The HIV care cascade among female sex workers in Zimbabwe: results of a population-based survey from the Sisters Antiretroviral therapy Programme for Prevention of HIV, an Integrated Response (SAPPH-IRe) Trial

Frances M Cowan MD[1, 2 §], Calum Davey MSc[3*], Elizabeth Fearon PhD[3*], Phillis Mushati MSc[2], Jeffrey Dirawo[2], Valentina Cambiano MSc[1], Sue Napierala Mavedzenge DPhil[4], Dagmar Hanisch MPH[5], Ramona Wong-Gruenwald MPH[6], Milton Chemhuru MD MPH[7], Nyasha Masuka MBChB MPH[7], Karin Hatzold MD[8], Owen Mugurungi MD[7], Joanna Busza MSc[9], Andrew Phillips PhD[1], James R Hargreaves PhD[3]

1 Department of Infection and Population Health, Institute of Epidemiology and Health Care, Faculty of Population Health Sciences, University College London, London, UK

2 Centre for Sexual Health & HIV/AIDS Research (CeSHHAR) Zimbabwe, Harare, Zimbabwe

3 Centre for Evaluation, Department of Social and Environmental Health Research, Public Health and Policy, London School of Hygiene and Tropical Medicine, London, UK

4 Women's Global Health Imperative, RTI International, San Francisco, California, United States of America

5 United Nations Population Fund, Harare, Zimbabwe

6 Gesellschaft für Internationale Zusammenarbeit, Harare, Zimbabwe

7 Ministry of Health and Child Welfare, Harare, Zimbabwe

8 Population Services International Global, Harare, Zimbabwe

9 Department of Population Studies, Epidemiology and Population Health, London School of Hygiene and Tropical Medicine, London, UK

Correspondence to:

Prof Frances Cowan
Centre for Sexual Health & HIV/AIDS Research (CeSHHAR) Zimbabwe
9 Monmouth Road
Avondale West, Harare
Zimbabwe
+263 (04) 332 074
+263 (04) 333 393
+263 (04) 308 042

FMC f.cowan@ucl.ac.uk

CD calum.davey@lshtm.ac.uk

EF elizabeth.fearon@lshtm.ac.uk

PM phillis@ceshhar.co.zw

JD jeffrey@ceshhar.co.zw
VC v.cambiano@ucl.ac.uk
SNM smavedzenge@rti.org
DH hanisch@unfpa.org
RW-G ramona.wong-gruenwald@giz.de
MC miltonchemhuru@yahoo.com
NM docnyasha@gmail.com
KH khatzold@psi-zim.co.zw
OM mugurungi@gmail.com
JB Joanna.Busza@lshtm.ac.uk
AP andrew.phillips@ucl.ac.uk
JRH james.Hargreaves@lshtm.ac.uk

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Abstract

Introduction: Female sex workers (FSW) in sub-Saharan Africa have a higher prevalence of HIV than other women of reproductive age. Social, legal, and structural barriers influence their access to care. Little is known about the HIV diagnosis and care cascade in most countries in southern Africa. We aimed to describe the HIV diagnosis and care cascade among FSW in Zimbabwe.

Methods: We conducted cross-sectional respondent driven sampling (RDS) surveys of FSW in 14 sites across Zimbabwe as the baseline for a cluster-randomised controlled trial investigating a combination HIV prevention and care package. We administered a questionnaire, tested women for HIV and measured viral load. We report the mean, minimum and maximum RDS-2 weighted site values.

Results: The survey included 2,722 women, approximately 200 per site. The mean HIV prevalence was 57.5% (42.8-79.2 site minimum and maximum). Of HIV positive women, 64.0% (51.6-73.7) were aware of their status, 67.7% (53.4-84.1) of these reported taking ART and 77.8% (64.4-90.8) of these had HIV viral load <1000 copies/ml. Among all HIV positive women, 49.5% had a viral load < 1000 copies/ml.

Conclusions: While the majority of HIV positive women aware of their status are accessing ART, 36.0% of HIV positive women are unaware of their status and 29.3% of all FSW have an unsuppressed HIV viral load. Investigation and investment into models of testing, treatment and care are necessary to reach UNAIDS 90:90:90 targets.

The trial is registered with the Pan African Clinical Trials Registry (PACTR201312000722390).

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Competing Interests

Dr. Phillips reports personal fees from Gilead Sciences, personal fees from GSK Vaccines, and having served on an advisory board for AbbVie, outside the submitted work.

Dr. Cambiano reports personal fees from Merck Sharp & Dohmed Limited, outside the submitted work.

Other authors declare no competing interests.

Author Contributions

Frances Cowan is the principal investigator of the trial, oversees trial design and implementation, data interpretation and writing of manuscript.

Calum Davey conducted data analysis, produced tables and figures, contributed to data interpretation and contributed to drafting and finalising the paper.

Elizabeth Fearon conducted data analysis, produced tables and figures, contributed to data interpretation and contributed to drafting and finalising the paper.

Phillis Mushati oversaw data collection, reviewed and approved the final manuscript.

Jeffrey Dirawo oversaw data management, reviewed and approved the final manuscript.

Valentina Cambiano contributed to planning the study, edited and approved the final manuscript.

Sue Napierala Mavedzenge contributed to planning the trial, provided comments on and approved the manuscript.

Dagmar Hanisch contributed to planning the study, reviewed and approved the final manuscript.

Karin Hatzold contributed to planning the study, reviewed and approved the final manuscript.

Owen Mugurungi, Nyasha Masuka and Milton Chemhuru contributed to planning the study, reviewed and approved the final manuscript.

Joanna Busza contributed to planning the study, reviewed and approved the final manuscript.

Andrew Phillips contributed to planning the study, edited and approved the final version.

James Hargreaves helped plan the analysis and contributed to drafting and finalising the paper.

All authors have approved the final manuscript.

Introduction

In sub-Saharan Africa, female sex workers (FSW) have high HIV incidence and prevalence and therefore are in particular need of good access to effective HIV testing, prevention and treatment services[1]. However, FSW are a marginalised group, sex work is illegal in many countries including Zimbabwe[2], and FSW are often stigmatised by communities and health workers[3, 4]. Typically, FSW are also highly mobile[5]. Designing service delivery approaches that meet the needs of this population is therefore complex but urgently needed.

There is currently little information about the HIV diagnosis and care cascade amongst FSW with which to guide programming. Previous studies of FSW in sub-Saharan Africa indicate that antiretroviral therapy (ART) can be provided to FSW[6] at costs comparable to that of provision in the general population[7]. A recent systematic review and meta-analysis of antiretroviral uptake, adherence and outcomes among FSW found that current ART use among HIV positive FSW was 39% (95% CI 29-48%), but noted a concerning lack of published data available[8]. Another review of the provision of sexual and reproductive health services for FSW in Africa found little emphasis among programmes on access to antiretroviral treatment and support for adherence[9]. While there is some evidence to guide the design of HIV prevention programmes for FSW in Africa, little is known about the best means to improve testing, access and adherence to ART and effective use of pre-exposure prophylaxis[10, 11].

In 2009, in response to a situational analysis conducted among FSW by Zimbabwe's National AIDS Council and partners[12], the 'Sisters with a Voice' programme was established in five sites, and has since expanded to 36 sites covering all the provinces of Zimbabwe. Services provided are based on guidance from the World Health Organisation[13] and include HIV testing and counselling, sexual and reproductive health services, condom provision and health education supported by trained peer educators and a programme of community mobilisation. Results of a respondent driven sampling (RDS) survey conducted in three towns in 2011[14], along with qualitative work[15], suggested that FSW in Zimbabwe were poorly engaged with HIV prevention and care services.

In response to this finding, we launched the **S**isters **A**ntiretroviral **P**rogramme for **P**revention of **H**IV – an **I**ntegrated **Re**sponse (SAPPH-IRe) trial, a cluster-randomised controlled trial conducted in 14 sites around Zimbabwe (7 matched-pairs). The aim is to determine the effectiveness and cost effectiveness of an enhanced community-based intervention to increase uptake, retention and adherence to antiretroviral-based prevention and therapy among FSW.

Outcomes were assessed at a population level in all 14 communities among FSW recruited to RDS surveys at baseline (December 2013), and will also be assessed at endline (April-May 2016).

Aiming to contribute to our scant knowledge of the HIV diagnosis and care cascade amongst FSW in sub-Saharan Africa, this paper describes the HIV diagnosis and care cascade at 14 sites around Zimbabwe at the baseline of the SAPPH-IRe trial. Data are presented on socio-demographic characteristics, HIV prevalence, ART coverage, viral suppression and the proportion of all FSW with unsuppressed HIV viral load: the primary endpoint for the SAPPH-IRe trial.

Methods

Study Population and Setting

Fourteen of the 36 sites where the 'Sisters' services are provided are included in the SAPPH-IRe trial. These sites were purposively selected to reflect different sex work location types (e.g. town, growth point, colliery/army base), were locations of adequate size (85-300 FSW attending clinics annually) and were geographically disparate to minimise contamination during the trial.

Data Collection

We conducted respondent driven sampling (RDS)[16] surveys of FSW using identical procedures in each of the 14 sites. We used RDS because it was unfeasible to assemble a sampling frame of the intended target population; it has been recommended for research amongst hard-to-reach populations[17]; we successfully conducted similar RDS surveys of FSW in 3 locations in 2011[14], and sex work in these settings is not conducted primarily within brothels or set venues making time-location sampling methods less appropriate. Women were eligible if they were aged 18 or over; had exchanged in sex for money or gifts in the preceding 30 days, and had lived at the site for at least the previous six months. In each site we first conducted 2-3 days of geographic and social mapping, including informal discussions with trained peer educators, healthcare staff, and community informants. This formative work informed specific criteria for purposely selected "seed" women to ensure that all sub-populations within the site's sex worker population were represented and helped determine how many of these seeds should be selected[18].

In line with RDS methodology, seed participants in each site were interviewed and given two recruitment coupons to pass on to their sex worker peers. Women were uniformly advised to recruit other sex workers whose name they knew and who knew their name, who had not already enrolled in the study and who met the study eligibility criteria. Interviewers used screening questions to confirm as far as possible that women given coupons met these criteria when they presented for interview. Six seeds were recruited in the smaller sites, while in four larger sites eight seeds were recruited. When women receiving the coupons attended for the interview ("recruits") they were also given two coupons to give out to women they knew who worked as FSW in that location. Coupons were coded such that recruiter/recruitee relationships could be tracked and unique IDs recorded. In all 14 sites a maximum of five iterations, or 'waves', of this process were performed (6 waves, including the initial seeds). We

aimed to recruit 200 FSW per site to give adequate power to detect the intervention effect at follow-up[19]. In line with other RDS surveys, women were reimbursed for participating in the survey ($5) and for recruiting eligible participants ($2 for each recruited). All participants gave informed consent to participate after receiving information about the study from trained interviewers and being given the opportunity to ask questions.

Five teams of trained researchers undertook data collection between 13 November and 20 December 2013. Interviewer-administered questionnaire data was collected onto tablet computers and directly loaded into a master database using a wireless internet connection in the field. Questionnaires included information on demographics, sex work, sexual behaviour and condom use, HIV testing history, ART use, stigma, experience of violence, relationships with other sex workers, and use of sexual and reproductive health services. We also collected data to determine personal network size, or 'degree', for RDS estimation. In our survey, the degree was the number of FSW a participant reported knowing personally, whose name they knew and who knew theirs, who were at least 18 years old, lived at the site, and whom the participant would consider recruiting to the study.

All women had a finger prick blood sample collected in the form of a dried blood spot (DBS) for detection of HIV antibody (AniLabsytems EIA kit (AniLabsystems Ltd, OyToilette 3, FIN-01720, Finland)). Blood samples were air-dried on filter papers and stored at room temperature, then transported biweekly to the Flowcytometry Laboratory in Harare. If HIV antibodies were detected then the DBS sample was tested for HIV viral load using NucliSENS EasyQ HIV-1 v2.0, both to confirm HIV positive status and to quantify the viral load. For samples with a positive HIV antibody test, but an undetectable viral load, a second confirmatory ELISA was performed (Enzygnost Anti-HIV 1/2 Plus ELISA (Germany)). At two trial sites, plasma samples were collected in addition to DBS and tested in parallel using NucliSENS EasyQ HIV-1 v2.0, to permit validation of the use of DBS for viral load quantification [20].

The Medical Research Council Zimbabwe, University College London, and the London School of Hygiene and Tropical Medicine gave ethical approval for the SAPPH-IRe trial, including the baseline data collection and analysis. The trial was also registered with the Research Council of Zimbabwe, the Pan African Clinical Trials Registry (PACTR201312000722390) and was approved by the Medicines Control Authority of Zimbabwe.

Data analysis

We follow the recommendations of the STROBE-RDS guidelines in reporting our study[21]. First, we described the sample recruited. A limitation of RDS is that it is difficult to describe non-participation rates since no sample frame is present, and we did not conduct 'exit interviews' of women who had distributed coupons to ascertain how many of their peers refused to take part. We calculated cluster-summaries for key socio-demographic characteristics of the sample. We calculated and report the mean of the 14 cluster-level RDS-2 weighted summaries and the range of estimates across clusters (minimum and maximum). Both as a total and summarised across clusters, we described the proportion of participants with suppressed HIV viral load, (<1000 copies/ml, as per WHO guidelines[22, 23]), and steps of the HIV care cascade underlying this: the proportion who were found to be HIV positive; the proportion who reported via questionnaire previously testing positive (i.e. knew their status); the proportion who reported being on ART, and the proportion who had a viral load of <1000 copies/ml. We described these estimates both as proportions of the previous step on the cascade and as proportions of the total of women testing HIV positive.

We used 'RDS-2' to conduct all analyses, which uses the 'Volz-Heckathorn' estimator[24] and has been found to be less biased than previous estimators[25]. RDS-2 is based on estimating the inclusion probabilities of each survey participant, assuming the recruitment process can be modelled as a 'random walk' over the social network of FSW. Within this model, the probability that each participant will be included is approximated as the inverse of the reported degree. Estimates were calculated in Stata 12 using the 'rds' analysis package[26], which removes seeds from the proportion estimates.

RDS-2 estimation assumes that recruitment chains progress such that final estimates are no longer dependent on the characteristics of the seeds, that recruitment does not become confined within sub-groups of the FSW population ('bottlenecks'), and assumes with-replacement sampling even when women cannot participate more than once in practice[25]. We assessed these assumptions and their potential for bias on estimates of HIV prevalence and suppressed viral load for each site, using plots of the convergence of HIV and viral suppression estimates over sample waves ('convergence plots') and plots of estimate convergence by seed ('bottleneck plots'). We also examined the difference between RDS-2 estimates and estimates produced using the RDS 'successive sampling' estimator[27] for a range of possible population sizes to assess the bias resulting from assuming with-replacement

257 sampling. These analyses were guided by published advice about RDS diagnostics[28] and used
258 the ‘rds’ package for the R statistical language[29]. Details of the diagnostic methods and
259 results are given in Appendix 1.

Results

RDS recruitment and estimation

In total 2,722 participants were recruited over six waves in 14 sites. Of these participants, 90 were seeds, of whom 62 (68.9%) were HIV positive and 29 (32.2%) had HIV viral load ≥ 1000 copies/ml. The number of non-seed "recruits" varied from 147 to 212 per site. There were an additional 15 participants from 8 sites who were missing recruiter information and who were treated as seeds and therefore dropped from the estimation.

Estimates for the proportion of FSW with suppressed viral load and for HIV prevalence appeared to converge well by the final sample wave for all sites except one for HIV prevalence and two for viral load, and there was little evidence of recruitment becoming confined within sub-groups from any site (see Appendix 1).

Characteristics of female sex workers

Participants were aged between 18 and 65, with a mean age of 31 years (minimum site mean of 29 and maximum of 34). Approximately one third of women had no or only primary education, another third had completed Forms 1-3 and the final third had completed at least Form 4 (see Table 1). Very few of the women were married (0.8% overall unweighted, the proportion was too small to calculate RDS weights) and 61.9% (range 46.4-70.6% across sites) were separated or divorced. The majority of women (53.5%) reported initiating sex work by 24 years old, with 17.4% (8.5 – 25.9) reporting having started sex work before they were 18 years old. In total 8.2% reported having no clients in the past week, 49.9% of women reported having between 1 and 5 clients per week; and 13.2% reported having 16 or more. Just under half of the women in each cluster (45.0%) were food insecure (food insecurity was indicated by any of the following: being unable to eat two meals a day; sometimes going to bed hungry; going an entire day without eating in the last week). More than a quarter of women (26.7%) had worked at another geographic location in the previous 12 months, while 52.2% had lived in their current location for six or more years. 61.4% of the women reported good or very good relations with other FSW.

Violence from intimate partners was the most common form of interpersonal violence ever experienced (40.3%), followed by violence from clients (27.7%). Violence from police in the previous year was 9.7% overall, though in one location it was 19.5%.

The majority of participants reported having previously tested for HIV (91.1%), and of those who were HIV negative 70.5% (52.7-88.8) reported having tested for HIV in the previous six months.

HIV and the diagnosis and care cascade

The HIV care cascade for HIV positive FSW is described in Figure 1. HIV prevalence amongst FSW was estimated to be 57.5%, ranging from 42.8% to 79.2% across sites.

Among those who tested HIV positive, an average of 64.0% (51.6 – 73.7) in each site were aware of their status, i.e. they reported a previous positive HIV test. Of those aware of their positive status, 67.7% (53.4 – 84.1) reported taking ART, which was 43.3% (32.3 – 54.0) of all those who tested HIV positive in the study. Across sites, an average of 77.8% (64.4 – 90.8) of women who were on ART had a viral load < 1000 copies/ml. Women on ART with viral loads <1000 copies/mL were 33.7% (range 36.5 – 62.2) of all those testing HIV positive. An additional 15.8% (range 12.6 – 16.6) of those testing positive had a viral load <1,000 copies/ml, despite not reporting being on ART. Of all HIV positive FSW, 43.3% (32.3 – 54.0) were on ART and 49.5% (36.5-62.2) had viral loads of <1000 copies/mL.

When considering all FSW as the denominator, there were an estimated 29.3% (18.9-42.3) of women who had an unsuppressed HIV viral load of ≥1000 copies/mL.

Discussion

We analysed data from 2,722 FSW recruited in 14 sites in Zimbabwe. HIV prevalence was very high (mean 57.5% across sites, ranging 42.8-79.2%). While recent HIV testing and access to ART were relatively common, still some 36.0% of HIV positive FSW did not report that they were positive in the research interview (26.3-48.4). The majority of women who tested HIV positive and reported being aware of their status reported accessing ART (67.7%) and of those, 77.8% had a viral load <1000 copies/ml. However, overall only 49.5% of all HIV positive women had a viral load <1000 copies/ml, in part because many were unaware of their status. Significant and rapid progress is needed to reduce HIV infection rates, increase HIV status awareness and improve overall levels of viral suppression.

We undertook an ambitious field study to collect baseline data and test the feasibility of our proposed approach to the trial endline data collection. We have shown that it was feasible to rapidly recruit approximately 200 FSW per site in 14 sites across Zimbabwe using RDS methodology. Our findings make an important contribution to the sparse literature on the HIV diagnosis and care cascade among FSW in sub-Saharan Africa[8]. We have been able to measure women having unsuppressed viral load as a proportion of all HIV positive sex workers, not only among those accessing ART, which is important given that approximately one third of HIV positive FSW were unaware of their status. Sampling approaches such as ours provide a key means for assessing how close we are to the 90:90:90 targets[30] in a given population or setting.

All sampling methods for hard-to-reach populations have limitations, and RDS is no exception. The estimation makes many assumptions about the recruitment process and the social networks of sex workers. Appropriate statistical techniques should be used though there remains debate about methods of analysis. We present diagnostics in Appendix 1. However, as in all applications of RDS in hidden populations it was not possible for us to empirically verify the extent to which the sample we recruited reflects the characteristics of FSWs working in the 14 sites. A major strength of our study was that we adopted identical field procedures in each of the sites, strengthening our capacity to compare findings across them.

Our estimate of viral load for HIV positive FSW was based on analysis of dried blood spot samples. While plasma analysis is normally considered the gold-standard approach, DBS appeared to be an acceptable method for viral load monitoring using the NucliSENS assay, and

we estimated high DBS sensitivity compared to plasma 'gold-standard' (sensitivity=87.4% and specificity=96.8%)[20].

Coverage of ART among HIV positive FSW was similar at 43.4% (range 32.3 – 54.0) to the 40% we had hypothesised prior to the trial[19]. This was slightly higher but in the range of the pooled estimate of 39.3% (27.2-52.9%) among sex workers from low and middle income in studies found in a recent meta-analysis and systematic review[8]. Some 67.7% of those FSW who were aware of their status and reported they were positive also reported taking ART (range 53.4-84.1%). This was similar to our findings in three sites in 2011, when we found 51-74% HIV positive FSWs who were aware of their HIV status were also engaged with care[14]. However, coverage is well below the 90:90:90 target set by UNAIDS[30]. Coverage among the general population of adult women in Zimbabwe is not known.

Overall 77.8% of those reporting taking ART had a viral load <1000 copies/ml, as did 15.8% of HIV positive women who did not report being on ART. That such a large proportion of women not on ART had a suppressed viral load was not anticipated; one explanation is that women under-reported their knowledge of HIV status and ART usage. However, there have been other surveys with similar findings: the 2012 Kenya AIDS Indicator Survey found that 30% of individuals who reported not being on ART were virally suppressed[31] and among men who have sex with men in the United States reporting to be unaware of their status and therefore not on ART in 2004-2011, 2/11 to 3/7 were found to be virally suppressed[32]. We plan to investigate this further.

Conclusions

In conclusion, our findings have contributed to knowledge of the HIV care cascade among sex workers in southern Africa. They confirm the urgent need for HIV prevention and care services in this population. We hope that the SAPPH-Ire trial will contribute to our understanding of how best to serve the needs of female sex workers in the region.

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Figure legend

Figure 1: *The y-axis indicates the proportion of women at each step of the cascade of all women testing HIV positive, while the figures on each bar indicate the proportion of women from each preceding step. Bars indicate the mean RDS weighted values across sites, while the coloured points are individual site values. The shaded portion of the virally suppressed bar represents those women who had a suppressed viral load, but who did not report taking ART.*

Supplemental Digital Content

Additional File 1, *Appendix 1. RDS Diagnostics*. This is a MS Word ".docx" file that describes and reports on recommended diagnostic procedures carried out to test assumptions made by the Respondent Driven Sampling (RDS) method.