HHS Public Access

Author manuscript

Sex Transm Infect. Author manuscript; available in PMC 2021 December 17.

Published in final edited form as:

Sex Transm Infect. 2020 March ; 96(2): 143–150. doi:10.1136/sextrans-2019-053961.

Considerable distance to reach 90-90-90 targets among female sex workers, men who have sex with men and transgender women in Port Moresby, Papua New Guinea: findings from a cross-sectional respondent-driven sampling survey

Avi J Hakim[1], **Steven G Badman**[2], **Damian Weikum**[1], **Angelyne Amos**[3], **Barne Willie**[3], **Rebecca Narokobi**[3], **Josephine Gabuzzi**[3], **Simon Pekon**[4], **Martha Kupul**[3], **Parker Hou**[3], **Herick Aeno**[3], **Ruthy Neo Boli**[3], **Joshua Nembari**[3], **Sophie Ase**[3], **John M Kaldor**[2], **Andrew J Vallely**[2,3], **Angela Kelly-Hanku**[2,3] **Kauntim mi tu Study Team**

[1]Division of Global HIV and Tuberculosis, US Centers for Disease Control and Prevention, Atlanta, Georgia, USA

[2]Kirby Institute for Infection and Immunity, UNSW Sydney, New South Wales, Australia

[3]Sexual and Reproductive Health, Papua New Guinea Institute of Medical Research, Goroka, Papua New Guinea

[4]Papua New Guinea National Department of Health, Port Moresby, Papua New Guinea

Abstract

Objective—To characterise the Joint United Nations Programme on HIV/AIDS 90-90-90 cascade among female sex workers (FSW) and men who have sex with men (MSM)/transgender women (TGW) in Port Moresby, Papua New Guinea (PNG).

Methods—We conducted respondent-driven sampling surveys among FSW and MSM/TGW in Port Moresby, PNG from June to October 2016. All participants spoke English or Tok Pisin and were aged >12 years. FSW had to be born female and sell/exchange sex with a male in the past 6 months. MSM/TGW had to be born male and have oral/anal sex with another male-born person in the past 6 months. Participants were interviewed and offered rapid HIV diagnostic and viral load testing. HIV viral suppression (VS) was defined as <1000 copies/mL.

Results—We recruited 674 FSW and 400 MSM/TGW; HIV prevalence was 15.2% (95% CI 11.7 to 18.8) and 8.5% (95% CI 5.0 to 11.9), respectively. Among FSW living with HIV, 39.0%

Correspondence to Avi J Hakim, US Centers for Disease Control and Prevention, Atlanta, GA 30329, USA; hxv8@cdc.gov.

Contributors AJH and AK-H designed the study and conceived of the manuscript. SGB and AJV led the biomarker component of the study. DW and AJH analysed the data. AA supervised the study, which was implemented by BW, RN, JG, SP, MK, PH, HA, RNB, JN and SA. JK provided technical direction. AJH and JMK contributed substantially to the writing of the manuscript. All authors reviewed the manuscript.

Competing interests None declared.

Ethics approval This study was approved by the PNG NDOH Medical Research Advisory Committee (#15.12), the Research Advisory Committee of NACS (#RES14004), the PNG Institute of Medical Research's Institutional Review Board (#1508) and the ethics committee of UNSW Sydney (#HC15355). The protocol was reviewed according to the Centers for Disease Control and Prevention's (CDC) human research protection procedures and was determined to be research, but CDC was not engaged (#2015–262).

(95% CI 26.6 to 51.4) self-reported having been diagnosed; of them 79.6% (95% CI 62.7 to 96.5) self-reported being on antiretroviral therapy (ART), and 54.1% (95% CI 31.8 to 76.4) achieved VS. Among MSM/TGW living with HIV, 24.4% (95% CI 4.7 to 44.1) self-reported having been diagnosed; of them 43.9% (95% CI 33.6 to 54.8) self-reported being on ART, and 86.1% (95% CI 71.1 to 93.9) achieved VS.

Conclusions—ART use among those aware of their HIV status is encouraging. However, the generally low awareness of infection status among FSW and MSM/TGW with HIV and the low VS among FSW on ART indicate an urgent need for innovative strategies to increase testing uptake and ART adherence among these populations. Monitoring drug resistance may be warranted.

INTRODUCTION

The most populous country in the South Pacific, Papua New Guinea (PNG) was long classified as having a generalised HIV epidemic.[1] HIV prevalence data initially only came from a limited number of urban antenatal clinic sites. Expansion of antenatal prevalence data from 17 sites in 2005 to 280 in 2011 has resulted in more complete information on the epidemic, and national HIV prevalence is now estimated at 0.8% among adults aged 15–49 years.[23] Simultaneously, a 2010 survey of female, male and transgender women (TGW) sex workers in the capital of Port Moresby found an HIV prevalence of 19.0%, 8.8% and 23.7%, respectively, and another survey of female sex workers (FSW) in Eastern Highlands Province found a prevalence of 7.0%.[4-6] This new information led to a growing recognition that HIV control efforts in PNG must focus on key populations, that is, sex workers (FSW), men who have sex with men (MSM) and TGW.[37]

Worldwide, key populations are at greater risk of acquiring HIV infection and face a greater burden of disease than the general population.[89] They also experience barriers in accessing HIV prevention and treatment services due in part to stigma, harassment, and other legal and social factors.[1011] In PNG, sex work and male-to-male sex are illegal and stigmatised.

The Joint United Nations Programme on HIV/AIDS (UNAIDS) set ambitious 90-90-90 targets for the percentages of people with HIV who know their infection status, are on antiretroviral therapy (ART) and have viral suppression: the ‘HIV treatment cascade’.[12] To implement this framework and track progress, countries need data to determine which populations are not being adequately reached by services. HIV biobehavioural surveys (BBS) are an essential tool for identifying population-level gaps in access and for measuring progress towards the 90-90-90 targets.[13] BBS are uniquely able to provide information on persons who access HIV services at general population and key populations (KP) facilities alike, and on those who do not access services.[13]

Data to guide PNG’s HIV response are sparse. No survey in PNG has sampled TGW who are not sex workers, and no population-based data exist to characterise progress against the 90-90-90 targets. In conjunction with the PNG National Department of Health and National AIDS Council Secretariat, we conducted a respondent-driven sampling (RDS) survey of FSW, MSM and TGW in Port Moresby to provide critical information to guide the

HIV response. We report on the HIV treatment cascade for these populations and identify correlates of diagnosed infection among FSW.

METHODS

Community consultation

Community consultation was undertaken with study population members. Recognising that TGW are distinct from MSM but are too few in number to achieve adequate sample size as an independent sample, the two populations were combined into one sample with agreement from population members.

Study population, setting and design

We conducted an RDS BBS of FSW and MSM/TGW in Port Moresby from June to October 2016, aiming to recruit 700 FSW and 700 MSM/TGW. RDS is a variant of snowball sampling that can be used to produce sampling weights and approximate a random sample.[14,15] Eligibility criteria were age >12 years, spoke English or Tok Pisin, and in possession of a valid study coupon. In addition, FSW needed to be born biologically female and have sold/exchanged sex in the past 6 months, while MSM/TGW needed to be born biologically male and had oral or anal sex with a male in the past 6 months.

Recruitment

Recruitment started with five FSW and four MSM/TGW seeds. To speed up and diversify recruitment, we added 4 FSW seeds and 12 MSM/TGW seeds. Seeds were selected to create diversity with respect to socially salient variables including age, sexual/gender identity, place of residence, and affiliation with a non-governmental or community-based organisation.

Data collection

After eligibility screening and providing verbal informed consent, participants underwent a computer-assisted personal interview. Interview domains included demographics, sexual history and identity, condom use, stigma, social cohesion, HIV knowledge, history of STDs and uptake of health services. The two-item Patient Health Questionnaire was used to screen for depression, with a score of 3 or above indicating major depressive disorder.[16] Comprehensive awareness of HIV was based on the UNAIDS definition.[17]

After the interview, participants received pretest HIV counselling before providing written informed consent for HIV testing. Fifteen millilitres of blood were taken through venipuncture for HIV testing and, if positive by confirmatory testing, CD4 T-cell count and HIV viral load testing. The national algorithm for HIV testing was used: determine HIV-1/2 (Alere, Massachusetts, USA), followed by confirmatory testing with HIV 1/2 Stat-Pak (Chembio, Medford, New York). HIV viral load testing was conducted using the GeneXpert HIV viral load assay (Cepheid, Sunnyvale, California). Participants were also offered STI testing and treatment, and tuberculosis testing and referral to treatment. Test results were returned to participants at the end of the first study visit. Those testing positive for HIV were offered to be escorted by a peer navigator to a treatment facility of their choice that

had been sensitised to work with key populations. Staff were trained to identify and refer all sexually exploited persons under the age of 18 years to partner organisations experienced in providing counselling and health, social and other protective services to these populations.

FSW received three coupons and MSM/TGW initially received three coupons with which to recruit peers. Midway through data collection, the number of coupons given to MSM/TGW was increased to four to increase recruitment. Participants received 45 PNG kina for their first visit (about US$14) and 10 PNG kina (about US$3) per successful recruit, plus 5 PNG kina (about US$1.5) for transportation at their second visit. All participants received information on HIV/STI, condoms and lubricants.

Data analysis

This analysis is restricted to FSW and MSM/TGW living with HIV. The primary endpoints of interest for analysis were (1) the proportion of those with HIV who had previously been diagnosed, (2) the proportion of those diagnosed who were on ART and (3) the proportion of those on ART who were virally suppressed. Suppressed HIV viral load was defined as <1000 copies/mL, and a viral load of >1500 copies/mL is noted as the threshold for heterosexual transmission.[18] We conducted a sensitivity analysis to explore the impact of self-reporting on cascade estimates and present the 90-90-90 cascade in two ways: (1) where inclusion in a step is based on self-reported response to the previous step, and (2) where inclusion in a step has been modified based on HIV viral load results and all participants with suppressed HIV viral load are considered to also be aware of their status and are on ART.

Tables 1-3 present self-reported results for awareness of HIV status and ART status, and lab-confirmed HIV viral load suppression as well as the prevalence of key characteristics among the survey populations. The bivariate analysis (table 4) assumed that all FSW with suppressed HIV viral load were also aware they were living with HIV. Bivariate analysis was not conducted among MSM/TGW due to insufficient statistical power. OR and 95% CI for FSW were calculated for bivariate comparisons among categorical variables, and a p value <0.05 was considered statistically significant.

All data presented are RDS-adjusted population estimates unless indicated. Wilson binomial proportions bounds based on RDS-adjusted data were used to estimate uncertainty for treatment status and viral suppression among MSM/TGW. Weights were imported from RDS Analyst V.0.62 (Los Angeles, California) using Gile's successive sampling estimator, and survey logistic procedures were used in SAS V.9.3 to identify factors associated with awareness of HIV status.

RESULTS

We enrolled 674 FSW and a combined sample of 400 MSM/TGW (354 MSM and 46 TGW). The HIV prevalence was 15.2% (95% CI 11.7 to 18.8) among FSW, 5.3% (95% CI 2.2 to 8.4) among MSM, 36.0% (95% CI 18.0 to 53.9) among TGW and 8.5% (95% CI 5.0 to 11.9) among MSM/TGW combined. Nearly half (45.9%) of FSW living with HIV were aged 25–34 years and 54.9% were separated or divorced (table 1). In contrast, 39.2%

of MSM/TGW living with HIV were aged 25–34 years and 72.3% had never been married (table 2). Almost half (44.2%) of MSM/TGW living with HIV identified their gender as TGW.

The 90-90-90 cascade among FSW

Among FSW living with HIV, 39.0% (95% CI 26.6 to 51.4) self-reported that they were aware of their HIV infection; of them 79.6% (95% CI 62.7 to 96.5) self-reported being on treatment, and 54.1% (95% CI 31.8 to 76.4) were virally suppressed (online supplementary figure 1A). Among all FSW living with HIV, 35.4% (95% CI 23.6 to 48.9) were virally suppressed. Of these women, 52.5% (95% CI 30.3 to 74.7) self-reported that they were aware they were living with HIV. Assuming that all FSW with suppressed viral load were aware of their HIV infection and on treatment yields a greater proportion who were aware of their status: 57.6% (95% CI 44.7 to 70.5). Of them, 86.2% (95% CI 74.3 to 98.1) were on treatment, and 71.3% (95% CI 55.0 to 87.6) were virally suppressed. The geometric mean viral load among FSW with HIV was 8130 (95% CI 2418 to 27 334), and 9.6% (95% CI 6.7 to 12.6) of all FSW had viral load ≥1500 copies/mL.

We next considered the association between individual characteristics and the components of the cascade. Self-reported awareness of HIV status among FSW living with HIV was 37.1% among those aged 15–24 years, 35.0% among those aged 25–34 years, and 66.9% among those aged 35 years or more (table 1). Among women for whom sex work was the main source of income, 29.4% were aware compared with 51.6% of those for whom it was not. Approximately one-third (35.2%) of women who were ashamed of selling/exchanging sex were aware of their infection compared with 45.9% of those who were not ashamed. Women responsible for one or more children at home had higher awareness (51.5%) than those responsible for no children (25.2%) (online supplementary table 1). Those who used a modern contraceptive method were also more aware than those who did not, 79.3% and 34.6%, respectively.

Among the 58.2% of FSW with HIV who did not use a condom at last sex, 33.4% were aware they were living with HIV (table 3). Moreover, 59.5% of HIV-infected FSW had symptoms of an STI in the last 12 months, and of them only 1.8% sought treatment for their symptoms (data not shown) and 33.9% were aware they were living with HIV (table 1). Among women who spoke with a peer educator or outreach worker in the last 12 months, 46.7% were aware of their HIV status.

In bivariate analysis (table 4), the following associations were found to be statistically significant for FSW being aware of HIV status: being responsible for one or more children at home compared with no children (OR: 3.2, 95% CI 1.1 to 10.1), not being ashamed of being a sex worker (OR: 3.9, 95% CI 1.2 to 12.2), using modern contraception (OR: 7.3, 95% CI 1.7 to 30.8), and using the internet or mobile apps to meet clients in the last 6 months (OR: 5.8, 95% CI 1.0 to 33.1).

The 90-90-90 cascade among MSM/TGW

Among MSM/TGW living with HIV, 24.4% (95% CI 4.7 to 44.1) self-reported that they were aware of their HIV infection; of them 43.9% (95% CI 33.6 to 54.8) self-reported

being on treatment, and 86.1% (95% CI 71.1 to 93.9) were virally suppressed (online supplementary figure 1b). Among all MSM/TGW living with HIV, 25.2% (95% CI 6.4 to 44.0) were virally suppressed, and among those who were virally suppressed 37.2% (95% CI 0.0 to 90.4) self-reported that they were aware they were living with HIV. Assuming that they were aware of their infection and on treatment reveals that 39.9% (95% CI 18.3 to 61.6) of MSM/TGW were aware of their status. Of them 65.7% (95% CI 57.3 to 73.3) were on treatment, and 94.3% (95% CI 87.3 to 97.6) were virally suppressed. Separating the two populations, we found that 1.6% (95% CI 0.0 to 5.4) of MSM living with HIV had been diagnosed compared with 88.4% (95% CI 73.2 to 100.0) of TGW. The geometric mean viral load among MSM and TGW with HIV was 24 965 (95% CI 3804 to 163 827), and 6.0% (95% CI 3.0 to 9.0) of all MSM/TGW had viral load ≥1500 copies/mL.

Among MSM/TGW, 2.1% of those who felt the need to hide that they have sex with men or TGW when accessing healthcare were aware of their infection, compared with 44.1% among those who did not (table 2). Similarly, awareness was 4.9% among those ashamed that they have sex with men or TGW and 32.9% among those who were not ashamed (online supplementary table 2). Awareness was also higher among those self-identifying as transgender than as those not doing so (55.3% vs 0.0%, respectively).

Similar to FSW, among the 57.6% of MSM/TGW with HIV who did not use condom at last sex, 21.9% were aware they were living with HIV. Moreover, 70.2% of HIV-infected MSM/TGW had symptoms of an STI in the last 12 months, and of them only 1.8% sought treatment for their symptoms (data not shown) and 29.8% were aware they were living with HIV. Among MSM/TGW who spoke with a peer educator or outreach worker in the last 12 months, 29.8% were aware of their HIV status.

DISCUSSION

The treatment cascades of FSW and MSM/TGW in Port Moresby reveal the considerable distance to reaching 90-90-90 targets among these populations. With only 35.4% of FSW and 25.2% of MSM/TGW with HIV virally suppressed, and 9.6% of all FSW and 6.0% of all MSM/TGW having viral load ≥1500 copies/mL, our survey highlights the potential for the number of new infections to increase, particularly among MSM/TGW. Transmission among MSM/TGW may be higher since the threshold of 1500 copies/mL is based on data from heterosexuals.[18] Together with self-reported awareness of 39.0% among FSW and 24.4% among MSM/TGW, these data further point to the continued role for traditional prevention services such as condom and lubricant promotion, alongside pre-exposure prophylaxis and HIV case finding.

Our survey is unique in that it included testing for HIV viral load and multiple STIs with same-day return of results and active linkage to care. To our knowledge, this is the first BBS of key populations to provide same-day return of *Chlamydia trachomatis*, *Neisseria gonorrhoeae* and HIV viral load results. As these tests were otherwise not available in PNG at the time of the survey, we believe their provision encouraged survey participation.

The potential for HIV transmission and acquisition remains high given the prevalence of STD symptoms and low awareness of HIV infection among FSW and MSM/TGW.[19] STI testing and treatment have been identified as among the most pressing needs for sex workers.[20] That few FSW and MSM/TGW are accessing STD treatment or HIV testing lays bare a missed opportunity for integrated sexual and reproductive health services for these populations.

Similar to other settings, the largest gap in the treatment cascades of FSW and MSM/TGW in Port Moresby was awareness of HIV-positive status.[21] Although a small proportion of FSW in Port Moresby living with HIV have been diagnosed, once diagnosed, HIV testing programmes have successfully linked nearly 90% to treatment. While testing programmes have had some success diagnosing TGW living with HIV, the same is not true for MSM, and linkage of both populations to treatment could be strengthened. The high proportion of FSW and MSM/TGW who spoke with an outreach worker or peer educator in the last 12 months but were unaware of their infection underscores a missed opportunity for community-based HIV testing, peer-mediated self-testing or referral to testing. Our findings also indicate the possible role that people who help FSW find clients can play in supporting HIV testing.

The proportion of FSW on ART with suppressed viral load is of particular concern, as the prevalence of transmitted drug resistance to non-nucleoside reverse transcriptase inhibitors is estimated at 16.1% in Port Moresby.[22] HIV viral suppression among MSM/TGW on ART was nearly 90%, suggesting limited transmitted drug resistance among them and their sexual networks. A larger sample size, drug resistance testing and genotyping could confirm this and elucidate whether their HIV epidemic is separate from that of FSW.

Our findings are limited by the self-reported nature of interview data. The proportion of virally suppressed people who indicated that they are not aware of their HIV status or are not on HIV treatment suggests social desirability bias which can be mitigated through the use of audio-computer-assisted self-interviews.[2324] We believe that modifying the treatment cascade as we did in our sensitivity analysis may provide a more accurate depiction of programme coverage as elite controllers are expected to comprise only 1% of the population because PNG's epidemic is relatively young and treatment coverage is low.[25] Testing for the presence of antiretroviral (ARV) medications could further elucidate the treatment cascade and help account for elite controllers. Such testing in a general population survey in Kenya revealed that 21.0% of HIV-infected people who indicated that they were uninfected had ARV medications in their blood, and of those indicating they were HIV-positive but not on ART 12.9% had ARVs in their blood.[26] While we had a larger than average sample size for FSW, it was still insufficient to conduct a thorough analysis of factors associated with each step of the cascade as our survey was powered to measure HIV prevalence.[27] The smaller number of MSM and TGW limited our analysis concerning the treatment cascade in these populations even further.

CONCLUSIONS

The gaps in service provision in Port Moresby offer opportunities for large gains with adequate resources and targeting of interventions. Without such support, there is the prospect

of a decrease in each step of the cascade and a worsening HIV epidemic among FSW, MSM and TGW in PNG. There is an urgent need for improved testing modalities to reach more of key population members in Port Moresby and the expansion of the nascent HIV viral load testing programme to monitor treatment outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements

We want to thank the survey participants for their collaboration and support with this survey. We are grateful to Kapul Champions for their ongoing support and engagement with the study and its findings. We would also like to thank Nick Dala of the PNG National Department of Health for his support with the survey.

Funding

This project has been supported by the Government of Australia, the Global Fund to Fight AIDS, TB and Malaria, and the President's Emergency Plan for AIDS Relief (PEPFAR) through the Centers for Disease Control and Prevention (CDC) under the terms of Cooperative Agreement Number 1 U2G GH001531-01 to Cardno. This publication was also supported by the CDC under the terms of Cooperative Agreement Number NU2GGH002093-01-00 to the Public Health institute.

REFERENCES

1. Papua New Guinea. In PNG, the epidemic that wasn't. Science 2014;345:158–61. [PubMed: 25013060]
2. Secretariat PNAC. Papua New Guinea HIV prevalence 2012 estimates. Port Moresby, 2013.
3. UNAIDS. Papua New Guinea | UNAIDS, 2017. Available: http://www.unaids.org/en/regionscountries/countries/papuanewguinea/
4. Wand H, Siba P Prevalence and correlates of HIV infection among sex workers in Papua New Guinea: first results from the Papua New Guinea and Australia sexual health improvement project (PASHIP). AIDS Behav 2015;19:2194–203. [PubMed: 26016470]
5. Maibani GRC, Lote N, Edward G, et al. Papua New Guinea - Australia Sexual Health Improvement Program. Report on the Baseline Survey. Goroka: PNG Institute of Medical Research, 2011.
6. Kelly A, Kupul M, Man WYN, et al. Ask and understand): people who sell and/or exchange sex in Port Moresby. Key quantitative findings. Papua New Guinea institute of Medical Research and the University of New South Wales: Sydney, Australia, 2011.
7. Secretariat P. Papua New Guinea national HIV and AIDS strategy 2011-2015. Port Moresby: National Department of Health, 2010.
8. Baral S, Beyrer C, Muessig K, et al. Burden of HIV among female sex workers in low-income and middle-income countries: a systematic review and meta-analysis. The Lancet Infectious Diseases 2012;12:538–49. [PubMed: 22424777]
9. Beyrer C, Baral SD, van Griensven F, et al. Global epidemiology of HIV infection in men who have sex with men. The Lancet 2012;380:367–77.
10. Arreola S, Santos G-M, Beck J, et al. Sexual stigma, criminalization, investment, and access to HIV services among men who have sex with men worldwide. AIDS Behav 2015;19:227–34. [PubMed: 25086670]
11. Ayala G, Makofane K, Santos G-M, et al. Access to basic HIV-related services and PreP acceptability among men who have sex with men worldwide: barriers, facilitators, and implications for combination prevention. J Sex Transm Dis 2013;2013:1–11.
12. UNAIDS. 90-90-90: an ambitious treatment target to help end the AIDS epidemic. Geneva, 2014.

13. Hladik W, Benech I, Bateganya M, et al. The utility of population-based surveys to describe the continuum of HIV services for key and general populations. Int J STD AIDS 2016;27:5–12. [PubMed: 25907348]
14. Heckathorn DD. Respondent-Driven sampling: a new approach to the study of hidden populations. Soc Probl 1997;44:174–99.
15. Heckathorn DD. Snowball versus Respondent-Driven sampling. Sociol Methodol 2011;41:355–66. [PubMed: 22228916]
16. Kroenke K, Spitzer RL, Williams JBW. The patient health Questionnaire-2: validity of a two-item depression screener. Med Care 2003;41:1284–92. [PubMed: 14583691]
17. UNAIDS. Global AIDS response progress reporting 2014: construction of core indicators for monitoring the 2011 United Nations political Declaration on HIV and AIDS. Geneva, 2014.
18. Quinn TC, Wawer MJ, Sewankambo N, et al. Viral load and heterosexual transmission of human immunodeficiency virus type 1. N Engl J Med 2000;342:921–9. [PubMed: 10738050]
19. Ward H, Rönn M. Contribution of sexually transmitted infections to the sexual transmission of HIV Curr Opin HIV AIDS 2010;5:305–10. [PubMed: 20543605]
20. Scorgie F, Nakato D, Harper E, et al. 'We are despised in the hospitals': sex workers' experiences of accessing health care in four African countries. Cult Health Sex 2013;15:450–65. [PubMed: 23414116]
21. Hakim AJ, MacDonald V Hladik W, et al. Gaps and opportunities: measuring the key population cascade through surveys and services to guide the HIV response. J Intern AIDS Soc 2018;21(1):e25119.
22. Lavu E, Kave E, Mosoro E, et al. High levels of transmitted HIV drug resistance in a study in Papua New Guinea. Plos One 2017;12:e0170265. [PubMed: 28146591]
23. Hewett PC, Mensch BS, Erulkar AS. Consistency in the reporting of sexual behavior by adolescent girls in Kenya: a comparison of interviewing methods. Sex Transm Infect 2004;80(suppl_2):ii43–8. [PubMed: 15572639]
24. Phillips AE, Gomez GB, Boily M-C, et al. A systematic review and meta-analysis of quantitative interviewing tools to investigate self-reported HIV and STI associated behaviours in low- and middle-income countries. Int J Epidemiol 2010;39:1541–55. [PubMed: 20630991]
25. Olson AD, Meyer L, Prins M, et al. An evaluation of HIV elite controller definitions within a large seroconverter cohort collaboration. PLoS ONE 2014;9:e86719. [PubMed: 24489776]
26. Kim AA, Mukui i, Young PW, et al. Undisclosed HIV infection and antiretroviral therapy use in the Kenya AIDS indicator survey 2012. AIDS 2016;30:2685–95. [PubMed: 27782965]
27. Johnston LG, Hakim AJ, Dittrich S, et al. A systematic review of published Respondent-Driven sampling surveys collecting behavioral and biologic data. AIDS Behav 2016;20:1754–76. [PubMed: 26992395]

Key messages

- Biobehavioural surveys can provide important information on the progress towards the Joint United Nations Programme on HIV/AIDS 90-90-90 targets to inform service provision and policies.
- The majority of female sex workers and men who have sex with men/transgender women in Port Moresby, Papua New Guinea who are living with HIV remain unaware of their HIV infection.
- Monitoring of viral suppression and drug resistance among key populations remains important.

Sex Transm Infect. Author manuscript; available in PMC 2021 December 17.

Table 1

Characteristics of HIV-positive female sex workers (FSW) at each stage of the conditional 90-90-90 cascade in Port Moresby, 2016

	HIV-positive (n=94)	Self-reported HIV-positive aware (n=42)	Self-reported on treatment (n=36)	Suppressed viral load (n=20)
	n (%; 95% CI)	n (%; 95% CI)	n (%; 95% CI)	n (%; 95% CI)
Age (years)				
15–24	28 (30.1; 17.9 to 42.2)	10 (37.1; 12.2 to 62.0)	7 (55.1; 4.6 to 100.0)	4 (74.8; 30.0 to 100.0)
25–34	42 (45.9; 32.6 to 59.2)	20 (35.0; 17.8 to 52.2)	19 (90.6; 71.7 to 100.0)	10 (48.2; 20.2 to 76.2)
35 or older	19 (24.0; 12.2 to 35.8)	12 (66.9; 38.7 to 95.0)	10 (85.6; 61.8 to 100.0)	6 (51.1; 2.8 to 99.3)
Highest level of education completed				
No formal education	25 (32.9; 20.2 to 45.7)	9 (34.8; 10.6 to 59.0)	6 (58.0; 8.8 to 100.0)	4 (87.3; 58.4 to 100.0)
Primary	51 (54.9; 41.8 to 68.1)	17 (29.6; 14.7 to 44.0)	14 (79.9; 55.5 to 100.0)	8 (59.8; 26.3 to 93.3)
High school or higher	17 (12.2; 4.0 to 20.3)	16 (97.8; 92.9 to 100.0)	16 (100.0; 100.0 to 100.0)	8 (29.3; 0.4 to 58.3)
Marital status				
Never married	12 (11.4; 3.4 to 19.5)	4 (19.4; 0.0 to 43.8)	3 (77.4; 2.9 to 100.0)	1 (41.6; 0.0 to 100.0)
Married	17 (19.3; 9.0 to 29.5)	10 (40.0;10.5 to 69.4)	9 (82.3; 45.2 to 100.0)	6 (74.3; 38.5 to 100.0)
Divorced or separated	51 (54.9; 41.9 to 67.8)	19 (35.4; 18.5 to 52.3)	17 (89.3; 72.7 to 100.0)	9 (41.8; 8.8 to 74.7)
Widowed	14 (14.4; 5.0 to 23.8)	9 (67.1; 29.6 to 100.0)	7 (58.4; 4.1 to 100.0)	4 (73.2; 23.5 to 100.0)
Sex work as main source of income				
Yes	61 (56.6; 43.5 to 69.6)	24 (29.4; 16.0 to 42.8)	20 (72.4; 47.5 to 97.3)	11 (50.4; 21.9 to 78.9)
No	33 (43.4; 30.4 to 56.5)	18 (51.6; 29.9 to 73.3)	16 (84.9; 60.7 to 100.0)	9 (56.4; 22.2 to 90.6)
Money earned last month				
<200 kina (~US$63)	13 (17.3; 6.6 to 28.0)	4 (35.6; 0.0 to 73.8)	4 (100.0; 100.0 to 100.0)	3 (88.3; 42.1 to 100.0)
200–499 kina (~US$63–US$156)	29 (36.6; 22.8 to 50.3)	15 (44.1; 19.6 to 68.7)	15 (100.0; 100.0 to 100.0)	7 (46.6; 8.5 to 84.7)
≥500 kina (~≥US$157)	37 (46.1; 32.0 to 60.1)			
Screened positive for depression				
Yes	28 (35.2; 22.5 to 47.8)	12 (39.2; 16.2 to 62.3)	10 (70.9; 31.2 to 100.0)	4 (54.0; 10.0 to 98.1)
No	66 (64.8; 52.2 to 77.5)	30 (38.9; 23.8 to 54.0)	26 (84.4; 67.9 to 100.0)	16 (54.1; 26.1 to 82)
Had STI symptoms, last 12 months				
Yes	52 (59.5; 46.9 to 72.1)	23 (33.9; 17.9 to 49.9)	18 (66.4; 38.0 to 94.8)	10 (67.4; 39.1 to 95.7)
No	41 (40.5; 27.9 to 53.1)	19 (49.2; 29.4 to 69.0)	18 (93.0; 78.3 to 100.0)	6 (30.4; 0.3 to 60.4)
Disclosed sex work to anyone				

	HIV-positive (n=94)	Self-reported HIV-positive aware (n=42)	Self-reported on treatment (n=36)	Suppressed viral load (n=20)
	n (%; 95% CI)	n (%; 95% CI)	n (%; 95% CI)	n (%; 95% CI)
Yes	69 (69.6; 57.6 to 81.6)	31 (37.2; 22.6 to 51.8)	27 (76.4; 53.7 to 99.1)	16 (58.0; 31.5 to 84.6)
No	25 (30.4; 18.4 to 42.4)	11 (43.3; 18.5 to 68.0)	9 (85.8; 61.0 to 100.0)	4 (47.2; 0.0 to 95.8)
Ashamed to be FSW				
Yes	60 (73.4; 62.7 to 84.2)	22 (30.5; 16.6 to 44.6)	17 (67.5; 40.1 to 94.9)	11 (57.4; 22.9 to 91.9)
No	33 (26.6; 15.8 to 37.3)	20 (63.1; 40.7 to 85.4)	19 (95.7; 86.5 to 100.0)	9 (51.0; 18.7 to 83.3)
Ashamed to disclose sex work to healthcare worker				
Yes	40 (51.8; 38.7 to 64.9)	17 (35.2;17.1 to 53.2)	14 (85.3; 66.0 to 100.0)	8 (66.8; 35.4 to 98.1)
No	51 (48.2; 35.1 to 61.3)	25 (45.9; 27.8 to 64.0)	22 (74.9; 48.2 to 100.0)	12 (42.2; 14.1 to 70.4)
Can rely on other FSW to accompany them to doctor or hospital				
Yes	26 (22.3; 12.2 to 32.3)	14 (60.1; 34.8 to 85.3)	11 (73.5; 42.5 to 100.0)	6 (45.4; 1.8 to 89.0)
No	67 (77.7; 67.7 to 87.8)	28 (34.4; 20.1 to 48.6)	25 (82.6; 61.0 to 100.0)	14 (58.0; 30.8 to 85.1)
Can rely on other FSW to help them with violent clients, partners or people				
Yes	56 (54.1; 41.5 to 67.7)	24 (37.8; 22.1 to 53.5)	20 (76.7; 54.6 to 98.7)	10 (44.5; 15.7 to 73.4)
No	38 (45.4; 32.3 to 58.5)	18 (40.5; 20.0 to 61.1)	16 (82.8; 54.4 to 100.0)	10 (64.0; 28.4 to 99.6)
Can rely on other FSW to borrow money from them				
Yes	45 (50.3; 37.3 to 63.3)	19 (33.8; 17.1 to 50.5)	15 (76.5; 52.2 to 100.0)	8 (44.5; 10.0 to 79.0)
No	49 (49.7; 36.7 to 62.7)	23 (44.2; 25.7 to 62.7)	21 (81.9; 56.8 to 100.0)	12 (60.9; 30.7 to 91.1)
Currently using modern contraceptive method				
Yes	16 (23.0; 10.5 to 35.4)	11 (79.3; 57.9 to 100.0)	11 (100.0; 100.0 to 100.0)	5 (37.3; 0.4 to 74.3)
No	48 (77.0; 64.6 to 89.5)	19 (34.6; 16.6 to 52.6)	17 (76.3; 44.4 to 100.0)	10 (60.1; 23.3 to 96.9)

Table 2

Characteristics of HIV-positive men who have sex with men (MSM) and transgender women (TGW) in Port Moresby, 2016

	HIV-positive MSM/TGW (n=30)	HIV-positive MSM (n=15)	HIV-positive TGW (n=15)	HIV-positive aware MSM/TGW (n=7)
	n (%; 95% CI)	n (%; 95% CI)	n (%; 95% CI)	n (%; 95% CI)
Age (years)				
15–24	11 (36.2; 14.8 to 57.7)	6 (34.2; 3.0 to 65.3)	5 (38.9; 5.7 to 72.1)	2 (21.6; 0.0 to 59.6)
25–34	12 (39.2; 17.2 to 61.3)	5 (35.7; 2.6 to 68.7)	7 (43.7; 10.8 to 76.6)	3 (27.3; 0.0 to 63.8)
35 or older	7 (24.5; 4.8 to 44.3)	4 (30.6; 0.0 to 62.6)	3 (17.4; 0.0 to 39.3)	2 (23.9; 0.0 to 67.3)
Completed high school education or higher				
Yes	15 (51.6; 29.0 to 74.1)	8 (61.5; 11.7 to 100.0)	7 (39.4; 8.9 to 70.0)	3 (16.0; 0.0 to 36.1)
No	15 (48.4; 25.9 to 71.0)	7 (38.8; 5.7 to 72.0)	8 (60.6; 30.0 to 91.1)	4 (33.4; 0.0 to 68.5)
Marital status				
Never married	23 (72.3; 51.0 to 93.6)	11 (61.6; 26.8 to 96.3)	12 (85.8; 67.6 to 100.0)	5 (27.2; 2.1 to 52.2)
Married, divorced or separated, widowed	7 (27.7; 6.4 to 49.0)	4 (38.4; 3.7 to 73.2)	3 (14.2; 0.0 to 32.4)	2 (17.2; 0.0 to 50.3)
Self-identified gender as TGW				
Yes	15 (44.2; 22.2 to 66.2)	0.0 (0.0; 0.0 to 0.0)	15 (100.0; 97.4-100.0)	7 (55.3; 23.2 to 87.3)
No	15 (55.8; 33.8 to 77.8)	15 (100.0; 98.0-100.0)	0.0 (0.0; 0.0 to 0.0)	0 (0.0; 0.0 to 0.0)
Feels the need to hide having sex with men/TGW when seeking healthcare				
Yes	13 (46.9; 24.2 to 69.5)	7 (57.6; 24.9 to 90.2)	6 (33.4; 4.2 to 62.5)	1 (2.1; 0.0 to 7.1)
No	17 (53.1; 30.5 to 75.8)	8 (42.4; 9.8 to 75.1)	9 (66.6; 37.5 to 95.8)	6 (44.1; 12.7 to 75.5)
Money earned last month				
<500 kina (~US$157)	7 (26.0; 3.1 to 49.0)	2 (9.9; 0.0 to 30.5)	5 (47.5; 8.5 to 86.4)	3 (55.5; 0.0 to 100.0)
500–999 kina (~US$157–US$314)	10 (52.8; 25.7 to 80.0)	5 (62.6; 21.0 to 100.0)	5 (39.8; 3.4 to 76.2)	1 (4.0; 0.0 to 13.7)
1000 kina or more (US$315 or more)	5 (21.2; 0.0 to 43.2)	3 (27.5; 0.0 to 66.6)	2 (12.7; 0.0 to 33.6)	1 (15.9; 0.0 to 65.0)
Screened positive for depression				
Yes	6 (10.0; 0.1 to 19.9)	4 (13.5; 0.0 to 31.1)	2 (5.6; 0.0 to 14.9)	2 (24.7; 0.0 to 73.3)
No	24 (90.0; 80.1 to 99.9)	11 (86.5; 68.9 to 100.0)	13 (94.4; 85.1 to 100.0)	5 (24.4; 2.5 to 46.2)
Can rely on other MSM/TGW to accompany them to doctor or hospital				
Yes	16 (56.0; 32.4 to 79.7)	6 (43.3; 6.4 to 80.3)	10 (70.4; 37.5 to 100.0)	5 (30.0; 0.1 to 59.9)
No	11 (44.0; 20.3 to 67.6)	7 (56.7; 19.7 to 93.6)	4 (29.6; 0.0 to 62.5)	2 (23.2; 0.0 to 59.7)
Had sex with a woman in the last 6 months				

	HIV-positive MSM/TGW (n=30)	HIV-positive MSM (n=15)	HIV-positive TGW (n=15)	HIV-positive aware MSM/TGW (n=7)
	n (%; 95% CI)	n (%; 95% CI)	n (%; 95% CI)	n (%; 95% CI)
Yes	10 (48.8; 19.2 to 78.4)	9 (59.4; 22.4 to 96.4)	1 (7.9; 0.0 to 30.5)	1 (3.4; 0.0 to 11.7)
No	9 (51.2; 21.6 to 80.8)	4 (40.6; 3.6 to 77.6)	5 (92.1; 69.5 to 100.0)	3 (23.6; 0.0 to 57.4)
Used internet or mobile apps to meet sex partners, last 6 months				
Yes	14 (54.4; 32.3 to 76.6)	8 (67.2; 36.8 to 97.5)	6 (38.3; 5.8 to 70.9)	3 (21.7; 0.0 to 50.3)
No	16 (45.6; 23.4 to 67.7)	7 (32.8; 2.5 to 63.2)	9 (61.7; 29.1 to 94.2)	4 (27.7; 0.0 to 58.3)
Had a male/TGW client who gave money or goods, last 6 months				
Yes	15 (54.2; 31.5 to 76.8)	4 (35.6; 1.6 to 69.6)	11 (77.2; 52.8 to 100.0)	4 (30.1; 0.0 to 62.7)
No	14 (45.8; 23.2 to 68.5)	10 (64.4; 30.4 to 98.4)	4 (22.8; 0.0 to 47.2)	3 (18.2; 0.0 to 41.3)
Bought sex from a male/TGW sex worker partner, last 6 months				
Yes	8 (15.1; 2.3 to 27.8)	4 (10.0; 0.0 to 23.4)	4 (21.4; 0.0 to 45.8)	3 (40.0; 0.0 to 90.9)
No	21 (84.9; 72.2 to 97.7)	10 (90.0; 76.6 to 100.0)	11 (78.6; 54.2 to 100.0)	4 (21.9; 0.0 to 44.6)
Used condom at last sex act				
Yes	14 (42.4; 20.5 to 64.3)	4 (22.7; 0.0 to 50.6)	10 (67.4; 35.5 to 99.2)	3 (27.8; 0.0 to 61.5)
No	16 (57.6; 35.7 to 79.5)	11 (77.3; 49.4 to 100.0)	5 (32.6; 0.8 to 64.5)	4 (21.9; 0.0 to 48.2)
Had STI symptoms, last 12 months				
Yes	21 (70.2; 49.7 to 90.8)	9 (58.8; 25.2 to 92.5)	12 (84.6; 64.3 to 100.0)	6 (29.8; 3.8 to 55.8)
No	9 (29.8; 9.2 to 50.3)	6 (41.2; 7.5 to 74.8)	3 (15.4; 0.0 to 35.7)	1 (11.7; 0.0 to 39.2)
Spoke with peer educator or outreach worker, last 12 months				
Yes	24 (74.6; 54.3 to 94.9)	9 (54.5; 20.5 to 88.5)	15 (100.0; 97.4-100.0)	7 (32.7; 7.8 to 57.7)
No	6 (25.4; 5.1 to 45.7)	6 (45.5; 11.5 to 79.5)	0.0 (0.0; 0.0 to 0.0)	0 (0.0; 0.0 to 0.0)
Given free condoms, last 12 months				
Yes	22 (60.9; 38.0 to 83.8)	8 (42.2; 8.8 to 75.7)	14 (84.5; 54.2 to 100.0)	6 (28.9; 3.8 to 53.9)
No	8 (39.1; 16.2 to 62.0)	7 (57.8; 24.3 to 91.2)	1 (15.5; 0.0 to 45.8)	11 (17.5; 0.0 to 57.0)

Table 3

Sex work characteristics, sexual behaviours and HIV services among HIV-positive female sex workers at each stage of the conditional 90-90-90 cascade in Port Moresby, 2016

	HIV-positive (n=94)	Self-reported HIV-positive aware (n=42)	Self-reported on treatment (n=36)	Self-reported suppressed viral load (n=20)
	n (%; 95% CI)	n (%; 95% CI)	n (%; 95% CI)	n (%; 95% CI)
Years selling sex				
≤2 years	31 (36.6; 23.9 to 49.3)	8 (27.9; 6.9 to 48.8)	5 (47.2; 0.0 to 100.0)	3 (82.7; 37.7 to 100.0)
3–4 years	20 (22.2; 11.3 to 33.2)	9 (31.5: 7.3 to 55.7)	8 (92.8; 75.4 to 100.0)	4 (57.2; 9.3 to 100.0)
5 years or more	43 (41.2; 28.5 to 53.8)	25 (53.0; 33.1 to 72.9)	23 (90.5; 76.1 to 100.0)	13 (46.1; 16.8 to 75.4)
Used internet or mobile apps to meet clients, last 6 months				
Yes	10 (9.6; 2.5 to 16.8)	8 (75.9; 41.0 to 100.0)	7 (81.4; 38.1 to 100.0)	4 (76.5; 34.6 to 100.0)
No	83 (90.4; 83.2 to 97.5)	34 (35.1; 22.3 to 47.9)	29 (79.2; 59.9 to 98.5)	16 (48.8; 24.1 to 73.5)
Has someone who facilitates meeting clients				
Yes	35 (37.4; 24.9 to 50.0)	13 (24.6; 9.0 to 40.3)	11 (70.5; 33.5 to 100.0)	8 (81.2; 55.9 to 100.0)
No	59 (62.6; 50.0 to 75.1)	29 (47.6; 30.9 to 64.3)	25 (82.4; 62.8 to 100.0)	12 (46.9; 19.6 to 74.2)
Had a main male partner, last 6 months				
Yes	52 (52.6; 39.6 to 65.6)	27 (40.4; 23.7 to 57.1)	23 (77.4; 56.2 to 98.5)	14 (66.1; 41.7 to 90.5)
No	42 (47.4; 34.4 to 60.4)	15 (37.5; 18.0 to 57.0)	13 (82.2; 52.2 to 100.0)	6 (40.6; 2.1 to 79.1)
Used condom at last sex act				
Yes	43 (41.8; 29.2 to 54.3)	22 (46.9; 27.9 to 65.9)	17 (72.9; 49.3 to 96.4)	10 (63.9; 34.1 to 93.6)
No	51 (58.2; 45.7 to 70.8)	20 (33.4; 16.5 to 50.3)	19 (86.3; 59.8 to 100.0)	10 (45.8; 12.5 to 79.0)
Spoke with peer educator or outreach worker, last 12 months				
Yes	52 (52.1; 39.1 to 65.0)	29 (46.7; 28.8 to 64.7)	25 (83.8; 66.9 to 100.0)	15 (56.3; 29.3 to 83.2)
No	42 (47.9; 35.0 to 60.9)	13 (30.7; 12.5 to 48.8)	11 (72.6; 34.6 to 100.0)	5 (50.0; 3.1 to 96.8)
Given free condoms, last 12 months				
Yes	62 (58.9; 45.9 to 71.9)	33 (45.7; 29.2 to 62.1)	29 (84.9; 69.4 to 100.0)	18 (66.2; 44.3 to 88.0)
No	32 (41.1; 28.1 to 54.1)	9 (32.1; 10.9 to 53.3)	7 (68.7; 22.4 to 100.0)	2 (23.6; 0.0 to 68.1)

Table 4

Bivariate model for awareness of HIV-positive status among FSW in Port Moresby, 2016*

Variable	n	OR (95% CI)	P value
Age	89		0.1663
15–24		Ref	
25–34		0.9 (0.3 to 3.3)	
35+		3.4 (0.7 to 16.5)	
Marital status	94		0.2449
Never married		Ref	
Married		2.8 (0.5 to 16.4)	
Divorced or separated		2.3 (0.5 to 10.8)	
Widowed		8.4 (1.1 to 66.0)	
Sex work as main source of income	94		0.0804
Yes		Ref	
No		2.6 (0.9 to 7.4)	
Money earned last month	79		0.9190
<200 kina (~US$63)		Ref	
200–499 kina (~US$63–US$156)		1.4 (0.2 to 8.4)	
≥500 kina (~≥US$157)		1.4 (0.3 to 7.5)	
Number of children responsible for at home	93		0.0365
None		Ref	
One or more		3.2 (1.1 to 9.2)	
Screened positive for depression	94		0.9802
Yes		Ref	
No		1.0 (0.3 to 3.0)	
Any STI symptoms, last 12 months	93		0.2344
Yes		Ref	
No		1.9 (0.7 to 5.4)	
Disclosed sex work to anyone	94		0.6634
Yes		Ref	
No		1.3 (0.4 to 4.0)	
Ashamed to sell sex	93		0.0201
Yes		Ref	
No		3.9 (1.2 to 12.2)	
Ashamed to disclose sex work to healthcare worker	91		0.4016
Yes		Ref	
No		1.6 (0.5 to 4.5)	
Can rely on other FSW to help them with violent clients, partners or people	94		0.8280
Yes		Ref	
No		1.1 (0.4 to 3.3)	
Can rely on other FSW to borrow money from them	94		0.4050
Yes		Ref	

Variable	n	OR (95% CI)	P value
No		1.6 (0.5 to 4.4)	
Using modern contraceptive method	64		0.0079
Yes		7.3 (1.7 to 30.8)	
No		Ref	
Years selling sex	94		0.1944
≤2 years		Ref	
3–4 years		1.2 (0.3 to 5.1)	
5 years or more		2.9 (0.8 to 10.6)	
Used internet or mobile apps to meet clients, last 6 months	94		0.0464
Yes		5.8 (1.0 to 33.1)	
No		Ref	
Has someone who facilitates meeting clients	94		0.0577
Yes		Ref	
No		2.8 (1.0 to 8.0)	
Had a main male partner, last 6 months	94		0.8226
Yes		Ref	
No		0.9 (0.3 to 2.6)	
Used condom at last sex act	94		0.2931
Yes		Ref	
No		0.6 (0.2 to 1.6)	
Spoke with peer educator or outreach worker, last 12 months	94		0.0714
Yes		Ref	
No		0.4 (0.1 to 1.1)	
Given free condoms, last 12 months	93		0.3219
Yes		Ref	
No		0.6 (0.2 to 1.8)	

*Assumes that all FSW with suppressed HIV viral load were also aware they were living with HIV.

FSW, female sex workers; ref, reference.