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Disparities in HIV/STI burden and care coverage among men and transgender persons who have sex with men in Nairobi, Kenya: a cross-sectional study

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ABSTRACT

Objectives The study aimed to estimate the prevalence of, and associations, with HIV and metrics of HIV care engagement in a representative population of gay, bisexual and other men who have sex with men (GBMSM) and transgender persons (TP) who have sex with men (GBMSM/TP)

Setting Urban districts of Nairobi, Kenya.

Design Cross-sectional.

Participants 608 eligible participants were identified through respondent-driven sampling over 19 waves of recruitment arising from ten seeds between May and December 2017. Inclusion criteria were: age >18 years; Nairobi residence; male sex assignment at birth or current identification as male, and recent consensual sex with male partners. Exclusion criteria were: missing or invalid recruitment coupon; repeat registration; intoxication at study visit.

Primary and secondary outcome measures HIV status measured using Determine Alere HIV 1/2 and First Response HIV 1–2.0 and GeneXpert HIV-1 Qual. Self-reported metrics of HIV status awareness, antiretroviral use and objective quantification of viral suppression using GeneXpert HIV-1 VL.

Results 26.4% (286/618) were HIV positive of whom 76.6% were status aware, 65.3% were on antiretroviral therapy (ART), and 47.4% were virally suppressed (<50 copies/mL). Participants 18–22 years were less likely to be status aware, be receiving ART or to have achieved viral suppression. Mean log viral load was 3.14 log higher in 18–22 years compared with older participants. Bacterial sexually transmitted infections were common at both urethral and rectal sites and most infections were asymptomatic by self-report (rectal 82.2%, urethral 82.3%).

Conclusions Engagement in the HIV diagnosis and care cascade among GBMSM/TP in Nairobi is markedly better than in most sub-Saharan African countries, yet falls short of achievements for the general population in Kenya and for GBMSM in high income settings. Young GBMSM/TP are least well served by the current configuration of adult key population services, and programmes should identify and address the sexual, social and developmental needs of adolescent and young key populations.

Strengths and limitations of this study

- ► Population representative estimates of HIV prevalence and HIV care cascade for this key population in Nairobi, employing methods to avoid sampling biases common for marginalised group research.
- ► Comprehensive array of HIV and sexually transmitted infection diagnostics able to highlight the prevalence of both infections undetectable by standard Kenyan national guidelines.
- ► Inclusion criteria limited to adults eighteen and over, precluding insights into HIV risk and care engagement in younger adolescents.
- ► HIV status awareness and care engagement measures may not be accurately reporting in self-completed surveys, despite known benefits of computer-assisted methods to reduce social disability bias.
- ► Cross-sectional surveys cannot infer direction of causation where this is not implicit.

BACKGROUND

Gay, bisexual and other men who have sex with men (GBMSM) and transgender persons (TP) bear disproportionate burdens of HIV risk and HIV infection around the world,[1–3] including in generalised epidemic settings in sub-Saharan Africa.[4 5] Structural and cultural obstacles, including criminalisation, institutional homophobia and societal antipathy towards these groups continue to challenge efforts to provide equitable access to effective HIV prevention and treatment, particularly in sub-Saharan Africa.[6] International agencies highlight the harmful consequences of unequal access to prevention and treatment on members of these populations and to efforts to curb national HIV epidemics.[7] Yet despite clear targets for increasing status awareness and antiretroviral therapy (ART) uptake among key populations,[8] very few sub-Saharan African countries conduct

surveillance to monitor the effectiveness and coverage of treatment programmes for these populations.[9 10]

Kenya has a declining generalised epidemic with an adult prevalence estimated at 4.9% in 2018, comprehensive national prevention and treatment responses including oral pre-exposure prophylaxis (PrEP), post-exposure prophylaxis, voluntary male circumcision, test and treat, and broad availability of viral load testing to support HIV care.[11] The Kenya Population-based HIV Impact Assessment study demonstrated the progress toward achievement of UNAIDS 90-90-90 targets in a national survey of the general population[12]: in 2018, 79.5% of adult persons living with HIV/AIDS (PLWH) (15–49 years) were aware of their HIV status, of whom 90.6% were receiving ART, of whom 90.9% (or 72% of all PLWH) were virally suppressed.[12] HIV surveillance is less comprehensive for GBMSM and TP in Kenya, despite a decade of research indicating high levels of need and poor service access. HIV prevalence was 18% among GBMSM/TP in Nairobi in 2010—more than three times that among the general population—and only 34% of those living with HIV were aware of their status.[13] In Eastern Kenya, outcomes of HIV care for GBMSM after treatment initiation, as assessed by virological suppression at 12 months, was just 63%, positively influenced by high coping self-efficacy and negatively influenced by intercourse practices thought to attract stigma.[14]

Kenya's HIV response is inclusive of key populations, including GBMSM and TP and national AIDS control policies include aims to enhance HIV prevention and treatment service for these populations in line with the WHO recommended package of key population interventions.[15 16] This has enabled a mixed model of prevention and care delivery through non-governmental organisations, private providers and state clinics largely concentrated in major cities. While diversification of sexual health provision may well have improved cultural competence and accessibility of services for these populations, there are no population representative estimates of the entire HIV diagnosis and care cascade for GBMSM/TP populations to monitor the effectiveness of this service model.

We aimed to (1) update the prevalence of HIV and other sexually-transmitted infections (STIs) in a population representative sample of cisgender male and TP who have sex with men living in Nairobi, (2) describe the HIV care cascade and viral load among GBMSM and TP living with HIV and (3) assess associations with prevalence of both HIV infection and detectable viraemia in this context.

METHODS

Recruitment and sampling

Respondent-driven sampling (RDS) was used to recruit 618 participants between May and December 2017 following established methods.[17] Seed participants were identified to the study by three community organisations who provide services to GBMSM communities in Nairobi (Gay and Lesbian Coalition of Kenya (GALCK), Ishtar MSM and Health Options for Young Men on STI/HIV/AIDS (HOYMAS). Following formative qualitative research, ten seeds were chosen to optimise diversity in age, marital status, gender identity, socioeconomic status and district of residence within Nairobi County.

Each participant was issued two recruitment coupons and instructions on how to recruit further eligible participants from their social networks. Inclusion criteria were: possession of a valid study coupon; age 18 or over; male gender assignment at birth or current identification as a man; residence within 50 km of Nairobi, and consensual anal or oral sexual activity with a man in the previous twelve months. Coupons detailed the location and contact details for the study site but disclosed no information about the purpose of the study. Coupons were uniquely numbered to verify recruiter-recruit links and coupon legitimacy. The opportunity for coupon duplication was reduced by use of non-standard grade watermarked paper, date stamping and limited period of validity after issue. Participants were reimbursed Ksh300 (~US$3) for each recruit they referred to the study who subsequently participated.

Study procedures

Seeds and coupon recipients who satisfied eligibility criteria underwent informed consent procedures with study staff. Recipients were ineligible if they reported coupon receipt from a stranger, coercion to attend or previous participation in the study. Unique identity was established using a commercially available digital fingerprint scanner.

Participant characteristics and behaviour were collected via self-completed SurveyGizmo questionnaire implemented in English and Kiswahili on touch-screen tablets taking approximately 90 min to complete (online supplemental material). The questionnaire covered multiple domains including demographic characteristics; sexual behaviour; alcohol and other substance use; knowledge of HIV transmission risks; use of existing HIV/STI prevention methods; recent anogenital symptoms suggestive of STI; experiences of sexuality-related stigma, discrimination or violence.[18 19] Sex was defined as any occurrence of anal or vaginal intercourse in the reference period. Transactional sex was defined as sex in exchange for money, gifts or favours. Sex against the will of the participant was defined as any episode of being physically forced or coerced into sex when this was unwanted. In addition, the questionnaire included prevalidated measures of alcohol use and dependence.[20] Social network size was elicited from a sequence of questions yielding the number of MSM, over the age of 18 living in Nairobi and met in person in the last 2 weeks.

Participants were offered HIV counselling and rapid testing following Kenyan HIV Testing Services (HTS) guidelines using two commercial rapid diagnostic kits (RDT: Determine Alere HIV 1/2 and First Response HIV

1–2.0).[21] Blood specimens were tested for syphilis (treponemal haemagglutination (TPHA) and rapid plasma reagin (RPR) tests), hepatitis B surface antigen and hepatitis C antibody (Mircrowell ELISA, Bios USA) and qualitative or quantitative HIV-1 PCR conditional on rapid test results (GeneXpert HIV-1 Qual or HIV-1 VL). Urine and rectal swabs were collected and tested for *Neisseria gonorrhoea* (NG) and *Chlamydia trachomatis* (CT) using PCR (GeneXpert CTNG).

HIV care continuum measures were based on Centers for Disease Control guidelines with a viral suppression threshold of <50 copies/mL.[22] Self-reported HIV status awareness and use of ART were collected both by computer-assisted survey and as part of HTS. Measures of linkage to care within 6 months of diagnosis and retention in care over the past 12 months were only elicited in the survey.

PLWHA not reporting receipt of care were referred to government services for initiation of ART. HIV negative participants were referred for PrEP eligibility assessment. Treatment for other STIs was provided free and according to national guidelines. Condoms and water-based lubricants were freely available in the study clinic as was information about sexual risk reduction and other GBMSM/TP-affirming local sexual health services. Participants were compensated Ksh500 (~US$5) for completing study procedures, as approved by the ethics review board.

Patient and public involvement

Patient and public organisations were involved in the design, management and dissemination of the project. The original research protocol was developed and adapted after consultation with a number of community-based organisations representing key populations in Nairobi, including the GALCK, HOYMAS, Ishtar MSM and the Sex Workers Outreach Programme (SWOP). Early in study planning, we submitted draft protocol and instruments for consideration of the G10 committee, a research sub-committee of GALCK. This resulted in the ratification of study objectives from community members and multiple improvements to study instruments. The G10 commended the investigators on the extent of community consultation conducted in preparation for the study, including our evidence of Good Participatory Practice. The G10 acted as the community advisory board for the duration of the study, offering prompt feedback on the experience of participants and wider perceived threats to study procedures or participants, such as election disruptions. Staff from HOYMAS, Ishtar MSM and SWOP were employed in study roles on reception and on social media as service navigators for participants seeking services or support outside the research. At study closure, we presented research findings directly to participants at a public meeting, in person and in writing to the boards of all key population serving organisations in Nairobi, as well as to formal policy-making agencies.

Statistical methods

RDS diagnostics including visualisation of recruitment chains, convergence and seed dependence, and statistical assessment of recruitment homophily were analysed using the *rds* library for R V.3.4.0.[23 24] Crude and sample weighted estimates (RDS-II method and excluding seeds)[23] of the prevalence of sociodemographic and behavioural factors, lab-confirmed and self-reported STIs and HIV cascade measures (for PLWHA only) are presented in accordance with good practice.[25] Given evidence of under-reporting of status awareness and ART use in HTS and surveys alone (see online supplemental material), a composite cascade was derived combining both sources and treating any report of HIV awareness or treatment receipt as a positive response. Age and partner count quintiles among PLWHA were coded and used throughout for consistency Analysis stratified by gender identity has been published previously.[26]

Associations with HIV prevalence in the entire sample, and prevalence of detectable HIV viraemia among PLWHA only, were assessed using robust Poisson regression with a non-clustered sandwich estimator[27] for an unbiased estimate of the prevalence ratio.[28] Multivariable models were specified including sociodemographic (model 1) or full (model 2) covariates associated with outcome at p<0.100. STIs other than HIV were not included as independent covariates in adjusted models given the strong likelihood of dependence on behavioural determinants of HIV risk. Given the bimodal distribution of viral load among PLWHA, comparisons between quantitative VL measures were limited to non-parametric significance testing (Kruskall-Wallis test) and distribution visualisation (Epanechnikov kernels). All analyses of association excluded purposively sampled seeds and were not sample weighted (given both the known risk of bias in applying network weights to multivariate analyses[29] and the correlation of pertinent behavioural measures with social network degree). Less than 5% of covariate measures were missing and were included in models as dummy variables. Analyses were performed in Stata V.16.

All participants provided separate written informed consent to the questionnaire, sample collection and sample storage, and were able to withdraw from any portion of the study.

RESULTS

A total of 761 individuals presented to the study site with the intention of participation. A total of 124 were ineligible due to fake or missing coupons, repeat attendance, intoxication or failure to meet inclusion criteria. Of the 637 individuals with confirmed eligibility, 29 declined participation during consent procedures. Of 608 recruits and 10 seeds completing informed consent, one participant declined blood testing and six declined rectal swabs. Four seeds accounted for 516 (84.9%) recruits. Depth of recruitment ranged from 1 to 19 waves per seed (median 7) (online supplemental material).

Table 1 Sample characteristics

	N	Crude %	RDS % N=608 (95% CI)*
Age in years			
18–22	225/618	36.4	38.2 (33.8 to 42.8)
23–26	169/618	27.4	27.2 (23.4 to 31.5)
27–32	136/618	22.0	20.6 (17.2 to 24.5)
33+	88/618	14.2	14.0 (11.1 to 17.5)
Employment			
Salaried (full or part time)	179/608	29.4	28.1 (24.1 to 32.4)
Self employed	159/608	26.2	27.4 (23.5 to 31.8)
Unemployed	247/608	40.6	41.7 (37.2 to 46.3)
Other	23/608	3.8	2.9 (1.7 to 4.7)
Education			
Primary	111/611	18.2	18.1 (14.8 to 21.9)
Secondary	329/611	53.9	55.0 (50.4 to 59.6)
Higher	171/611	28.0	26.9 (23.0 to 31.1)
Income (Kenya Shillings per month)			
<Ksh5K	224/574	39.0	40.9 (36.2 to 45.7)
Ksh5K to <Ksh10K	166/574	28.9	27.7 (23.6 to 32.1)
Ksh10K+	184/574	32.1	31.5 (27.2 to 36.1)
Country of birth			
Kenya	484/607	79.7	78.8 (74.6 to 82.4)
Other African country	112/607	18.5	19.8 (16.3 to 23.9)
Non-African country	11/607	1.8	1.4 (0.7 to 2.9)
Sexual identity			
Gay/homosexual	448/609	73.6	73.2 (69.0 to 77.2)
Bisexual	143/609	23.5	23.4 (19.7 to 27.6)
Other	18/609	3.0	3.3 (2.0 to 5.6)
Gender identity			
Cisgender male	522/618	84.5	85.0 (81.5 to 88.0)
Transfeminine	70/618	11.3	11.3 (8.7 to 14.5)
Other†	26/618	4.2	3.7 (2.6 to 5.7)
Sexual behaviour—male partners			
Male sexual partners (last 3 months)			
None	74/618	12.0	12.5 (9.7 to 15.9)
1–3	405/618	65.5	72.7 (68.5 to 76.5)
4 or more	139/618	22.5	14.8 (12.1 to 18.0)
Sold sex (last 12 months)	297/613	48.5	43.8 (39.3 to 48.4)
Paid for sex (last 12 months)	177/614	28.8	28.2 (24.2 to 32.6)
Anal intercourse with male partner (last 3 months)			
None	77/618	12.5	13.1 (10.2 to 16.5)
Receptive only	158/618	25.6	24.8 (21.1 to 29.0)
Insertive only	220/618	35.6	37.9 (33.5 to 42.5)
Receptive and insertive	163/618	26.4	24.2 (20.6 to 28.3)

Continued

Table 1 shows the characteristics of enrolled participants. Median age was 24 years (IQR 21–29) with 38.2% between the ages of 18–22 years. Most participants reported having attended postprimary education, however, a high proportion of participants reported being unemployed. A minority of participants reported a birthplace outside of Kenya, predominantly in neighbouring East African countries, in particular Uganda (n=90). Three-quarters of participants self-identified as gay or homosexual, and 15.0% self-identified as non-cisgender (predominantly transfeminine or female). Only 35.3% (30.9%–39.9%, 229/580) reported having been in contact with community-based organisations targeting GBMSM/TP during the previous year.

Participants reported a median of two male sexual partners in the past 3 months (IQR 1–3). Male partner counts were higher among the 44% of participants who reported selling sex to men in the past year (median 3 vs 2 different partners in the last 3 months, Kruskall-Wallis p<0.001). Forty-nine per cent (44.5–53.6) reported receptive anal intercourse in the past 3 months, of whom 54.2% (175/321 47.8–60.5) reported at least one episode that was condomless. 62.1% (57.6–66.5) reported insertive anal sex with male partners over the same period, of whom 44.2% (175/383 38.5–50.0) at least one condomless episode. Over a quarter of participants reported female sexual partners over that period and participants were similarly likely to have sold sex to, or purchased sex from, females. A significant proportion of participants reported experiencing sex against their will in the last 12 months. Among HIV negative participants, 59.2% (237/396 53.4%–64.6%) reported HIV testing within the last 6 months and 4.4% (25/430 2.7%–7.0%) reported current oral PrEP use.

A total of 186 participants tested HIV positive (crude 30.1%, RDS-II 26.4%). Two individuals were positive only on PCR testing, representing 2.1% (2/186, 0.5–8.2%) of PLWHA or 0.76% (2/426, 0.18–0.30%) of participants testing negative by the national RDT algorithm. Five participants had evidence of active syphilis infection, and hepatitis B and C prevalence was low. Laboratory-confirmed rectal STIs were more prevalent than urethral STIs, and rectal NG was the most common site-specific STI. 82.2% confirmed rectal infections (90/106, 72.0–89.3%) and 82.3% confirmed urethral infections (49/60, 68.8–90.8) were asymptomatic on self-report. HIV prevalence was crudely associated with prevalent laboratory-confirmed rectal NG (PR 2.19 (1.72–2.78), p<0.001), rectal CT (PR 1.49 (1.06–2.08), p=0.020) and urethral NG (PR 1.92 (1.34–2.75), p<0.001) and with self-reported symptoms at rectal (PR 2.37 (1.85–3.05), p<0.001) and urethral sites (PR 2.00 (1.49–2.69), p<0.001)

Table 2 shows crude and adjusted variable associations with HIV status. Across models, increasing age was strongly associated with increasing HIV prevalence. In fully adjusted models HIV prevalence rose on average 6.4% per year of age (5.0%–7.9%), p<0.001), from 13% among 18–22 years to 48.9% among those over 32 years

Table 1 Continued

	N	Crude %	RDS % N=608 (95% CI)*
Condomless anal intercourse (last 3 months)			
None	353/618	57.1	58.2 (53.6 to 62.6)
Receptive only	90/618	14.6	14.4 (11.5 to 18.0)
Insertive only	90/618	14.6	14.9 (11.9 to 18.5)
Both	85/618	13.8	12.5 (9.8 to 15.8)
Condomless anal intercourse with male partners (last 3 months)	265/618	42.9	41.8 (37.4 to 46.4)
Sexual behaviour—female partners			
Female sexual partner (last 3 months)	174/618	28.2	28.3 (24.4 to 32.7)
Sold sex to female partner (last 12 months)	58/615	9.4	9.0 (6.7 to 12.1)
Paid for sex with female partner (last 12 months)	67/614	10.9	11.2 (8.6 to 14.6)
Condomless intercourse with female partners (last 3 months)	94/618	15.2	15.9 (12.8 to 19.6)
Sexual violence			
Forced to have sex against will (last 12 months)	87/615	14.1	13.1 (10.3 to 16.5)
Substance use behaviour			
Alcohol use (last 2 weeks)			
Never	261/618	42.2	45.1 (40.6 to 49.7)
Monthly	269/618	43.5	42.5 (38.0 to 47.1)
Weekly	88/618	14.2	12.4 (9.8 to 15.7)
Other substance use (3 m)‡	51/618	8.3	8.0 (5.8 to 10.8)
HIV			
HIV-RNA (GeneXpert HIV-1 Qual) only	2/617	0.3	0.6 (0.1 to 2.2)
Rapid test (determine/first response)	184/617	29.8	25.8 (22.1 to 30.0)
Total	186/618	30.1	26.4 (22.6 to 30.6)
Syphilis			
Positive (TPHA+ / RPR >3)	5/614	0.8	1.1 (0.4 to 2.8)
Hepatitis B			
Positive hepatitis B surface antigen (HBsAg)	30/614	4.9	4.4 (2.8 to 6.7)
Hepatitis C			
Positive anti-hepatitis C virus antibody (anti-HCV Ab)	3/614	0.5	0.4 (0.1 to 1.7)
Rectal STIs			
Lab-confirmed rectal *N. gonorrhoeae*	76/611	12.4	13.2 (10.4 to 16.8)
Lab-confirmed rectal *C. trachomatis*	53/611	8.7	8.1 (5.9 to 10.9)
Self-reported rectal STI symptoms	51/609	8.4	8.6 (6.3 to 11.6)
Urethral STIs			
Lab-confirmed urethral *N. gonnorhoeae*	27/614	4.4	4.4 (2.9 to 6.7)
Lab-confirmed urethral *C. trachomatis*	39/614	6.4	7.3 (5.2 to 10.3)
Self-reported urethral STI symptoms	43/601	7.2	6.4 (4.5 to 9.0)

*Seeds dropped and RDS-II weighting.
†'Other' includes transmasculine participants and participants not currently identifying with the terms male, female or transgender.
‡Ecstacy, amphetimines, mephamphetamine, mephedrone, heroin, gamma-hydroxybutyric acid (GHB), rohypnol, cocacine, crack cocaine, benzene, amyl nitrite.
RDS, respondent-driven sampling; STIs, sexually transmitted infections.

of age. Participants reporting a birthplace outside Kenya but within Africa had less than half the HIV prevalence of Kenyan-born participants in all models. Transfeminine participants had a 50% higher prevalence than cisgender GBMSM after adjustment for sociodemographic factors, yet not after adjustment for behavioural factors. In crude analyses, HIV infection was associated with higher male partner counts, selling sex to men and receptive anal intercourse. In adjusted models, recent receptive anal intercourse was also independently associated with HIV, while recent condomless sex with a female partner was inversely associated with HIV prevalence.

Figure 1A shows the composite, RDS-II-adjusted care cascade among participants with HIV infection (see online supplemental material for cascades based on survey and HTS measures only). 97.9% (91.8%–99.5%, RDS-II, n=184) were detected by the HTS regimen, 76.6% (68.2%–83.3%, RDS-II, n=137) reported status awareness and 65.3% (56.6%–73.2%, RDS-II, n=129) reported currently receiving ART. 47.4% (38.9%–56.0%), RDS-II, n=92) of PLWHA were virally supressed (<50 copies/mL). Median viral load was highest among two PCR positive participants with negative rapid tests (6.46 $\log_{10}$

Table 2 Associations with HIV status, GBMSM/TP, Nairobi 2017

			HIV prevalence	HIV prevalence ratio (crude)		HIV prevalence ratio with sociodemographic adjustment (model 1)*		HIV prevalence ratio with full adjustment (model 2)†	
		n/N	Crude % N=618	PR (95% CI)‡	Wald p value	aPR (95% CI)	Wald p value	aPR (95% CI)	Wald p value
Sociodemographic characteristics									
Age (years)	18–22	34/225	15.1	Ref	**<0.0001**	Ref	**<0.0001**	Ref	**<0.0001**
	23–26	54/168	32.1	**2.12 (1.45 to 3.10)**		**2.25 (1.53 to 3.30)**		**2.00 (1.38 to 2.90)**	
	27–32	51/136	37.5	**2.45 (1.68 to 3.59)**		**2.72 (1.83 to 4.03)**		**2.54 (1.72 to 3.75)**	
	33+	47/88	53.4	**3.51 (2.43 to 5.06)**		**3.67 (2.51 to 5.36)**		**3.98 (2.78 to 5.71)**	
Employment	Salaried	70/179	39.1	Ref		Ref		Ref	
	Self employed	45/159	28.3	**0.75 (0.55 to 1.02)**	**0.0679**	**0.73 (0.54 to 0.98)**	**0.0341**	0.80 (0.60 to 1.07)	0.1289
	Unemployed	62/247	25.2	**0.66 (0.50 to 0.88)**	**0.0043**	0.83 (0.63 to 1.10)	0.1911	0.79 (0.61 to 1.02)	0.0730
	Other	6/23	26.1	0.68 (0.33 to 1.38)	0.2849	0.98 (0.53 to 1.81)	0.9874	1.00 (0.57 to 1.77)	0.9927
Education	Primary	42/111	37.8	Ref		Ref		Ref	
	Secondary	94/329	28.6	0.76 (0.56 to 1.02)	0.0669	0.92 (0.69 to 1.23)	0.5731	0.91 (0.70 to 1.19)	0.4972
	Higher	49/171	28.8	0.78 (0.55 to 1.09)	0.1401	0.81 (0.58 to 1.12)	0.1997	0.78 (0.58 to 1.05)	0.0976
Country of birth	Kenya	163/484	33.8	Ref		Ref		Ref	
	Other African country	14/112	12.5	**0.38 (0.23 to 0.63)**	**0.0002**	**0.31 (0.18 to 0.52)**	**<0.0001**	**0.38 (0.23 to 0.63)**	**0.0001**
	Non-African country	4/11	36.4	1.08 (0.49 to 2.39)	0.8458	0.99 (0.47 to 2.10)	0.9874	1.13 (0.54 to 2.38)	0.7455
Sexual identity	Gay/homosexual	140/448	31.3	Ref					
	Bisexual	37/143	25.9	0.82 (0.60 to 1.12)	0.2150	–	–	–	–
	Other	6/18	33.3	1.06 (0.54 to 2.07)	0.8582	–	–	–	–
Gender identity	Cisgender male	151/522	29.0	Ref		Ref		Ref	
	Transfeminine	28/70	40.0	**1.40 (1.02 to 1.93)**	**0.0356**	**1.50 (1.09 to 2.05)**	**0.0115**	1.18 (0.86 to 1.61)	0.4200
	Other§	7/26	26.9	0.93 (0.49 to 1.78)	0.8298	0.92 (0.48 to 1.77)	0.8114	0.75 (0.41 to 1.40)	0.3606
Sexual behaviour—male partners									
Male sexual partners (3 months)	None	7/74	9.5	Ref	**<0.0001**	Ref		Ref	0.4028
	1–3	122/405	30.2	**3.10 (1.51 to 6.38)**		**2.57 (1.30 to 5.09)**	**0.0054**	1.50 (0.75 to 3.01)	
	four or more	57/139	41.0	**4.22 (2.03 to 8.79)**		**3.06 (1.52 to 6.17)**		1.62 (0.79 to 3.34)	
Sold sex to male partner (12 months)	Yes	107/297	36.0	**1.42 (1.11 to 1.82)**	**0.0049**	**1.33 (1.04 to 1.70)**	**0.0228**	1.00 (0.98 to 1.02)	0.8295
	No	78/316	24.8	Ref				Ref	
Paid for sex with male partner (12 months)	Yes	61/177	34.5	1.19 (0.92 to 1.54)	0.1775	1.05 (0.82 to 1.33)	0.7184	–	–
	No	124/437	28.4	Ref					

Continued

Table 2 Continued

			HIV prevalence	HIV prevalence ratio (crude)		HIV prevalence ratio with sociodemographic adjustment (model 1)*		HIV prevalence ratio with full adjustment (model 2)†	
		n/N	Crude % N=618	PR (95% CI)‡	Wald p value	aPR (95% CI)	Wald p value	aPR (95% CI)	Wald p value
Receptive anal intercourse with male partner (3 months)	Yes	139/321	43.4	**2.82 (2.10 to 3.80)**	**<0.0001**	**2.46 (1.84 to 3.28)**	**<0.0001**	**2.16 (1.59 to 2.93)**	**<0.0001**
	No	47/297	15.8	Ref				Ref	
Insertive anal intercourse with male partner (3 months)	Yes	118/383	30.9	1.04 (0.81 to 1.34)	0.7654	1.02 (0.80 to 1.31)	0.8424	–	–
	No	68/235	28.9	Ref					
Condomless anal intercourse (3 months)	Yes	97/265	36.6	**1.40 (1.10 to 1.78)**	**0.0063**	**1.37 (1.08 to 1.73)**	**0.0093**	1.20 (0.94 to 1.52)	0.1454
	No	89/353	25.3	Ref				Ref	
Sexual behaviour—female partners									
Female sexual partner (3 months)	Yes	45/174	25.9	0.83 (0.62 to 1.11)	0.2066	**0.68 (0.51 to 0.89)**	**0.0047**	1.03 (0.72 to 1.47)	0.8826
	No	141/444	31.8	Ref				Ref	
Sold sex to female partner (12 months)	Yes	18/58	31.0	1.03 (0.69 to 1.54)	0.8905	0.92 (0.62 to 1.36)	0.6630	–	–
	No	168/557	30.2	Ref					
Paid for sex with female partner (12 months)	Yes	17/67	25.4	0.84 (0.55 to 1.29)	0.4255	0.69 (0.46 to 1.05)	0.0859	1.00 (0.98 to 1.02)	0.9082
	No	168/547	30.8	Ref				Ref	
Condomless intercourse (3 months)	Yes	22/94	23.4	0.76 (0.52 to 1.13)	0.1743	**0.60 (0.41 to 0.90)**	**0.0085**	**0.56 (0.33 to 0.94)**	**0.0264**
	No	164/524	31.4	Ref				Ref	
Sexual violence									
Forced to have sex against will (12 months)	Yes	26/87	29.9	0.98 (0.70 to 1.39)	0.9281	1.15 (0.83 to 1.58)	0.4034	–	–
	No	160/528	30.4	Ref					
Substance use behaviour									
Alcohol use (current)	Never	87/261	33.3	Ref	0.2800				
	Monthly	77/269	28.7	0.86 (0.67 to 1.12)		0.85 (0.67 to 1.09)	0.1141	–	–
	Weekly	22/88	25.0	0.75 (0.50 to 1.12)		0.69 (0.47 to 1.00)			
Other substance use (3 months)¶	Yes	17/51	33.3	1.09 (0.72 to 1.66)	0.6857	1.22 (0.86 to 1.74)	0.2708	–	–
	No	169/567	29.9	Ref					

Bold values indicate measures of association with p<0.05
*Multiivariable Poisson regression with robust estimation of variance and adjustment for sociodemographic factors (age, education and sexual identity) with seeds excluded.
†Multiivariable Poisson regression with robust estimation of variance and adjustment for tabled sociodemographic and behavioural factors with seeds excluded.
‡Crude bivariable Poisson regression with robust estimation of variance.
§'Other' includes transmasculine participants and participants not currently identifying with the terms male, female or transgender.
¶Ecstacy, amphetimines, mephamphetamine, mephedrone, heroin, gamma-hydroxybutyric acid (GHB), rohypnol, cocacine, crack cocaine, benzene, amyl nitrite.
aPR, adjusted prevalence ratio; GBMSM/TP, gay, bisexual and other men who have sex with men/transgender persons; PR, prevalence ratio.

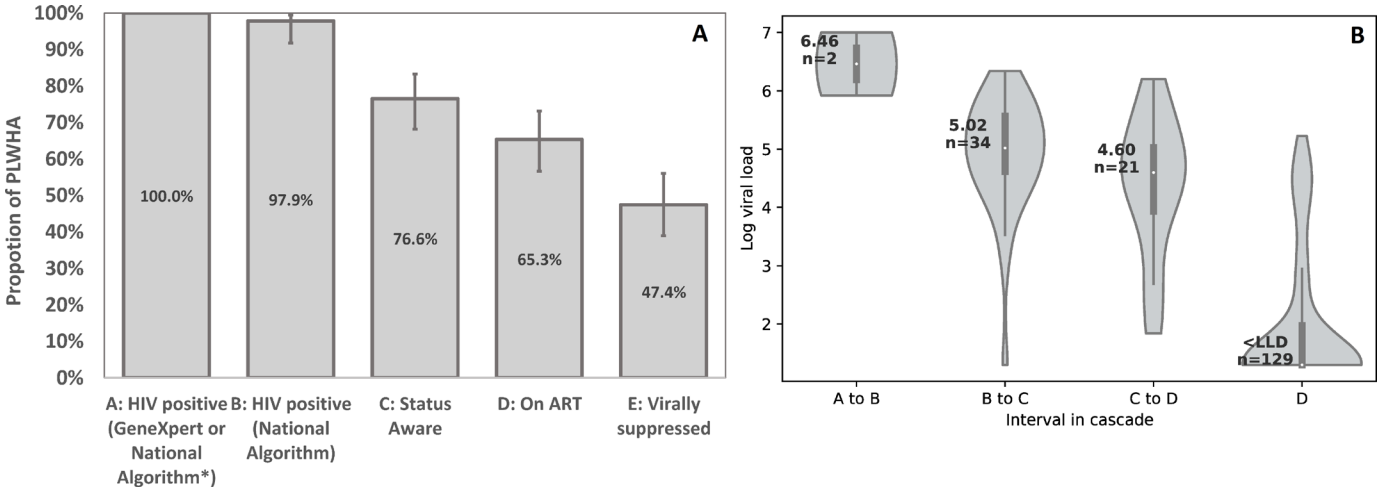

Figure 1 (A) Diagnosis and care cascade among GBMSM/TP living with HIV. *Kenyan National HIV testing algorithm: Serial Determine Alere and First Response Rapid Diagnostic Tests. Point estimates are RDS adjusted and exclude seeds. Error bars represent 95% CIs. (B) Log viral load median and distribution by level of diagnosis and care cascade engagement. Intervals: (A, B) HIV positive only on GeneXpert; (B, C) HIV positive on RDT but participant not status aware; (C, D)—Participant reports status awareness but reports no current use of ART; (D) Participants reports current use of ART. Vertical bars represent IQR, white dots represent median log viral load. Median and category sample size stated in label. <LLD: (40 copies/mm^3). P values from Kruskall-Wallis equality of populations rank test. ART, antiretroviral therapy; GBMSM/TP, gay, bisexual and other men who have sex with men/transgender persons; LLD, lower limit of detection; PLWHA, persons living with HIV/AIDS; RDS, respondent-driven sampling.

copies/mL), and declined significantly by each progressive step across the care continuum (figure 1B). Among 131 participants declaring receipt of HIV care, 61 (41.7 (31.9–52.2%) last received care in a community organisation, 44 (36.9% (27.4%–47.6%) in a public hospital, and 26 (21.5% (14.1%–31.3%) from a private provider.

Factors associated with detectable viraemia among PLHWA are shown in table 3. A strong and significant inverse trend was apparent between increasing age and prevalence of detectable viraemia in both crude and adjusted models. On average, the prevalence of detectable HIV viraemia decreased by 4.2% per year of age (1.8%–6.6%, test for linear trend, p=0.0001). These trends were apparent across all metrics of the HIV care cascade (figure 2A). Median log viral load among participants aged 18–22 was significantly higher than older age groups (4.44 vs 1.30 $\log_{10}$ copies/mL, Kruskall-Wallis p=0.0012, figure 2B), and both participants with acute HIV infections were within this youngest age-group. Increasing levels of education attendance were also associated with a declining level of viral detection among PLWHA, however, this trend was not statistically significant. Behavioural correlates of prevalent HIV viraemia in the demographically adjusted model (model 1) were payment for sex in the last 3 months (with either male or female partners) and recent condomless anal intercourse with female partners, while there was an inverse association with recently selling sex to male partners.

DISCUSSION

Over a quarter of GBMSM and TP in Nairobi now live with HIV infection. Our HIV prevalence estimate is higher than previous RDS estimates from the same city in 2010 (18.2%[13]) as well as convenience samples elsewhere in Kenya (19.8% Malindi 2010[30]; 16.6% Kisumu 2015).[31] Extrapolation of the observed proportion with evidence of acute/early HIV infection not detectable by fourth generation testing (assuming a conservative estimate of 14-day window period between GeneXpert and RDT detection) suggests an annual HIV incident risk of 15% (4%–58%). Persistently high HIV/STI risk is consistent with high reported levels of known behavioural and biological acquisition risks that have not improved over time[13]: over 40% of GBMSM/TP report recent condomless anal intercourse and transactional partnerships, and a high proportion have concurrent, often asymptomatic, STIs. The frequent reports of sex with female partners, including transactional sex, among GBMSM is consistent with previous research in Kenya, as is the lower observed HIV risk among bisexually active as opposed to exclusive GBMSM likely due to differences in role behaviour and network prevalence.[32] Antiretroviral prevention uptake remains poor for these populations and while the national PrEP programme was in the process of deployment during this study, subsequent evaluation since confirms inadequate uptake and persistence among GBMSM/TP.[33]

However, this study does highlight significant progress in reaching key populations with HIV testing and care. We estimate that three-quarters of GBMSM/TP living with HIV in Nairobi are aware of their status and nearly half have been supported to achieve viral suppression, analogous to 77-85-73 against UNAIDS targets. This cascade compares favourably to collated GMSM/TP cascade data from elsewhere in sub-Saharan Africa (18-53-76)[9]

Table 3 Associations with detectable VL among participants living with HIV, GBMSM/TP, Nairobi 2017

			Prevalence of detectable viral load >50 copies/mL	Viral detection prevalence ratio (crude)*		Viral detection prevalence ratio with sociodemographic adjustment (model 1)†		Viral detection ratio with full adjustment (model 2)‡	
		n/N	Crude % N=186	PR (95% CI)	Wald p value	aPR (95% CI)	Wald p value	aPR (95% CI)	Wald p value
Sociodemographic characteristics									
Age (years)	18–22	25/34	73.5	Ref	**0.0020**	Ref	**0.0052**	Ref	**0.0103**
	23–26	29/54	53.7	**0.73 (0.53 to 1.01)**		**0.74 (0.53 to 1.04)**		**0.84 (0.61 to 1.16)**	
	27–32	24/51	47.1	**0.64 (0.45 to 0.92)**		**0.65 (0.45 to 0.94)**		**0.71 (0.50 to 1.02)**	
	33+	16/47	34.0	**0.44 (0.28 to 0.70)**		**0.46 (0.29 to 0.74)**		**0.46 (0.29 to 0.74)**	
Employment	Salaried	37/70	72.9	Ref		–	–	–	–
	Self employed	21/45	46.7	0.89 (0.61 to 1.32)	0.5692	–	–	–	–
	Unemployed	33/62	53.2	1.02 (0.73 to 1.41)	0.9109	–	–	–	–
	Other	2/6	33.3	0.64 (0.20 to 2.03)	0.4469	–	–	–	–
Education	Primary	27/42	64.3	Ref		Ref	Ref	Ref	
	Secondary	47/94	50.0	0.79 (0.58 to 1.08)	0.1334	0.77 (0.56 to 1.05)	0.1015	0.81 (0.60 to 1.08)	0.1597
	Higher	20/49	40.8	**0.64 (0.43 to 0.97)**	**0.0355**	**0.64 (0.42 to 0.97)**	**0.0371**	0.68 (0.46 to 1.00)	0.0501
Country of birth	Kenya	86/163	52.8	Ref		–	–	–	–
	Other African country	6/14	42.9	0.82 (0.44 to 1.52)	0.5241	–	–	–	–
	Non-African country	1/4	25.0	0.48 (0.09 to 2.63)	0.3947	–	–	–	–
Sexual identity	Gay/homosexual	77/140	55.0	Ref		Ref		Ref	
	Bisexual	13/37	35.1	0.66 (0.42 to 1.05)	0.0828	0.78 (0.50 to 1.22)	0.2803	0.68 (0.45 to 1.03)	0.0646
	Other	4/6	66.7	1.23 (0.68 to 2.21)	0.4957	1.31 (0.78 to 2.18)	0.3065	1.33 (0.80 to 2.21)	0.2741
Gender identity	Cisgender male	76/151	50.3	Ref		–	–	–	–
	Transfeminine	16/28	57.1	1.14 (0.80 to 1.64)	0.4672	–	–	–	–
	Other§	2/7	28.6	0.57 (0.17 to 1.87)	0.3549	–	–	–	–
Sexual behaviour—male partners									
Male sexual partners (3 months)	None	3/7	42.9	Ref	**0.0336**	Ref	0.1202	–	–
	1–3	71/122	58.2	**1.35 (0.56 to 3.23)**		1.04 (0.48 to 2.24)		–	
	Four or more	20/57	35.1	**0.81 (0.32 to 2.05)**		0.68 (0.29 to 1.58)		–	
Sold sex to male partner (12 months)	Yes	46/107	43.0	**0.69 (0.52 to 0.91)**	**0.0101**	**0.66 (0.50 to 0.86)**	**0.0028**	**0.55 (0.41 to 0.75)**	**0.0001**
	No	48/78	61.5	Ref		Ref		Ref	
Paid for sex with male partner (12 months)	Yes	37/61	60.7	**1.28 (0.96 to 1.70)**	**0.0895**	**1.44 (1.10 to 1.88)**	**0.0084**	**1.72 (1.25 to 2.35)**	**0.0008**
	No	57/124	46.0	Ref		Ref		Ref	

Continued

Table 3 Continued

			Prevalence of detectable viral load >50 copies/mL	Viral detection prevalence ratio (crude)*		Viral detection prevalence ratio with sociodemographic adjustment (model 1)†		Viral detection ratio with full adjustment (model 2)‡	
		n/N	Crude % N=186	PR (95% CI)	Wald p value	aPR (95% CI)	Wald p value	aPR (95% CI)	Wald p value
Receptive anal intercourse with male partner (3 months)	Yes	73/139	52.5	1.25 (0.86 to 1.83)	0.2416	1.04 (0.72 to 1.50)	0.8420	–	–
	No	21/47	44.7	Ref		Ref		–	
Insertive anal intercourse with male partner (3 months)	Yes	59/118	50.0	0.96 (0.72 to 1.29)	0.8029	1.07 (0.81 to 1.43)	0.6192	–	–
	No	35/68	51.5	Ref		Ref		–	
Condomless anal intercourse (3 months)	Yes	56/97	57.7	1.35 (1.00 to 1.81)	0.0508	1.30 (0.97 to 1.74)	0.0740	1.24 (0.95 to 1.63)	0.1166
	No	38/89	42.7	Ref		Ref		Ref	
Sexual behaviour—female partners									
Female sexual partner (3 months)	Yes	24/45	53.3	1.08 (0.78 to 1.49)	0.6304	1.26 (0.94 to 1.67)	0.1164	–	–
	No	70/141	49.7	Ref		Ref		–	–
Sold sex to female partner (12 months)	Yes	9/18	50.0	0.99 (0.61 to 1.62)	0.9806	0.96 (0.65 to 1.41)	0.8344	–	–
	No	85/168	50.6	Ref		Ref		–	–
Paid for sex with female partner (12 months)	Yes	14/17	82.4	**1.74 (1.33 to 2.29)**	**0.0001**	**1.64 (1.26 to 2.11)**	**0.0002**	1.22 (0.90 to 1.66)	0.1912
	No	80/168	47.6	Ref		Ref		Ref	
Condomless intercourse (3 months)	Yes	14/22	63.6	1.31 (0.92 to 1.87)	0.1319	**1.62 (1.19 to 2.21)**	**0.0023**	1.37 (0.96 to 1.95)	0.0789
	No	80/164	48.8	Ref		**Ref**		Ref	
Sexual violence									
Forced to have sex against will (12 months)	Yes	11/26	42.3	0.82 (0.51 to 1.32)	0.4130	0.83 (0.55 to 1.28)	0.4022	–	–
	No	83/160	51.9	Ref		Ref		–	–
Substance use behaviour									
Alcohol use (current)	Never	47/87	54.0	Ref	0.7032	Ref		–	–
	Monthly	3/77	48.1	0.90 (0.66 to 1.22)		0.94 (0.70 to 1.26)	0.8611	–	–
	Weekly	10/22	45.5	0.85 (0.52 to 1.40)		0.90 (0.56 to 1.45)		–	–
Other substance use (3 months)¶	Yes	11/17	64.7	1.27 (0.84 to 1.92)	0.2498	1.28 (0.85 to 1.94)	0.2425	–	–
	No	83/169	49.1	Ref		Ref		–	–

Continued

Table 3 Continued

	n/N	Prevalence of detectable viral load >50 copies/mL	Viral detection prevalence ratio (crude)*		Viral detection prevalence ratio with sociodemographic adjustment (model 1)†		Viral detection ratio with full adjustment (model 2)‡	
		Crude % N=186	PR (95% CI)	Wald p value	aPR (95% CI)	Wald p value	aPR (95% CI)	Wald p value

*Crude bivariable Poisson regression with robust estimation of variance.
†Multiivariable Poisson regression with robust estimation of variance and adjustment for sociodemographic factors (age, education and sexual identity) with seeds excluded.
‡Multivariable Poisson regression with robust estimation of variance and adjustment for tabled sociodemographic and behavioural factors with seeds excluded.
§'Other' includes transmasculine participants and participants not currently identifying with the terms male, female or transgender.
¶Ecstacy, amphetimines, mephamphetamine, mephedrone, heroin, gamma-hydroxybutyric acid (GHB), rohypnol, cocacine, crack cocaine, benzene, amyl nitrite.
aPR, adjusted prevalence ratio; GBMSM/TP, gay, bisexual and other men who have sex with men/transgender persons; PR, prevalence ratio.

as well as to that reported in global self-reported surveys (NA-82–58).[34] This is by no means a small achievement of HIV programming within a societal context of homophobic discrimination and criminalisation of same sex behaviour[6] and represents marked improvements in access to HIV care that will directly translate into better health outcomes for GBMSM and TP living with HIV. However, cascades fall behind those for PLWH in the Kenyan general population (80-96-91 in 2017)[12] and for GBMSM and transgender in high-income settings.[35]

There is increasing evidence demonstrating the effectiveness of mHealth[36 37] and other social media interventions[38] on testing uptake and linkage to HIV services for GBMSM, while effects on retention and care outcomes are as yet inconclusive. Internet based interventions may be highly suited to the context of this study since internet services and social media are widely accessible and utilised among these populations.[39] However, any such intervention requires cautious adaptation and testing given associated risks arising from disclosure these services that has also been reported in this context. LINKAGES recommend peer navigation strategies as an element of core HIV-related interventions for key populations,[40] yet such strategies remain underused in Kenyan key population programmes despite local evidence of the effectiveness of this approach on care outcomes.[41] Most of the community-based organisations serving GBMSM/TP in Nairobi already use various models of peer outreach for client engagement, and the addition of quality assured peer navigation could be both complementary and impactful.

Inequalities in coverage of HIV diagnosis and care for persons living with HIV were principally driven by age. We observed strong positive associations between increasing age and virological suppression, as well as other metrics of the care cascade. Median viral load was 3.14 log higher among participants age 18–22 living with HIV than older GMSM/TP (4.44v 1.30 respectively, p=0.0022), reflecting both lower status awareness and care engagement in addition to higher HIV incident risk in the youngest age group. The observation that HIV prevalence was 13% among GBMSM/TP aged 18–22 years suggests that risk begins earlier in adolescence when prevention and care may be even less accessible. Although comparable evidence is scarce from elsewhere in sub Saharan Africa, Ramadhani reported higher HIV risk behaviour and incidence, yet lower healthcare engagement, status awareness and virological suppression among Nigerian GBMSM/TP aged 16–19 years.[42]

The WHO highlight the need for national responses to be acceptable to young key populations,[43] and our findings suggest a focus on GBMSM/TP youth is overdue and will be essential to the overall success of Kenyan key population HIV response. Improving accessibility to youth may require redress of structural barriers to service access, such as age-based consent criteria, training of staff to recognise additional needs of young GBMSM/TP, but must also account for the prospect that young members

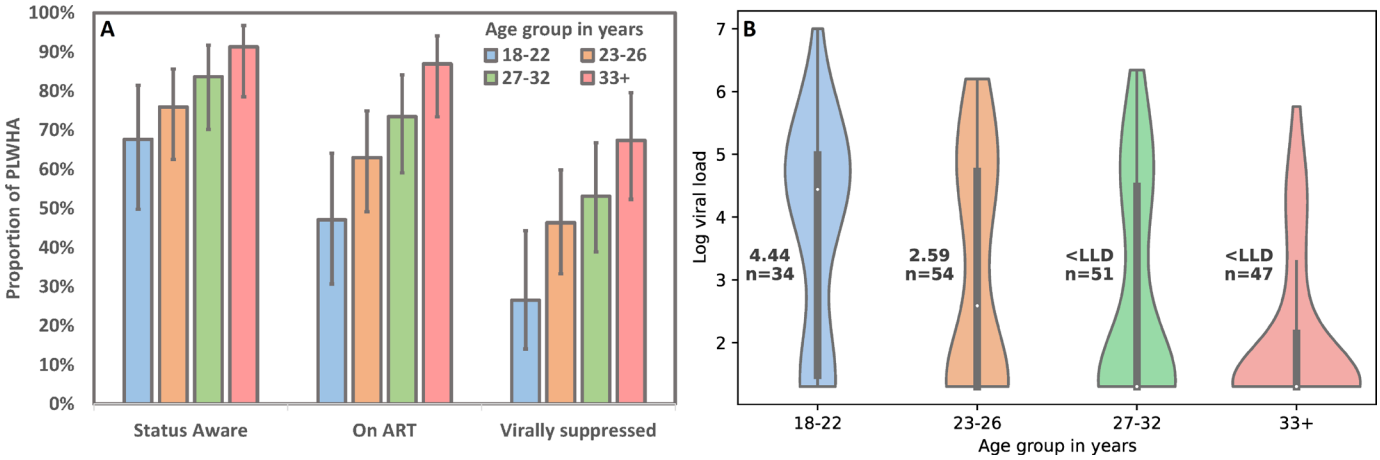

Figure 2 (A) HIV care cascade measures by age group. Point estimates are unadjusted for sampling strategy and exclude seeds. Error bars represent 95% CIs. (B) Log viral load median and distribution by age group. Vertical bars represent IQR, white dots represent median viral load (also stated in label). <LLD: (40 copies/mm^3). ART, antiretroviral therapy; LLD, lower limit of detection; PLWHA, persons living with HIV/AIDS.

of key populations will be sceptical of the confidentiality and safety of healthcare settings.[44] Pettifor proposes that services for adolescent and young MSM need to be targeted and holistic, given the complex and concurrent challenges of conceptualising HIV risk and prevention during a period of personal biological and psychological change, and often alongside stressors related to acceptance and disclosure of sexual or gender identity to family and friends.[44] Effective interventions targeting HIV prevention and care engagement among young MSM have mostly been tested in the USA, and offer supportive evidence for both digital interventions on testing uptake[45] and peer-based network support interventions to support retention.[46] Adaptation and demonstration of acceptability of interventions to young GBMSM/TP in highly stigmatised contexts should be a priority.

Our findings also suggest that improved diagnostics could complement both HIV prevention and care for GBMSM/TP in Nairobi. A small but significant proportion of GBMSM/TP were identified with prevalent acute/early HIV infection accompanied by high viral loads, and undetected by current national testing practices. In addition, we found a high proportion of GBMSM/TP with asymptomatic, urethral and rectal STIs, well recognised as a cofactor in HIV transmission.[47] Laboratory capacity for STI diagnosis remains limited and expensive in Kenya, therefore most providers, especially community-based organisations, rely solely on syndromic management. Our findings concur with others in suggesting such approaches alone have unacceptably poor diagnostic performance.[48 49] The decreasing complexity and cost of point-of-care PCR technologies should encourage policymakers to re-evaluate the cost-effectiveness of providing access to PCR-based HIV and STI diagnostics particularly in community settings.[50]

A key strength of the study was the population representative design that avoids many of the biases intrinsic to studies conducted solely among GBMSM/TP already engaged with research programs or service providers. RDS diagnostics suggest convergence on all main demographic measures, and these measures compared closely to a previous study of the same design in Nairobi.[13] The complex steps required to demonstrate eligibility for inclusion in coupon-referral studies might have presented obstacles to legitimate study access for some genuine coupon recipients, and our inclusion criteria might also have limited participation for important subpopulations, such as persons who inject drugs or harmful alcohol users. Limitations of the study include the cross-sectional design (precluding examination of causal direction of correlates) and the reliance on self-reported measures of behaviours and service uptake that are potentially subject to memory error and social desirability bias. Foremost among these was differential under-reporting of status awareness and antiretroviral use in surveys and with care providers. This phenomenon has been reported by other population-based studies, has the potential to significantly distort interpretation of cascade measures and underscores the need for verification of self-reported measures wherever possible.[51 52]

In summary, coverage of HIV care for GBMSM and TP living with HIV in Nairobi is close to that achieved in the general population and reflects the inclusive approach of the national HIV/AIDS strategy in Kenya. However, ending AIDS for key populations demands even better access to care, a re-energised PrEP response, and access to relevant HIV and STI diagnostics available wherever GBMSM/TP feel safe seeking these services. Going forward policy-makers must now seek to understand and address the specific sexual health service preferences of adolescent and younger key populations in order to address age-related inequalities in access to diagnosis and care.

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Data availability statement Data are available on reasonable request. Data from this study have not been deposited publicly because of the potential risk of deductive disclosure that may arise from individual data needed for valid analysis of the data, and the potential individual and social harms that may arise from such disclosure in a context of criminalisation and stigmatisation. However, all authors aim to make the data underlying the findings of the study available for legitimate research purposes, and requests will be considered by the London School of Hygiene and Tropical Medicine Research Operations Office Data Management lead (alex.hollander@lshtm.ac.uk). The request must specify the purpose of research, the list of required variables, and if personally identifiers or sensitive data are sought, specify measures to maintain information security and governance that will be applied in storage, handling and reporting the data.

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