Condom use among young women who sell sex in Zimbabwe: a prevention cascade analysis to identify gaps in HIV prevention programming

Sungai T Chabata1,§, Bernadette Hensen2, Tarisai Chiyaka1, Phillis Mushati1, Joanna Busza3, Sian Floyd4, Isolde Birdthistle4, James R Hargreaves3 and Frances M Cowan1,5

§Corresponding author: Sungai T Chabata, Centre for Sexual Health and HIV/AIDS Research (CeSHHAR), 4 Bath Road, Belgravia, Harare, Zimbabwe. Tel: +263 77 3577686. (sungai@ceshhar.co.zw; sungaichabata@gmail.com)

Abstract

Introduction: Adolescent girls and young women (AGYW), including those who sell sex in sub-Saharan Africa, are especially vulnerable to HIV. Reaching them with effective prevention is a programmatic priority. The HIV prevention cascade can be used to track intervention coverage, and identify gaps and opportunities for programme strengthening. The aim of this study was to characterise gaps in condom use and identify reasons underlying these gaps among young women who sell sex (YWSS) in Zimbabwe using data from enrolment into an impact evaluation of the DREAMS programme. DREAMS provided a package of biomedical, social and economic interventions to AGYW aged 10 to 24 with the aim of reducing HIV incidence.

Methods: In 2017, we recruited YWSS aged 18 to 24 using respondent-driven sampling in six sites across Zimbabwe. We measured knowledge about efficacy of, access to, and effective (consistent) use of condoms with the most recent three sexual partners, separately by whether YWSS self-identified as female sex workers (FSW) or not. Among YWSS without knowledge about efficacy of, not having access to, and not effectively using condoms, we described the potential reasons underlying the gaps in the condom cascade. To identify socio-demographic characteristics associated with effective condom use, we used logistic regression modelling. All analyses were RDS-II weighted and restricted to YWSS testing HIV-negative at enrolment.

Results: We enrolled 2431 YWSS. Among 1842 (76%) YWSS testing HIV-negative, 66% (n = 1221) self-identified as FSW. 89% of HIV-negative YWSS demonstrated knowledge about efficacy of condoms, 80% reported access to condoms and 58% reported using condoms consistently with the three most recent sexual partners. Knowledge about efficacy of and effective use of condoms was similar regardless of whether or not YWSS self-identified as FSW, but YWSS self-identifying as FSW reported better access to condoms compared to those who did not (87% vs 68%; age- and site-adjusted (adjOR) = 2.69; 95% CI: 2.01 to 3.60; p < 0.001). Women who reported experiencing sexual violence in the past year and common mental disorder in the past week were less likely to use condoms consistently (43% vs. 68%; adjOR = 0.49; 95% CI: 0.35 to 0.68; p < 0.001) and (51% vs. 61%; adjOR = 0.76; 95% CI: 0.60 to 0.97; p = 0.029), respectively.

Conclusions: Despite high knowledge about efficacy of and access to condoms, there remain large gaps in self-reported consistent condom use among YWSS. Addressing the structural determinants of YWSS’ inconsistent condom use, including violence, could reduce this gap. YWSS who do not self-identify as FSW have less access to condoms and may require additional programmatic intervention.

Keywords: HIV prevention cascade; condom cascade; female sex worker; young women who sell sex; HIV prevention; Zimbabwe; sub-Saharan Africa

Received 30 September 2019; Accepted 22 April 2020

Copyright © 2020 The Authors. Journal of the International AIDS Society published by John Wiley & Sons Ltd on behalf of the International AIDS Society. This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

1 INTRODUCTION

Although HIV incidence is decreasing in sub-Saharan Africa, it remains high among adolescent girls and young women (AGYW) aged 15 to 24 [1]. Among AGYW, young women who sell sex (YWSS) are at particularly high HIV risk [2], less likely to access health services, more likely to experience violence from sexual partners, and less likely to use condoms consistently due to a lower ability to negotiate condom use [3]. Reducing HIV incidence among AGYW requires increased coverage of efficacious prevention methods, including condoms and oral pre-exposure prophylaxis (PrEP)[4–6].

The DREAMS Partnership was launched in ten African countries, including Zimbabwe, aiming to reduce HIV risk among AGYW through the delivery of comprehensive combination HIV prevention programming [7,8]. In Zimbabwe, where
YWSS, including young FSW, were among the target population, the core package included condom promotion and provision, and an offer of oral PrEP, supported by a range of behavioural and structural interventions [9].

HIV prevention cascades can highlight gaps in motivation for, access to and effective use of prevention tools [10,11]. Criticisms of the framework emphasise that HIV prevention is non-linear and complex, there are several prevention options, the prevention needs of individuals differ and change over time, and that measuring complex domains such as motivation, is challenging and not conducive to simplified models [12]. We operationalised a prevention cascade analysis for YWSS in Zimbabwe using data from enrolment into an impact evaluation of DREAMS. Overall, our goal was to explore whether application of prevention cascades at enrolment could be used to inform prevention programming by identifying priority interventions [13].

2 | METHODS

2.1 | Study setting and population

Between April and July 2017, we used respondent-driven sampling (RDS) in six sites across Zimbabwe to identify and recruit YWSS to a cohort study to evaluate the impact of DREAMS on HIV incidence [14,15]. Women were recruited from two large cities where DREAMS was implemented and a comparison group of women were recruited from four small towns selected based on their similarity with the DREAMS sites. In all six sites the national HIV prevention and treatment programme for FSW, “Sisters with a Voice”, provides support and services to FSW, including HIV testing, community mobilisation, and condoms.

Women were eligible to participate if they were 18 to 24 years of age and explicitly exchanged sex for money, goods or services in the past month. Our aim was to recruit any young women engaged in selling sex, even if these women did not see themselves as FSW. Based on the sample size required for the impact evaluation [14], we aimed to recruit ~600 YWSS in each large city, and ~300 in each small urban site.

2.2 | Data collection

Data collection methods have been described elsewhere [14]. As reported [16], we conducted geographic and social mapping at each site to identify 6-10 ‘seed’ participants, women who were purposefully selected to be representative of the social typology of YWSS, which is mainly street based, and geographic location of selling sex. Each ‘seed’ was interviewed and given two recruitment coupons to pass on to YWSS in her social network [14]. When YWSS receiving a coupon attended the survey site, they were given two coupons to pass on to two YWSS they knew, who sold sex in that location and who had not previously been recruited to the survey. Each participant was given an incentive of US$3 for participating in the survey, and an additional US$2 for each YWSS recruited. In all six sites, a maximum of six iterations of recruitment were performed [14].

YWSS consenting to participate completed a questionnaire on socio-demographics, sexual behaviours, including a partner loop that asked about condom use at last sex and condom-less sex in the past month with three most recent sexual partners, self-identification as FSW, and uptake of HIV services, including testing. Participants were offered rapid HIV testing services according to national HIV testing guidelines and were told the result of their HIV test.

2.3 | Measures

We operationalised the HIV prevention cascade measuring three core steps: knowledge about condom efficacy, access to and effective use of condoms [10,11]. We used knowledge about condom efficacy as a proxy for motivation to use condoms because we had insufficient data to measure motivation to align the condom cascade with the Schaefer et al framework [10]. We hypothesised that cascades may differ by whether or not women self-identified as FSW and constructed cascades for women who did and did not identify as such. All measures were self-reported.

Knowledge about efficacy of condoms was defined as agreeing that using condoms every time you have sex can prevent an HIV negative person from acquiring HIV infection. Access to condoms was defined as reporting that condoms are always available in places where women choose to obtain them. Effective use of condoms was defined as having used condoms during all sexual acts with three most recent partners in the past month. Three recent partners were a smaller proportion of the average number of partners reported by YWSS self-identified as FSW (20%) compared to those not self-identified as FSW (60%). Effective condom use was a derived variable that combined data from two variables: condom use at last sex and condom-less sex in the past month, with three most recent partners. The variable was coded 1 if women reported any condom-less sex with any partner, and coded 0 only if they reported no condom-less sex at last sex and in the last month with all three partners.

After constructing the cascade, we described perceived norms and perceptions about condom use among women without knowledge of condom efficacy, hypothesising that these might help better understand the gaps in their knowledge [13]. We described perceived use of condoms with (1) regular partners and (2) casual partners/clients by other young women, (3) perceived importance of using condoms with all sexual partners, and (4) whether using a condom every time they have sex is a good thing to do. Among women defined as not having access to condoms, we described whether women reported that: (1) it is easy for women like themselves to access free condoms, (2) it is expensive to travel to places where they get condoms, and (3) they are always able to get condoms for free at the places where they get condoms. Among women defined as not using condoms effectively, we described whether YWSS reported an ability to use condoms correctly, to negotiate condom use with any sexual partner, and confidence in their ability to ask a new sexual partner to use a condom. These measures related to self-efficacy and skills were based on those developed and used in other settings in sub-Saharan Africa [17-20].

In a risk factor analysis, we included variables known to be associated with effective condom use in the literature [21] and that could be amenable to identifying women at risk of not using condoms and strategies to improve condom use, including: age, educational attainment, marital status, self-identification as FSW, whether women ever experienced physical and sexual violence from a sexual partner or police, women’s
relationship with other YWSS, number of close female friends, consumption of more than six alcoholic drinks in one night during last 12 months, and symptoms of common mental health disorders (CMD). Risk of CMD was assessed using the locally validated Shona Symptom Questionnaire (SSQ-14) [22], a set of fourteen questions about symptoms of depression and anxiety in the previous one week (cut off for risk of CMD is $\geq 9/14$) [22-24].

2.4 | Statistical analysis

All analyses were restricted to women who tested HIV negative on the rapid HIV test offered during the survey. Data were RDS-II weighted, with women's responses weighted by the inverse of the reported number of YWSS that they knew i.e. the number of other women that she could have recruited to the survey [25], based on well established rationale for RDS-II weighting [26,27]. We pooled data from the six survey sites and normalised the RDS-II weights by site. Participant socio-demographic and sexual behaviour characteristics, as well as variables related to the cascade were described, and stratified by self-identification as FSW.

We constructed the condom cascade for all YWSS as well as by whether or not they self-identified as FSW, and compared each step by self-identification as FSW adjusting for age at the time of the survey and site of recruitment.

Subsequently, we used logistic regression to identify socio-demographic and sexual behaviour characteristics associated with effective condom use. For logistic regression analyses, we dropped seed participants and included a fixed term for site. Factors associated with effective condom use at $p \leq 0.10$-level in univariable analysis were included in the multivariable regression model, adjusting for all factors associated with effective condom use in the univariable analysis. We also explored whether the associations between the variables of interest and effective condom use were modified by whether or not women self-identified as FSW. Evidence of effect modification in unadjusted analyses ($p \leq 0.10$) resulted in further exploration in adjusted analyses.

Finally, we described potential reasons underlying gaps in the condom cascade among women defined as not having knowledge about condom efficacy, not having access to condoms, and not using condoms effectively. This analysis was also stratified by whether women self-identified as FSW or not. Analyses were conducted using STATA version 14.2.

2.5 | Ethics

The DREAMS impact evaluation was reviewed and approved by the Medical Research Council of Zimbabwe (Ref MRCZ/A/2085) and the London School of Hygiene and Tropical Medicine (Ref 11835). All participants were given information about the study and asked for written informed consent for participation.

3 | RESULTS

3.1 | Characteristics of women recruited to the study

We recruited 2431 YWSS, 1204 in two large cities and 1227 in the four small towns, 1842 (76%) tested HIV negative. The majority of HIV negative YWSS were aged 20 to 24 years (58%), had some but incomplete secondary school education, were never married, and reported having insufficient food in the past month (Table 1). Sixty-six percent (66%) self-identified as FSW. YWSS self-identifying as FSW were older, more likely to be divorced/separated, more likely to consume alcohol and to report good relationships with other YWSS (Table 1). YWSS identifying as FSW reported having more sexual partners and sex work clients in the past month compared to YWSS not identifying as FSW. YWSS self-identifying as FSW were also more likely to be at risk of CMD within the last week (37% vs. 27%), to have experienced physical and sexual violence from a sexual partner, and violence from police (6% vs. 2%) compared to non-identifying YWSS.

3.2 | The condom cascade

Overall, 89% of YWSS agreed that using condoms every time during sex can prevent an HIV negative person from acquiring HIV infection (efficacy knowledge), 80% reported that condoms were always available at places from which they chose to obtain them (access), and 58% reported having used condoms during all sexual acts with three most recent partners in the past month (effective use) (Figure 1).

A higher proportion of YWSS self-identifying as FSW reported access to condoms compared to YWSS not identifying as FSW (87% vs. 67%; age- and site-adjusted OR $= 2.69$; 95% CI: 2.01 to 3.60; $p < 0.001$). Knowledge about efficacy of condoms and effective use of condoms were similar between both groups of YWSS (90% vs. 89%; OR $= 1.00$; 95% CI: 0.68 to 1.47; $p = 0.997$), and (57% vs. 60%; OR $= 0.94$; 95% CI: 0.61 to 1.28; $p = 0.123$), respectively.

Adjusting for factors associated with effective condom use in univariable analysis, there was evidence that effective condom use was lower among YWSS at risk of CMD (51% vs. not at risk 61%; adjOR $= 0.76$; 95% CI: 0.60 to 0.97; $p = 0.029$) and women who ever experienced physical violence from a sexual partner (51% vs. women not experiencing physical violence 62%; adjOR $= 0.74$; 95% CI: 0.58 to 0.96; $p = 0.021$) (Table 2). There was strong evidence that effective condom use was lower among women who had experienced sexual violence in past 12 months compared to women reporting no sexual violence (43% vs. 60%; adjOR $= 0.49$; 95% CI: 0.35 to 0.67; $p < 0.001$). YWSS who reported neither a good nor bad relationship with other YWSS were less likely to use condoms effectively compared to YWSS with good relationship with other YWSS (50% vs. 60%; adjOR $= 0.49$; 95% CI: 0.35 to 0.68; $p = 0.030$). There was little evidence of an association with other factors explored and no statistical evidence for any effect modification by self-identification as FSW.

3.3 | Potential reasons underlying lack of knowledge about efficacy of, access to and effective use of condoms

Among YWSS who did not perceive condoms to be effective at preventing HIV, the majority reported that other YWSS use condoms with their casual partners/clients (80%) and regular partners (58%). Most women perceived the use of condoms with all sexual partners as important (97%) and considered using condoms every sex act as a good thing to do (84%). A
Table 1. Socio-demographic and sexual behavioural characteristics of YWSS testing HIV negative at enrolment into an RDS survey, by self-identification as FSW, RDS-II weighted (N = 1842)

|                                | YWSS not identifying as FSW (N = 621) | YWSS identifying as FSW (N = 1221) | All YWSS (N = 1842)α | Comparison p-value<sup>c</sup> |
|--------------------------------|---------------------------------------|------------------------------------|----------------------|-------------------------------|
|                                | n          | %          | n          | %          | n          | %          |                                   |
| Age                            |            |            |            |            |            |            |                                   |
| 18 to 19                       | 316        | 52.4       | 409        | 35.4       | 725        | 41.6       | <0.001                             |
| 20 to 24                       | 305        | 47.6       | 812        | 64.6       | 1117       | 58.4       |                                   |
| Highest level of education     |            |            |            |            |            |            | <0.001                             |
| None/ incomplete primary        | 18         | 2.7        | 87         | 7.7        | 105        | 5.9        |                                   |
| Complete primary               | 44         | 7.6        | 108        | 9.5        | 152        | 8.8        |                                   |
| Incomplete secondary           | 518        | 82.9       | 990        | 80.0       | 1508       | 81.1       |                                   |
| Complete secondary or higher   | 41         | 6.7        | 36         | 2.9        | 77         | 4.2        |                                   |
| Marital status                 |            |            |            |            |            |            | <0.001                             |
| Never been married             | 465        | 75.2       | 685        | 56.9       | 1150       | 63.6       |                                   |
| Married/ living together as if married | 21       | 3.4        | 16         | 1.7        | 37         | 2.3        |                                   |
| Divorced/ separated            | 135        | 21.4       | 512        | 40.8       | 647        | 33.9       |                                   |
| Widowed                        | 0          | 0.0        | 8          | 0.6        | 8          | 0.4        |                                   |
| Insufficient food in past month|            |            |            |            |            |            | 0.002                              |
| No                             | 308        | 50.5       | 517        | 41.7       | 825        | 44.9       |                                   |
| Yes                            | 313        | 49.5       | 704        | 58.3       | 1017       | 55.1       |                                   |
| Age at start of selling sex    |            |            |            |            |            |            | 0.001                              |
| <15                            | 60         | 9.1        | 142        | 11.8       | 202        | 10.8       |                                   |
| 16 to 17                       | 246        | 41.5       | 392        | 31.7       | 638        | 35.3       |                                   |
| 18 to 24                       | 311        | 49.4       | 687        | 56.5       | 998        | 53.9       |                                   |
| Duration since first started selling sex (years) |            |            |            |            |            |            | <0.001                             |
| 0 to 2                         | 403        | 67.8       | 633        | 52.5       | 1036       | 58.0       |                                   |
| 3 to 4                         | 162        | 25.0       | 372        | 30.9       | 534        | 28.8       |                                   |
| ≥5                             | 52         | 7.2        | 216        | 16.7       | 268        | 13.2       |                                   |
| Number of sexual partners in the past month |            |            |            |            |            |            | <0.001                             |
| 0 to 4                         | 474        | 80.0       | 432        | 37.3       | 906        | 52.8       |                                   |
| 5 to 9                         | 82         | 10.9       | 303        | 25.9       | 385        | 20.5       |                                   |
| ≥10                            | 64         | 9.1        | 481        | 36.8       | 545        | 26.7       |                                   |
| Number of clients in the past month |            |            |            |            |            |            | <0.001                             |
| 0 to 4                         | 501        | 84.1       | 485        | 42.1       | 986        | 57.4       |                                   |
| 5 to 9                         | 62         | 7.8        | 276        | 23.6       | 338        | 17.9       |                                   |
| ≥10                            | 57         | 8.1        | 454        | 34.3       | 511        | 24.8       |                                   |
| Relationship with other YWSS   |            |            |            |            |            |            | <0.001                             |
| Good                           | 385        | 63.6       | 869        | 71.6       | 1254       | 68.7       |                                   |
| Neither good nor bad           | 125        | 21.2       | 229        | 18.6       | 353        | 19.5       |                                   |
| Bad                            | 60         | 10.3       | 97         | 8.2        | 157        | 9.0        |                                   |
| No relationship                | 48         | 4.9        | 26         | 2.1        | 74         | 2.7        |                                   |
| No. of close female friends    |            |            |            |            |            |            | 0.231                              |
| 0                              | 127        | 22.0       | 219        | 19.7       | 346        | 20.5       |                                   |
| 1                              | 356        | 56.8       | 667        | 55.0       | 1023       | 55.7       |                                   |
| ≥2                             | 138        | 21.2       | 335        | 25.3       | 473        | 25.8       |                                   |
| Alcohol consumption in the past 12 months |            |            |            |            |            |            | <0.001                             |
| Never                          | 354        | 60.1       | 480        | 41.7       | 834        | 48.4       |                                   |
| Once a month or less           | 103        | 17.6       | 159        | 13.4       | 262        | 15.0       |                                   |
| 2 to 4 times per month         | 67         | 9.7        | 183        | 14.5       | 250        | 12.7       |                                   |
| 2 to 3 times per week          | 60         | 8.3        | 212        | 16.5       | 272        | 13.5       |                                   |
| 4 or more times per week       | 37         | 4.3        | 187        | 13.9       | 224        | 10.4       |                                   |

α: RDS-II weighted 
<sup>c</sup>: Comparison p-value
high proportion (68%) of women reported that they cannot rely on condoms because they break easily (Figure 2A). There was little evidence that these factors differed by self-identification as FSW.

Among YWSS who lacked access to condoms, the majority (64%) reported that it is easy for young women like them to access free condoms and that they are always able to get condoms for free (58%). Access to free condoms was similar regardless of whether women self-identified as FSW or not (70% vs 61% respectively; age- and site-adjusted (adjOR) =1.43; 95% CI: 0.82 to 2.47; \( p = 0.204 \)) (Figure 2B). Few women (31%) reported that places to get condoms are far

### Table 1. (Continued)

| Comparison p-value
|---|
| <0.001 |

| Had more than six alcoholic drinks in one night during last 12 months | n | % | n | % | n | % |
|---|---|---|---|---|---|---|
| YWSS not identifying as FSW (N = 621) | 354 | 60.1 | 480 | 41.7 | 834 | 48.4 |
| YWSS identifying as FSW (N = 1221) | 160 | 25.3 | 386 | 32.2 | 546 | 29.7 |
| All YWSS (N = 1842) \( ^* \) | 107 | 14.6 | 355 | 26.1 | 462 | 21.9 |

| Risk of CMD \( ^b \) | n | % | n | % | n | % |
|---|---|---|---|---|---|---|
| YWSS not identifying as FSW (N = 621) | 443 | 72.7 | 768 | 62.9 | 1211 | 66.4 |
| YWSS identifying as FSW (N = 1221) | 178 | 27.3 | 453 | 37.1 | 631 | 33.6 |

| Ever experienced physical violence from sexual partner | Comparison p-value
|---|---|
| <0.001 |
| YWSS not identifying as FSW (N = 621) | n | % | n | % | n | % |
| YWSS identifying as FSW (N = 1221) | n | % | n | % | n | % |
| All YWSS (N = 1842) \( ^c \) | n | % | n | % | n | % |

| Experienced sexual violence from a sexual partner in the past 12 months | Comparison p-value
|---|---|
| 0.010 |
| YWSS not identifying as FSW (N = 621) | n | % | n | % | n | % |
| YWSS identifying as FSW (N = 1221) | n | % | n | % | n | % |
| All YWSS (N = 1842) \( ^c \) | n | % | n | % | n | % |

| Experienced any form of violence from police in the past 12 months | Comparison p-value
|---|---|
| <0.001 |
| YWSS not identifying as FSW (N = 621) | n | % | n | % | n | % |
| YWSS identifying as FSW (N = 1221) | n | % | n | % | n | % |
| All YWSS (N = 1842) \( ^c \) | n | % | n | % | n | % |

\( ^a \)17 women missing data on whether or not they self-identify as FSW; \( ^b \)Cut-off of \( \geq 9 \); \( ^c \)Adjusted for age and site. CMD, common mental health disorders.

Figure 1. Condom cascades among YWSS overall, YWSS self-identifying as FSW and YWSS not self-identifying as FSW. Black spots indicate site-specific estimates.

YWSS, young women who sell sex; FSW, female sex worker.
Table 2. Factors associated with effective condom use among YWSS testing HIV negative at enrolment into an RDS survey, RDS-II weighted (N = 1810)

| Characteristic                        | N (%)       | # of YWSS who had effective condom use in the past month (N = 1058) | Crude OR (95% CI) | p-value | Adjusted ORa (95%CI) | p-value |
|---------------------------------------|-------------|---------------------------------------------------------------------|-------------------|---------|----------------------|---------|
| Age at enrolment                      |             |                                                                     |                   |         |                      |         |
| 18 to 19                              | 712 (41.5)  | 432 (59.9)                                                          | 1                 | 0.039   |                      | 0.965   |
| 20 to 24                              | 1098 (58.5)| 626 (56.1)                                                          | 0.78 (0.62 to 0.99)| 0.99   | 0.99 (0.76 to 1.30)  | 0.584   |
| Highest level of education            |             |                                                                     |                   |         |                      |         |
| Primary or less                       | 253 (14.6)  | 141 (55.4)                                                          | 1                 | 0.584   |                      |         |
| Incomplete secondary                  | 776 (42.9)  | 476 (58.5)                                                          | 1.20 (0.85 to 1.69)|         |                      |         |
| Complete secondary or higher          | 781 (42.5)  | 441 (57.6)                                                          | 1.16 (0.82 to 1.65)|         |                      |         |
| Marital status                        |             |                                                                     |                   |         |                      |         |
| Never married                         | 1130 (63.7)| 667 (59.4)                                                          | 1                 | 0.003   |                      | 0.062   |
| Ever married                          | 680 (36.3)  | 391 (54.7)                                                          | 0.69 (0.54 to 0.89)| 0.77   | 0.77 (0.59 to 1.01)  |         |
| Insufficient food in past month       |             |                                                                     |                   |         |                      |         |
| No                                    | 807 (44.8)  | 466 (55.5)                                                          | 1                 | 0.506   |                      |         |
| Yes                                   | 1003 (55.2)| 592 (59.4)                                                          | 1.08 (0.86 to 1.36)|         |                      |         |
| Self-identified as FSW                |             |                                                                     |                   |         |                      |         |
| No                                    | 598 (35.8)  | 356 (60.3)                                                          | 1                 | 0.023   |                      | 0.386   |
| Yes                                   | 1195 (64.2)| 696 (56.7)                                                          | 0.75 (0.59 to 0.96)| 0.89   | 0.89 (0.69 to 1.16)  |         |
| Age at start of selling sex           |             |                                                                     |                   |         |                      |         |
| ≤15                                   | 196 (10.8)  | 103 (50.2)                                                          | 1                 | 0.166   |                      |         |
| 16 to 17                              | 637 (35.7)  | 363 (54.9)                                                          | 1.15 (0.79 to 1.69)|         |                      |         |
| 18 to 24                              | 974 (53.5)  | 590 (60.9)                                                          | 1.36 (0.95 to 1.96)|         |                      |         |
| Duration since first started selling sex (years) |         |                                                                     |                   |         |                      |         |
| 0 to 2                                | 1015 (57.7)| 631 (61.1)                                                          | 1                 | 0.003   |                      | 0.054   |
| 3 to 4                                | 530 (29.0)  | 293 (54.9)                                                          | 0.81 (0.63 to 1.04)| 0.86   | 0.86 (0.66 to 1.12)  |         |
| ≥5                                    | 262 (13.3)  | 132 (48.3)                                                          | 0.58 (0.42 to 0.80)| 0.64   | 0.64 (0.45 to 0.91)  |         |
| Relationship with other YWSS          |             |                                                                     |                   |         |                      |         |
| Good                                  | 1238 (69.1)| 746 (60.2)                                                          | 1                 | 0.025   |                      | 0.030   |
| Neither good nor bad                  | 345 (19.5)  | 182 (49.7)                                                          | 0.67 (0.51 to 0.90)| 0.67   | 0.67 (0.50 to 0.90)  |         |
| Bad or no relationship                | 223 (11.4)  | 127 (56.1)                                                          | 0.88 (0.62 to 1.24)| 0.88   | 0.88 (0.63 to 1.25)  |         |
| No. of close female friends           |             |                                                                     |                   |         |                      |         |
| 0                                     | 342 (20.7)  | 198 (57.8)                                                          | 1                 | 0.578   |                      |         |
| 1                                     | 1008 (55.6)| 584 (57.1)                                                          | 0.99 (0.75 to 1.34)|         |                      |         |
| ≥2                                    | 460 (23.7)  | 276 (58.8)                                                          | 1.15 (0.82 to 1.62)|         |                      |         |
| Had more than six alcoholic drinks in one night during last 12 months |         |                                                                     |                   |         |                      |         |
| Have not had alcohol in last 12 months | 816 (48.1)| 506 (61.7)                                                          | 1                 | 0.032   |                      | 0.450   |
| Drank alcohol but no occasions of more than six drinks |         |                                                                     |                   |         |                      |         |
| Yes, at least one occasion            | 452 (22.0)  | 233 (51.9)                                                          | 0.72 (0.54 to 0.97)|         |                      | 0.99    | 0.72 to 1.35         |
from their homes or that it is expensive to travel to get condoms (16%), with no evidence for difference by how YWSS self-identified. Forty-percent (40%) reported that staff at places where they get condoms talk badly about them because they sell sex, with no evidence for a difference by self-identification as FSW.

Among YWSS not using condoms effectively, YWSS self-identified as FSW were more likely to report that they were confident to get condoms when they needed them (92% vs. 79%; adjOR = 2.61; 95% CI: 1.41 to 4.84; p = 0.002) and were able to use condoms correctly (87% vs. 75%; adjOR = 1.95; 95% CI: 1.15 to 3.31; p = 0.013) compared to YWSS not identifying as FSW. Ability to negotiate condom use with any sexual partner and confidence in one's ability to ask a new sexual partner to use a condom was high and similar between both groups of YWSS (Figure 2C).

4 | DISCUSSION

We operationalised a condom cascade using data collected from HIV-negative YWSS in six sites in Zimbabwe in 2017. Knowledge about the efficacy of condoms was high. However, reported effective use with their three most recent partners was low and access to condoms differed between YWSS who self-identified as FSW and those who did not. YWSS perceived that their peers used condoms and considered condoms important. Yet condoms were not considered reliable, YWSS not identifying as FSW had less access to free condoms and lower condom use self-efficacy. Effective condom use was lower among those experiencing violence and being at risk of CMD, suggesting that these factors affect women's capability to use condoms.

Our analysis revealed gaps in access to condoms and in confidence in condom use, particularly among YWSS not identifying as FSW, who were younger and started selling sex more recently. These gaps point to the need for tailored programming depending on how YWSS self-identify [21,28]. Demand creation for condoms may have been neglected in recent years. Re-enforcing the message that condoms are effective when used correctly, coupled with promotion of how to use condoms properly and that they should be used consistently, is critical. At the time of our study, PrEP was not widely available; few women had heard of PrEP. Currently, there is little literature on motivation to use PrEP and factors affecting ability to adhere to PrEP [29]. Prevention cascades may inform our thinking about how to support PrEP use and adherence, highlighting that alongside access and knowledge of PrEP efficacy, programmes need to consider self-efficacy and confidence, and how violence and CMD are likely to affect longer-term PrEP use. Further, our study suggests the need to promote PrEP as an option for women who feel they cannot negotiate condom use because they are at risk of violence, or who may struggle to negotiate condom use with partners who insist on condom-less sex [30].

### Table 2. (Continued)

| Characteristic                                      | N (%)       | # of YWSS who had effective condom use in the past month | Crude OR (95% CI) | p-value | Adjusted ORa (95% CI) | p-value |
|-----------------------------------------------------|-------------|--------------------------------------------------------|-------------------|---------|-----------------------|---------|
| Risk of CMD in the past week                         |             | (N = 1058) n (%)                                      |                   |         |                       |         |
| No                                                  | 1182 (66.1) | 737 (61.0)                                             | 1                 | <0.001  | 1                     | 0.029   |
| Yes                                                 | 628 (33.9)  | 321 (51.1)                                             | 0.66 (0.52 to 0.83)|         | 0.76 (0.60 to 0.97)   |         |
| Ever experienced physical violence from sexual partner|             |                                                         |                   | <0.001  |                       | 0.021   |
| No                                                  | 1122 (64.1) | 697 (61.5)                                             | 1                 | <0.001  |                       | <0.001  |
| Yes                                                 | 688 (35.9)  | 361 (50.8)                                             | 0.60 (0.48 to 0.76)|         | 0.74 (0.58 to 0.96)   |         |
| Experienced sexual violence from a sexual partner in the past 12 months |             |                                                         |                   | <0.001  |                       |         |
| No                                                  | 1518 (84.7) | 930 (60.3)                                             | 1                 |         |                       |         |
| Yes                                                 | 291 (15.3)  | 127 (42.6)                                             | 0.43 (0.31 to 0.58)|         | 0.49 (0.35 to 0.67)   |         |
| Experienced any form of violence from police in the past 12 months |             |                                                         |                   | 0.003   |                       | 0.239   |
| No                                                  | 1726 (95.9) | 1016 (58.4)                                            | 1                 |         |                       |         |
| Yes                                                 | 80 (4.1)    | 40 (40.4)                                              | 0.45 (0.27 to 0.77)|         | 0.71 (0.41 to 1.25)   |         |

p-value is from Wald test. YWSS, young women who sell sex; FSW, female sex worker; RDS, respondent-driven sampling; OR, odds ratio.

*a* Adjusted for all factors associated with effective condom use in crude analysis.
YWSS, young women who sell sex; FSW, female sex workers.

using condoms, respectively.

knowledge about efficacy of, not having access to, and not effectively
cacy of, access to and effective use of condoms among YWSS without
Figure 2. Potential reasons underlying gaps in knowledge about effi-

cy, access to and effective use of condoms among YWSS without knowledge about efficacy of, not having access to, and not effectively
using condoms, respectively.

YWSS, young women who sell sex; FSW, female sex workers.

Self-efficacy to use condoms is likely compromised by physi-
cal and sexual violence from sexual partners. HIV prevention
programmes need to provide access to violence prevention services, including violence mitigation packages [31,32].
Women participating in the survey reported high levels of vio-

lence, and our analysis of the final cascade step revealed that
experiencing violence was associated with reported ineffective
use of condoms with their three most recent partners. These
findings are similar to other studies [33,34], which have shown
that intimate partner violence is associated with poorer con-
dom use among YWSS who do not self-identify as FSW [36]. Our RDS diagnostics (reported elsewhere [21,37]) suggest that our sample is likely to be representative
of the network of YWSS recruited. These analyses gave us a
unique opportunity to operationalise a prevention cascade
within a large group of HIV-negative YWSS, recruited for an
impact evaluation of DREAMS, among whom data on condom
use is limited in sub-Saharan Africa [38].

A limitation of the data we report is our reliance on self-re-
ports of subjects prone to social desirability bias. Approaches to
strengthen valid reporting, including ACASI, are available but
were not possible to use in these surveys. We were not able to
include detailed questions about partner’s influence in determin-

ing condom use. However, understanding women’s agency in
condom negotiation with individual partners may be better
placed for qualitative inquiry, particularly among those women
who reported experiencing violence and for whom violence was
strongly associated with effective condom use [14,15].

The cascades we present have limitations. In the absence of
a standard measure for motivation [10], we used knowledge
about the efficacy of condoms as the first step in our cascade.
Knowledge that condoms can prevent HIV is necessary but
not sufficient for motivation. We described norms and percep-
tions regarding condom use, which revealed that many women
consider condoms unreliable. Our measure of access is also
limited. Condoms always being available may not mean women
have access if the places where condoms are available are not
acceptable [10]. Discrimination by staff may deter YWSS from
accessing condoms [39]. Among YWSS defined as lacking
access to condoms, some reported that staff at the place they
get condoms talk badly about them because they sell sex. Our
measure of effective condom use may also over-report consis-
tent condom use. Women’s behaviours with their three most
recent partners may not be reflective of behaviours with all
partners. Also, YWSS could be having condom-less sex due to
pregnancy intentions, particularly with a non-paying partner.

We estimate that our approach focusing on the three most
recent partners covered at least 50% of partners in the last
month. As such, and despite limitations, our measure is similar
to those reported in other studies [40]. The questions to
quantify reasons for any gaps in knowledge about efficacy,
access and effective use were related to domains considered
of importance in the cascade presented by Schaefer et al [10]
and Hargreaves et al [11], and combine behavioural theories
[41]. There may, however, be reasons underlying gaps in
access to condoms among YWSS who do not self-identify as
FSW and in effective use among all women that we failed to
measure, including whether women disclosed their sex work
to friends, family and partners.

A further limitation is that the prevention cascade is
intended to be a simple and practical framework to strengthen
prevention programming [10,42]. Although the cascades we
present are in themselves simple, the collection of data
through RDS surveys is complex and such data is not rou-
tinely available to programmes. However, questions included
in the survey or related to motivation and access could be col-
llected by peer educators or through micro-planning methods,
with qualitative data collection methods used to complement
quantitative findings. Data routinely collected by FSW programmes in Kenya and in Zimbabwe [43,44] provided powerful information to strengthen programming, revealing gaps in reaching younger FSW [42]. Combining survey data, when available, with data collection by peer educators, including micro-planning, could prove a powerful tool to identify gaps and strengthen programming for YWSS in Zimbabwe and other settings [42,45].

5 | CONCLUSIONS

We used the HIV prevention cascade to determine effective condom use among YWSS at high risk of HIV and identify programme gaps and possible strategies to increase condom use. This approach was very useful in identifying gaps but needs to be complemented by qualitative enquiry to better understand why gaps exist.

AUTHORS’ AFFILIATIONS

1Centre for Sexual Health and HIV/AIDS Research (CeSHHAR) Zimbabwe, Harare, Zimbabwe; 2Faculty of Infectious and Tropical Diseases, London School of Hygiene and Tropical Medicine, London, United Kingdom; 3Faculty of Public Health and Policy, London School of Hygiene and Tropical Medicine, London, United Kingdom; 4Faculty of Epidemiology and Population Health, London School of Hygiene and Tropical Medicine, London, United Kingdom; 5Centre for Sexual Health and HIV/AIDS Research (CeSHHAR) Zimbabwe, Harare, Zimbabwe; 6Faculty of Epidemiology and Population Health, London School of Hygiene and Tropical Medicine, Liverpool, United Kingdom; 7Faculty of Clinical Sciences and International Public Health, Liverpool School of Tropical Medicine, Liverpool, United Kingdom

COMPETING INTERESTS

No competing interests to declare.

AUTHORS’ CONTRIBUTIONS

SC planned and conducted the analysis, and wrote the first draft; BH was involved in planning the analysis and contributed to writing; TC and PM led the data collection; JB provided critical review of the article, particularly the introduction; SF, IB, JH, and FC were involved in the conception of the study, and BH, FC and JH critically revised the article. All authors contributed to the writing and have read and approved the final version.

ACKNOWLEDGEMENTS

We would like to thank the survey team and the women who participated in the study.

FUNDING

The DREAMS impact evaluation in Zimbabwe was funded by the Bill & Melinda Gates Foundation [OPP1136774, http://www.gatesfoundation.org]. Foundation staff advised the study team, but did not substantively affect the study design, instruments, interpretation of data or decision to publish.

REFERENCES

1. Dellar RC, Dlamini S, Karim QA. Adolescent girls and young women: key populations for HIV epidemic control. J Int AIDS Soc. 2015;18 2 Suppl 1:19408. https://doi.org/10.7448/ias.18.2.19408
2. UNAIDS. HIV and young people who sell sex: a technical brief. Geneva, Switzerland; 2014.
3. Busza J, Metwot S, Magrumo R, Wong-Greenwald R, Hanisch D, Cowan F. Underage and underserved: reaching young women who sell sex in Zimbabwe. AIDS Care. 2016;28 Supp2:14–20
4. Skovdal M. Facilitating engagement with PrEP and other HIV prevention technologies through practice-based combination prevention. J Int AIDS Soc. 2019;22(54):e25294. https://doi.org/10.1002/jia2.25294.
5. Petroni S, Ngo TD. Stopping HIV in adolescents: gender and modes of transmission. Lancet. 2018;392(10162):2335–6. https://doi.org/10.1016/s0140-6736(18)32150-0
6. Cornell M, Dowel K. Reaching key adolescent populations. Current Opinion in HIV and AIDS. 2018;13(3):274-280. https://doi.org/10.1097/COH.0000000000000457
7. Abdool Karim Q, Baxter C, Bixir D. Prevention of HIV in Adolescent Girls and Young Women: Key to an AIDS-Free Generation. J Acquir Immune Defic Syndr. 2017;77 Suppl 1:517–26. https://doi.org/10.1097/Qai.0000000000001316.
8. Saud J, Bachman TA, Toiv NF, Cooney C, Beaman R. The DREAMS core package of interventions: a comprehensive approach to preventing HIV among adolescent girls and young women. PLoS ONE. 2018;13:e0208167. https://doi.org/10.1371/journal.pone.0208167.
9. Chimbindi N, Birdhistle I, Shahnemesh M, Osindo J, Mushati P, Ondenge K, et al. Translating DREAMS into practice: early lessons from implementation in six settings. PLoS ONE. 2018;13:e0208243. https://doi.org/10.1371/journal.pone.0208243.
10. Schaefer R, Gregson S, Fearon E, Hensen B, Hallett TB, Hargreaves JR. HIV prevention cascades: a unifying framework to replicate the successes of treatment cascades. Lancet. HIV. 2019;6(1):e60–e6. https://doi.org/10.1016/s2352-3018(18)30327-8.
11. Hargreaves JR, Delany-Morrette S, Hallett TB, Johnson S, Kapiga S, Bhat-charjee P, et al. The HIV prevention cascade: integrating theories of epidemiological, behavioural, and social science into programme design and monitoring. Lancet HIV. 2016;3(7):e318–22. https://doi.org/10.1016/s2352-3018(16)30063-7.
12. Godfrey-Faussett P. The HIV prevention cascade: more smoke than thunder? The Lancet HIV. 2016;3(7):e286–e8. https://doi.org/10.1016/s2352-3018(16)30062-5.
13. Moorhouse L, Schaefer R, Thomas R, Nyamukapa C, Skovdal M, Hallett TB, et al. Application of the HIV prevention cascade to identify, develop and evaluate interventions to improve use of prevention methods: examples from a study in East Zimbabwe. J Int AIDS Soc. 2019;22(4):e25309. https://doi.org/10.1002/jia2.25309.
14. Hensen B, Hargreaves JR, Chiyaka T, Chabata S, Mushati P, Floyd S, et al. Evaluating the impact of DREAMS on HIV incidence among young women who sell sex: protocol for a non-randomised study in Zimbabwe. BMC Public Health. 2018;18(1):203. https://doi.org/10.1186/s12889-018-5085-6.
15. Birdhistle I, Schaffrit S, Kvaro D, Shahnemesh M, Ziraba A, Kabiru CW, et al. Evaluating the impact of the DREAMS partnership to reduce HIV incidence among adolescent girls and young women in four settings: a study protocol. BMC Public Health. 2018;18(1):912. https://doi.org/10.1186/s12889-018-5789-7.
16. Chiyaka T, Mushati P, Hensen B, Chabata S, Hargreaves JR, Floyd S, et al. Reaching young women who sell sex: Methods and results of social mapping to describe and identify young women for DREAMS impact evaluation in Zimbabwe. Plos One. 2018;13:e0194301. https://doi.org/10.1371/journal.pone.0194301.
17. Oppong Asante K, Osajo J, Doku PN. The role of condom use self-efficacy on intended and actual condom use among university students in Ghana. J Community Health. 2016;41(1):97–104. https://doi.org/10.1007/s10900-015-0073-6.
18. Closson K, Dietrich JJ, Lachowsky NJ, Nkala B, Palmer A, Cui Z, et al. Sexual self-efficacy and gender: a review of condom use and sexual negotiation among young men and women in Sub-Saharan Africa. J Sex Res. 2018;55(4-5):522–39. https://doi.org/10.1080/00224499.2017.1421607.
19. Leddy A, Chakravarti D, Diadi D, Sibruyn G, Darbes L. Sexual communication self-efficacy, hegemonic masculine norms and condom use among heterosexual couples in South Africa. AIDS Care. 2016;28(2):228–33. https://doi.org/10.1080/09540121.2015.1080792.
20. Ajayi AI, Olajumwon EO. What predicts self-efficacy? Understanding the role of sociodemographic, behavioural and parental factors on condom use self-efficacy among university students in Nigeria. Plos ONE. 2019;14:e0221804. https://doi.org/10.1371/journal.pone.0221804.
21. Hensen B, Chabata ST, Floyd S, Chiyaka T, Mushati P, Busza J, et al. HIV risk among young women who sell sex whether they identify as sex workers: analysis of respondent-driven sampling surveys, Zimbabwe. J Int AIDS Soc. 2019;22:e25410. https://doi.org/10.1002/jia2.25410.
22. Chingono R, Chibanda D, Chabata ST, Mariwoga G, Mupambireyi Z, Simms V, et al. Validation of the 8-item Shona Symptom Questionnaire, as a measure of common mental disorders in Harare. Acta Psychiatrica Scandinavica. 1997;95:469–75.
24. Chibanda D, Verhey R, Gibson LJ, Munetsi E, Machando D, Rusakaniko S, et al. Validation of screening tools for depression and anxiety disorders in a primary care population with high HIV prevalence in Zimbabwe. J Affect Disord. 2016;198:50–5. https://doi.org/10.1016/j.jad.2016.03.006.
25. Volz E, Heckathorn DD. Probability based estimation theory for respondent driven sampling. J Off Stat. 2008;24(1):79–97.
26. Heckathorn DD. Extensions of respondent-driven sampling: analyzing continuous variables and controlling for differential recruitment. Sociol Methodol. 2007;37(1):151–207.
27. Cowan FM, Mtetwa S, Davey C, Fearon E, Dirawo J, Wong-Gruenwald R, et al. Engagement with HIV prevention treatment and care among female sex workers in Zimbabwe: a respondent driven sampling survey. PLoS ONE. 2013;8:e77080. https://doi.org/10.1371/journal.pone.0077080.
28. Prakash R, Bhattacharjee P, Blanchard A, Musyoki H, Anthony J, Kimani J, et al. Effects of exposure to an intensive HIV-prevention programme on behavioural changes among female sex workers in Nairoi, Kenya. Afr J AIDS Res. 2018;17(2):99–108. https://doi.org/10.2998/16085906.2017.1377268.
29. Ahmed N, Pike C, Bekker L-G. Scaling up pre-exposure prophylaxis in sub-Saharan Africa. Curr Opin Infect Dis. 2019;32(1):24–30. https://doi.org/10.1097/qco.0000000000000511.
30. Cáceres CF, O'Reilly KR, Mayer KH, Baggaley R. PrEP implementation: moving from trials to policy and practice. J Int AIDS Soc. 2015;18(4 Suppl 3):20222. https://doi.org/10.7448/IAS.18.4.20222.
31. Parkhurst JO. Structural approaches for prevention of sexually transmitted HIV in high populations: definitions and an operational approach. J Int AIDS Soc. 2014;17(1):19052. https://doi.org/10.7448/IAS.17.1.19052.
32. Twahirwa Rwema JO, Lyons CE, Ketende S, Bowring AL, Rao A, Comins C, et al. Characterizing the influence of structural determinants of HIV risk on consistent condom use among female sex workers in Senegal. J Acquir Immune Defic Syndr. 2019;81(1):63–71. https://doi.org/10.1097/qai.0000000000001991.
33. Swan H, O’Connell DJ. The impact of intimate partner violence on women’s condom negotiation efficacy. J Interpers Violence. 2012;27(4):775–92. https://doi.org/10.1177/0886260511423240.
34. Onyango MA, Adu-Sarkodie Y, Agyarko-Poku T, Asafo MK, Sylvester J, Wondbergem P, et al. It’s All About Making a Life: Poverty, HIV, Violence, and other vulnerabilities faced by young female sex workers in Kumasi, Ghana. J Acquir Immune Defic Syndr. 2015;68:5131–57. https://doi.org/10.1097/qai.0000000000000455.
35. Bandyopadhyay K, Banerjee S, Goswami DN, Dasgupta A, Jana S. Predictors of inconsistent condom use among female sex workers: a community-based study in a red-light area of Kolkata, India. Indian J Community Med. 2018;43(4):274–8. https://doi.org/10.4103/ijcm.IJCM_84_18.
36. Busza J, Mtetwa S, Chirawu P, Cowan F. Triple jeopardy: adolescent experiences of sex work and migration in Zimbabwe. Health Place. 2014;28:85–91. https://doi.org/10.1016/j.healthplace.2014.04.002.
37. Chabata ST, Hensen B, Chiyyka T, Mushati P, Mtetwa S, Hanisch D, et al. Changes over time in HIV prevalence and sexual behaviour among young female sex-workers in 14 sites in Zimbabwe, 2013–2016. AIDS Behav. 2019;23(6):1494–507. https://doi.org/10.1007/s10461-019-02410-1.
38. Weiner R, Sisimayi C. Development and institutionalising HIV Prevention Cascades in the National Monitoring System in Zimbabwe: 2019.
39. Wanyenze RK, Musinguzi G, Kiguli J, Nuwaha F, Mujisha G, Musinguzi J, et al. "When they know that you are a sex worker, you will be the last person to be treated": perceptions and experiences of female sex workers in accessing HIV services in Uganda. BMC Int Health Hum Rights. 2017;17(1):11. https://doi.org/10.1186/s12914-017-0119-1.
40. Fearon E, Phillips A, Mtetwa S, Chabata ST, Mushati P, Cambiano V, et al. How can programs better support female sex workers to avoid HIV Infection in Zimbabwe? A prevention cascade analysis. J Acquir Immune Defic Syndr. 2019;81(1):24–35. https://doi.org/10.1097/qai.0000000000001980.
41. Michie S, van Stralen MM, West R. The behaviour change wheel: A new method for characterising and designing behaviour change interventions. Implement Sci. 2011;6(1):42. https://doi.org/10.1186/1748-5908-6-42.
42. Bhattacharjee P, Musyoki HK, Becker M, Musimbi J, Kassu S, Kikos J, et al. HIV prevention programme cascades: insights from HIV programme monitoring for female sex workers in Kenya. J Int AIDS Soc. 2019;22 Suppl 4:e25311. https://doi.org/10.1002/jia2.25311.
43. Cowan FM, Chabata ST, Musemburi S, Fearon E, Davey C, Ndori-Mharadze T, et al. Strengthening the scale-up and uptake of effective interventions for sex workers for population impact in Zimbabwe. J Int AIDS Soc. 2019;22 Suppl 4:e25320. https://doi.org/10.1002/jia2.25320.
44. Busza J, Chiyyka T, Musemburi S, Fearon E, Davey C, Chabata S, et al. Enhancing national prevention and treatment services for sex workers in Zimbabwe: a process evaluation of the SAPPH-IRe trial. Health Policy Plan. 2019;34(5):337–45. https://doi.org/10.1093/heapolicy/czz037.
45. Bhattacharjee P, Musyoki H, Prakash R, Malaba S, Dallabetta G, Wheeler T, et al. Micro-planning at scale with key populations in Kenya: Optimising peer educator ratios for programme outreach and HIV/STI service utilisation. PLoS ONE. 2018;13(3):e0205056. https://doi.org/10.1371/journal.pone.0205056.