–88.1)
Religious affiliation				
Protestant	535 (15.5)	451 (83.5; 79.7–87.4)	409 (89.6; 86.4–92.9)	357 (87.0; 83.1–90.9)
Roman Catholic	243 (7.6)	206 (81.6; 75.7–87.4)	185 (89.1; 84.0–94.3)	163 (86.4; 80.1–92.6)
Pentecostal	634 (19.2)	516 (77.8; 73.3–82.2)	463 (89.2; 85.7–92.8)	397 (82.8; 78.2–87.5)
Apostolic sect	1104 (32.1)	877 (76.9; 73.8–80.0)	776 (88.1; 85.7–90.6)	672 (85.6; 82.6–88.6)
Other	410 (10.8)	313 (73.6; 68.0–79.2)	284 (90.0; 86.1–93.9)	246 (84.8; 79.7–90.0)
None	455 (14.8)	336 (68.8; 63.6–74.0)	290 (84.7; 80.1–89.2)	250 (85.6; 80.9–90.3)
Worked in the last 12 months				
Yes	1257 (39.2)	954 (73.3; 70.2–76.4)	833 (86.9; 84.5–89.3)	720 (85.1; 82.1–88.1)

Characteristic	HIV Positive (N=3,383)	Aware of HIV-positive status (N=2,699)	Aware and on ART (N=2,407)	On ART and have suppressed viral load (N=2,085)
	n (%)	n (%; 95% CI)	n (%; 95% CI)	n (%; 95% CI)
No	2125 (60.8)	1744 (79.1; 77.0–81.2)	1573 (89.3; 87.7–91.0)	1364 (85.3; 83.1–87.6)
Wealth quintile				
Lowest	843 (20.4)	690 (79.4; 75.9–82.9)	623 (89.7; 86.9–92.6)	535 (83.9; 80.3–87.5)
Second	679 (18.5)	540 (76.9; 73.2–80.6)	497 (90.8; 87.8–93.8)	431 (86.3; 82.9–89.7)
Middle	624 (19.0)	496 (77.4; 73.2–81.6)	434 (87.3; 84.1–90.4)	370 (83.7; 79.4–88.0)
Fourth	627 (22.3)	491 (74.5; 69.7–79.4)	434 (88.1; 85.0–91.1)	377 (85.6; 81.4–89.8)
Highest	610 (19.7)	482 (76.2; 71.6–80.8)	419 (86.2; 83.1–89.4)	372 (87.0; 83.3–90.6)
Been away from home in the last 12 months				
Yes	508 (15.8)	402 (75.9; 70.9–80.8)	350 (86.8; 82.6–91.0)	302 (84.4; 79.8–89.0)
No	2796 (84.7)	2235 (77.1; 75.2–79.0)	2008 (88.9; 87.5–90.4)	1743 (85.5; 83.5–87.5)
Comprehensive knowledge of HIV				
Yes	840 (51.2)	697 (79.8; 76.6–83.0)	632 (90.5; 87.8–93.3)	554 (86.8; 83.6–89.9)
No	844 (48.8)	654 (75.0; 71.3–78.7)	572 (86.4; 83.2–89.6)	484 (83.5; 79.5–87.4)
Number of sexual partners in the past 12 months				
0	940 (27.9)	787 (82.1; 79.3–84.8)	726 (91.1; 88.8–93.4)	636 (86.2; 83.1–89.3)
1	2046 (62.1)	1621 (76.6; 74.2–78.9)	1430 (87.8; 86.0–89.5)	1237 (85.3; 83.0–87.7)
2	277 (10.0)	195 (66.3; 59.5–73.1)	159 (80.8; 74.7–86.9)	133 (81.5; 74.1–89.0)
Gave birth in last 12 months *				
Yes	156 (23.4)	142 (89.7; 83.9–95.4)	133 (92.7; 87.3–98.0)	112 (85.3; 78.5–92.1)
No	502 (76.6)	404 (77.9; 73.6–82.3)	358 (88.2; 84.9–91.5)	305 (84.0; 79.6–88.3)
Gave birth in last 3 years *				
Yes	484 (74.2)	409 (82.4; 78.1–86.7)	376 (91.4; 88.1–94.6)	321 (84.8; 80.6–89.0)
No	174 (25.8)	137 (75.8; 68.4–83.2)	115 (83.1; 77.2–89.0)	96 (82.7; 74.6–90.8)
Been forced to have sex *				
Yes	84 (5.1)	70 (83.1; 74.2–92.0)	57 (79.0; 67.8–90.3)	53 (92.5; 85.2–99.9)
No	1517 (94.9)	1243 (79.8; 77.4–82.1)	1120 (89.6; 87.7–91.5)	982 (86.6; 84.5–88.7)
STD diagnosis in last 12 months				
Yes	156 (5.1)	142 (89.5; 83.3–95.7)	108 (76.9; 69.0–84.9)	85 (76.4; 67.5–85.4)
No	3010 (94.9)	2386 (76.4; 74.3–78.4)	2136 (88.7; 87.3–90.1)	1862 (85.9; 84.1–87.7)
CD4 count				
<200	521 (17.0)	369 (70.0; 65.5–74.6)	303 (82.4; 78.1–86.7)	158 (51.5; 44.8–58.3)
200–499	1732 (51.0)	1354 (74.3; 71.9–76.8)	1208 (88.2; 86.2–90.2)	1069 (87.6; 85.5–89.8)
500	1127 (32.0)	973 (84.4; 81.5–87.2)	894 (91.5; 89.4–93.5)	858 (95.7; 94.1–97.3)
Taking cotrimoxazole				
Yes	1883 (76.2)		1753 (93.1; 91.7–94.4)	1510 (84.9; 82.7–87.0)

Characteristic	HIV Positive (N=3,383)	Aware of HIV-positive status (N=2,699)	Aware and on ART (N=2,407)	On ART and have suppressed viral load (N=2,085)
	n (%)	n (%; 95% CI)	n (%; 95% CI)	n (%; 95% CI)
No	615 (23.8)		514 (80.8; 77.4–84.3)	466 (90.3; 87.2–93.4)

* Includes women only

Abbreviations: ART, antiretroviral therapy; CI, confidence interval; STD, sexually transmitted disease.

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Table 2.

Engagement with health services

Variable	n (%)	% (95% CI)
Unaware of HIV status		
Saw a doctor or nurse in a health facility in the last 12 months		
Yes	252 (36.8)	37.0 (32.6–41.4)
No	432 (63.2)	63.0 (58.6–67.4)
Among those receiving health services, offered an HIV test during any of these visits		
Yes	122 (48.4)	47.6 (40.9–54.3)
No	130 (51.6)	52.4 (45.7–59.1)
Time since last HIV test		
Never tested	231 (41.4)	41.7 (36.8–46.7)
<6 months	23 (4.1)	4.6 (2.6–6.6)
6–12 months	34 (6.1)	5.9 (3.9–8.0)
1–2 years	67 (12.0)	11.8 (8.9–14.7)
>2 years	203 (36.4)	35.9 (31.5–40.3)
Reason never tested for HIV		
Don't know where to test	2 (0.3)	0.3 (0.0–0.8)
Cost	13 (1.9)	
Too far away	9 (1.3)	1.2 (0.3–2.0)
Afraid others will know about the result	14 (2.0)	2.3 (0.9–3.6)
Don't need to test/low risk	56 (8.2)	8.3 (5.8–10.8)
Family reasons	7 (1.0)	
Don't want to know I have HIV	17 (2.5)	3.0 (1.6–4.4)
Cannot get treatment for HIV	--	--
Test kits not available	2 (0.3)	0.2 (0.0–0.6)
Religious reasons	2 (0.3)	0.3 (0.0–0.8)
Other	121 (17.7)	17.1 (14.0–20.2)
Aware and not on treatment:		
Time since HIV+ diagnosis		
<6 months	31 (13.4)	13.8 (8.6–19.0)
6–12 months	31 (13.4)	13.1 (8.3–17.9)
>1 year	170 (73.3)	73.1 (66.1–80.2)
Received HIV care		
Yes	198 (67.8)	66.4 (60.3–72.4)
No	94 (32.2)	33.6 (27.6–39.7)
Ever taken ART		
Yes	32 (13.8)	14.9 (9.7–20.2)
No	200 (86.2)	85.1 (79.8–90.3)
Main reason never took ART		

Variable	n (%)	% (95% CI)
Not eligible	92 (46.9)	44.4 (36.3–52.4)
Not prescribed	51 (26.0)	26.9 (21.0–32.9)
Other	53 (27.0)	28.7 (21.3–36.2)
Taking cotrimoxazole		
Yes	130 (56.3)	53.7 (46.1–61.4)
No	101 (43.7)	46.3 (38.6–53.9)
Reason not taking cotrimoxazole		
Was not prescribed	34 (33.7)	34.7 (24.6–44.8)
I have trouble taking a tablet everyday	--	--
I had side effects/rash	9 (8.9)	8.0 (2.5–13.5)
Facility too far away for me to get cotrimoxazole regularly	1 (1.0)	1.0 (0.0–2.9)
Do not need it/not sick	11 (10.9)	11.6 (3.9–19.4)
Cost of medications	4 (4.0)	5.7 (0.0–12.2)
Cost of transport	1 (1.0)	0.9 (0.0–2.9)
Doctor said no longer needed	9 (8.9)	7.8 (2.2–13.4)
Other	32 (31.7)	30.3 (21.1–39.4)

Abbreviations: CI, confidence interval; ART, antiretroviral therapy.

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Table 3:

Correlates of awareness of HIV-positive status, aware and on ART, and on ART with suppressed VL

Variable	Correlates of awareness of HIV-positive status			Correlates of being aware of HIV status and on ART			Correlates of being on ART and having suppressed viral load			
	OR (95% CI)	p-value	aOR (95% CI)	OR (95% CI)	p-value	aOR (95% CI)	OR (95% CI)	p-value	aOR (95% CI)	p-value
Sex		<0.0001			0.6950			0.0113		0.0115
Male	0.6 (0.5–0.8)		0.6 (0.5–0.8)	0.9 (0.7–1.3)			0.7 (0.5–0.9)		0.7 (0.5–0.9)	
Female	Ref		Ref	ref			ref			
Age (years)		<0.0001			<0.0001			0.0005		0.0004
15–24	0.3 (0.2–0.4)		0.2 (0.2–0.4)	0.2 (0.1–0.5)		0.2 (0.1–0.4)	0.4 (0.2–0.6)		0.4 (0.2–0.7)	
25–34	0.5 (0.3–0.6)		0.5 (0.3–0.7)	0.2 (0.1–0.3)		0.2 (0.1–0.4)	0.4 (0.2–0.6)		0.3 (0.2–0.5)	
35–49	1.0 (0.7–1.3)		1.1 (0.8–1.5)	0.3 (0.2–0.5)		0.3 (0.2–0.6)	0.4 (0.3–0.7)		0.4 (0.3–0.6)	
50–64	Ref		Ref	Ref		Ref	Ref		Ref	
Residence		0.1380			0.2212			0.7822		
Urban	Ref			Ref			1.0 (0.7–1.3)			
Rural	1.2 (0.9–1.5)			1.2 (0.9–1.5)				0.6144		
Highest level of education completed		0.0408			0.1101					
No education	Ref		Ref	Ref			Ref			
Primary	1.0 (0.6–1.6)		1.7 (1.0–2.9)	0.5 (0.2–1.3)			0.7 (0.3–1.4)			
Secondary	0.8 (0.5–1.2)		1.5 (0.8–2.6)	0.4 (0.1–1.0)			0.7 (0.4–1.5)			
>Secondary	0.5 (0.3–1.1)		1.1 (0.5–2.2)	0.4 (0.1–1.7)			0.6 (0.2–1.8)			
Marital status		0.0001			0.0555			0.0387		0.8815
Never married	Ref		Ref	Ref		Ref	Ref		Ref	
Married or living together	1.4 (1.1–1.9)		0.9 (0.6–1.4)	0.7 (0.4–1.3)		0.6 (0.3–1.2)	1.3 (0.9–2.0)		0.9 (0.5–1.7)	

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Variable	Correlates of awareness of HIV-positive status			Correlates of being aware of HIV status and on ART			Correlates of being on ART and having suppressed viral load		
	OR (95% CI)	p-value	aOR (95% CI)	OR (95% CI)	p-value	aOR (95% CI)	OR (95% CI)	p-value	aOR (95% CI)
Divorced or separated	1.3 (0.9–1.9)		0.7 (0.5–1.1)	0.6 (0.3–1.1)		0.5 (0.2–1.1)	1.4 (0.8–2.3)		0.8 (0.4–1.6)
Widowed	2.8 (1.9–4.2)		0.9 (0.5–1.6)	1.1 (0.6–2.0)		0.6 (0.2–1.3)	2.1 (1.3–3.4)		1.0 (0.5–2.0)
Worked in the last 12 months		0.0020			0.1056			0.9030	
Yes	Ref		Ref	Ref		Ref	Ref		
No	1.4 (1.1–1.7)		1.2 (1.0–1.4)	1.3 (0.9–1.7)		1.2 (0.8–1.6)	1.0 (0.8–1.4)		
Wealth quintile		0.5193			0.2187				
Lowest	Ref			Ref			Ref	0.6156	
Second	0.9 (0.6–1.2)			1.1 (0.7–1.8)			1.2 (0.8–1.7)		
Middle	0.9 (0.6–1.2)			0.8 (0.5–1.2)			1.0 (0.7–1.5)		
Fourth	0.8 (0.5–1.1)			0.8 (0.6–1.3)			1.1 (0.7–1.7)		
Highest	0.8 (0.6–1.2)			0.7 (0.5–1.1)			1.3 (0.8–1.9)		
Been away from home in the last 12 months		0.5982			0.3089			0.6363	
Yes	Ref			Ref			Ref		
No	1.1 (0.8–1.4)			1.2 (0.8–1.8)			1.1 (0.7–1.6)		
Number of sexual partners in the past 12 months		0.0002			0.0032			0.4483	
0	Ref		Ref	Ref		Ref	Ref		
1	0.7 (0.6–0.9)		0.7 (0.5–0.9)	0.7 (0.5–1.0)		1.0 (0.6–1.5)	0.9 (0.7–1.3)		
2	0.4 (0.3–0.6)		0.5 (0.3–0.7)	0.4 (0.3–0.7)		0.8 (0.4–1.5)	0.7 (0.4–1.2)		
Gave birth in last 12 months*		0.0072			0.1902			0.7420	
Yes	Ref			Ref			Ref		
No	0.4 (0.2–0.8)			0.6 (0.3–1.3)			0.9 (0.5–1.7)		
Gave birth in last 3 years*		0.1081			0.0122			0.6330	
Yes	Ref			Ref			Ref		

Variable	Correlates of awareness of HIV-positive status			Correlates of being aware of HIV status and on ART			Correlates of being on ART and having suppressed viral load			
	OR (95% CI)	p-value	aOR (95% CI)	OR (95% CI)	p-value	aOR (95% CI)	OR (95% CI)	p-value	aOR (95% CI)	p-value
No	0.7 (0.4–1.1)			0.5 (0.3–0.8)			0.9 (0.4–1.7)			
Been forced to have sex*		0.4936			0.0218			0.2809		
Yes	Ref			Ref			Ref			
No	0.8 (0.4–1.5)			2.3 (1.1–4.6)			0.5 (0.2–1.8)			
STD diagnosis in last 12 months		0.0085			0.0012			0.0165		
Yes	Ref			Ref			Ref			
No	0.4 (0.2–0.8)			2.4 (1.5–3.8)			1.9 (1.1–3.1)			
Taking cotrimoxazole					<.0001			0.0180		0.0124
Yes				Ref		Ref	Ref		Ref	
No				0.3 (0.2–0.4)		0.3 (0.2–0.5)	1.6 (1.1–2.5)		1.7 (1.1–2.5)	

Abbreviations: aOR, adjusted odds ratio; CI, confidence intervals; ART, antiretroviral therapy; OR, odds ratio; STD, sexually transmitted disease.