



Published in final edited form as:

AIDS Care. 2024 July ; 36(sup1): 201–210. doi:10.1080/09540121.2024.2307383.

Social Network Strategy (SNS) for HIV Testing: A New Approach for Identifying Individuals with Undiagnosed HIV Infection in Tanzania

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Abstract

Social network strategy (SNS) testing uses network connections to refer individuals at high risk to HIV testing services (HTS). In Tanzania, SNS testing is offered in communities and health facilities. In communities, SNS testing targets key and vulnerable populations (KVP), while in health facilities it complements index testing by reaching unelicited index contacts. Routine data were used to assess performance and trends over time in PEPFAR-supported sites between October 2021 and March 2023. Key indicators included SNS social contacts tested, and new HIV-positives individuals identified. Descriptive and statistical analysis were conducted. Univariable and multivariable analysis were applied, and variables with P -values <0.2 at univariable analysis were considered for multivariable analysis. Overall, 121,739 SNS contacts were tested, and 7,731 (6.4%) previously undiagnosed individuals living with HIV were identified. Tested contacts and identified HIV-positives were mostly aged ≥ 15 years ($>99.7\%$) and females (80.6% of tests, 79.4% of HIV-positives). Most SNS contacts were tested (78,363; 64.7%) and diagnosed (6376; 82.5%) in communities. SNS tests and HIV-positives grew 11.5 and 6.1-fold respectively, from October-December 2021 to January-March 2023, with majority of clients reached in communities vs. facilities (78,763 vs. 42,976). These results indicate that SNS testing is a promising HIV case-finding approach in Tanzania.

Keywords

Tanzania; social network strategy; HIV testing services; sub-Saharan Africa; SDG 3

INTRODUCTION

Many countries in sub-Saharan Africa (SSA) are focused on reaching the Joint United Nations Programme on HIV/AIDS (UNAIDS)'s 95–95–95 strategy (UNAIDS, 2015) and responding to the United Nations Sustainable Development Goal (SDG) 3 (UN, 2023). A 2016–2017 national population-based household survey conducted in Tanzania showed that only 61.0% of people living with HIV in Tanzania knew their status, (TACAIDS, 2018). To address this gap, the Government of Tanzania (GOT) through the Ministry of Health (MOH), in collaboration with the U.S. President's Emergency Plan for AIDS Relief (PEPFAR), prioritized more effective and targeted HIV case identification strategies, such as index testing, optimized facility based provider-initiated testing and counseling (PITC), HIV self-testing and focused community HIV testing services (HTS) targeting key and vulnerable populations (KVP) at high risk of HIV infection (NACP, 2017, 2019). KVP is defined as groups at increased risk of HIV transmission/acquisition, i.e. female sex workers (FSW), men who have sex with men (MSM), and people who inject drugs (PWID), or long distance track drivers, fisherfolks/fishing community and miners/mining community (NACP, 2017)

Reflecting on the HIV case identification strategies deployed after the Tanzania HIV Impact Survey 2016–2017 (TACAIDS, 2018), one potential modality to improve HTS and HIV case

identification activities was index testing, a case finding modality that demonstrated great programmatic impact in identifying individuals with undiagnosed HIV infections across most sub-populations and age groups (Dalal et al., 2017; Kahabuka et al., 2017; Lyamuya et al., 2020; Mahachi et al., 2019; Sharma et al., 2018). Understanding that the challenges of reaching undiagnosed PLHIV increase as the identification gap decreases (Chamie et al., 2021), Tanzania considered social network strategies (SNS testing) for HTS as an additional modality to reach networks at high risk for HIV and to identify PLHIV who would otherwise not be diagnosed through routine HTS (McCree et al., 2013; PEPFAR, 2023; Stojanovski et al., 2021). In 2021, PEPFAR recommended SNS testing to enhance HIV case finding among networks of high-risk individuals (PEPFAR, 2021b), especially in countries with large gaps to reaching UNAIDS' first 95. These findings are consistent with the World Health Organization (WHO) and Centers for Disease Control and Prevention's (CDC) descriptions of SNS as a case finding strategy that improves identification of PLHIV who do not know their HIV status (CDC, 2023; WHO, 2019). Additionally, SNS testing promoted uptake of HIV self-testing as well as Pre-exposure Prophylaxis (PrEP) (Chamie et al., 2021; Kwan et al., 2023; Lee & Schafer, 2023; Sheira et al., 2022), which are integral parts of HTS and HIV prevention respectively. Tanzania's MOH, in collaboration with PEPFAR and its implementing partners (IPs), started to implement and report SNS testing data from both communities and facilities starting in October 2021 (PEPFAR fiscal year 2022) (PEPFAR, 2021a).

SNS testing has been implemented globally and in SSA (Chamie et al., 2021; Farquhar et al., 2022; Lee & Schafer, 2023) primarily targeting networks of KVP identified above (Girault et al., 2015), (Denisiuk et al., 2023), (Sheira et al., 2022). SNS testing was also used to complement index testing, which is an established effective HIV case finding modality. PEPFAR described this hybrid of modalities as "blended" where HIV positive index clients were used as seeds, who were given HTS referral coupons to take to index contacts who would not be elicited or reached through routine index testing (PEPFAR, 2023). The elicitation of index contacts who, for different reasons, cannot be identified through index testing are elicited as social contacts by SNS testing. This approach provided index cases the freedom of participation and safety assurance for themselves and their partners (Grimsrud et al., 2023; PEPFAR, 2021a), including age-discordant sexual partnerships with increased HIV risk to the younger partner (Ritchwood et al., 2016), due to social-legal issues like incarceration for sex with minor age, it may be challenging for an older index case to identify younger partners as sexual contacts under index testing program, would rather list them anonymously as social contact under SNS testing.

This paper describes performance of SNS testing scale-up, its trend over time and factors associated with uptake of SNS in Tanzania from October 2021 to March 2023. Also, it highlights efforts by GOT led by MOH under PEPFAR's to ensure scale-up of SNS testing with fidelity and its potential impact on the overall HIV case finding strategies towards reaching HIV epidemic control.

MATERIALS AND METHODS

Overall HTS delivery and SNS testing implementation

HTS is provided by trained health care workers according to MOH-approved, national guidelines and standard operating procedures (SOPs) (NACP, 2019). Key case finding modalities reported by PEPFAR in Tanzania include: identifying, finding, and testing individuals exposed to HIV-positive clients (index testing), HIV testing at health facility TB clinics (TB Clinic), community HIV testing outreach activities (community mobile testing), provider-initiated HIV risk screening and testing (optimized PITC), and SNS testing (NACP, 2019). Also, the two prevention monitoring HTS modalities which focused on prevention of mother to child transmission (PMTCT) are; HIV testing of pregnant women at their first antenatal care clinic (ANC) for their current pregnancy (HIV testing at antenatal clinic (ANC)), and HIV testing of pregnant or breast feeding women after first ANC test up to 18 months post-delivery (maternal retesting) (NACP, 2019; PEPFAR, 2021a).

Tanzania started reporting SNS testing as a HTS modality in October 2021, which is the beginning of PEPFAR fiscal year 2022. SNS testing has been implemented in both community and health facility (facility) settings. In communities, it targeted mainly KVP known as “seeds or recruiters” who were given coupons to share with their social contacts at high-risk for HIV acquisition and or transmission (NACP, 2017). Seeds or recruiters are often KVP themselves (HIV-positive or high-risk HIV negative clients) who are instructed to refer their high-risk network members for HTS (CDC, 2023; WHO, 2019). In facilities, SNS testing served as a practical extension of index testing to reach the unelicited contacts who may be sexual/needles sharing partners or biological children, or other high-risk network members of a HIV-positive client. SNS testing cascade implies looking at the SNS performance in association of seeds/recruits (initial client), social contacts elicited, social contacts tested and testing results.

Data collection, recording and reporting

In Tanzania, the collection, recording, and reporting of HTS data from community and health facility sites uses national HTS tools. HTS data are collected and reviewed for accuracy, completeness, and consistency, then recorded in a PEPFAR-developed system called “Data for Accountability Transparency Impact Monitoring” (DATIM). DATIM serves as a centralized platform for data management and reporting, ensuring consistent and comprehensive reporting of HTS services across sites supported by PEPFAR. SNS testing is reported as a HTS service delivery modality for community and health facility sites (PEPFAR, 2021a). SNS testing indicators collected include number of SNS tests and number HIV-positives identified disaggregated by age and sex.

Data analysis

Programmatic data captured in DATIM were downloaded for the analysis period of interest. Site level data were imported to generate pivot tables on an MS Excel spreadsheet limited to HTS variables (indicators) reported over 18 months, i.e., October 2021 through March 2023. HIV positivity yield (“yield”) was calculated as the percentage of total HIV-positives divided by total HIV tests done. SNS testing contribution was calculated as percentage

of SNS test results divided by total HIV test results from all HTS modalities together. Descriptive analyses were conducted using the Microsoft Excel software. Performance of each of the HTS modalities was done to show HIV tests, resulted HIV-positives, percentages of HIV-positives (yield) and percentage contribution for each HTS modality. Additionally, performance of SNS testing was shown in terms of social contacts tested, HIV-positive identified and proportion of SNS testing to all modalities' total testing disaggregated by setting (community/facility), sex, and age. SNS testing trend analysis on quarterly (3-month) basis for the reporting duration was conducted and further disaggregated by different attributes of setting (facility vs. community). For the statistical analysis, the inferential analysis was done using a Poisson log-linear model accounting for robust standard errors to assess factors associated with number of people receiving HTS. The multivariable model was developed to control for the possible confounders that could exist for some of the factors with outcome of interest. The independent variables for the regression model included age, sex, and facility type and the dependent variable was HTS through SNS testing. The robust standard errors were opted to control for mild violation of the distribution assumption. Both univariable and multivariable analysis were applied, and variables with P-values <0.2 at univariable analysis were considered for multivariable analysis.

RESULTS:

Overall results by modality, setting, sex, and age

During the 18-month analysis period (October 2021 – March 2023), PEPFAR Tanzania reported a total of 5,856,460 HIV tests conducted through all modalities and identified 261,466 new HIV cases. The index testing modality contributed over half (53.4%) of all HIV positives identified (Table 1). During this period, SNS testing reported 121,739 tests and 7,731 new HIV positives. Approximately two thirds (64.7%) of SNS tests and over three quarters (82.5%) of HIV-positive cases identified were from communities. Also, over three quarters of both SNS tests (80.6%) and HIV-positives cases (79.4%) were females and most aged above 15 years (>99.7% for both tests and positives). The overall SNS testing positivity rate is 6.4%, with no significant difference between sexes (males 6.7%, females 6.3%), but with variations by settings i.e., community 8.1% and facility 3.2% (Table 2). The positivity rates were highest among females aged 35 years (>10%) and males 45 years (>15%) compared to other age groups above 15 years. Also, higher positivity rates were observed among children—females aged 1–4 years (10.5%) and males aged 10–14 years (22.7%) (Table 3). Dispensaries had a lower uptake of SNS testing, while health centers and hospitals were not significantly different from communities. The results also showed younger populations were testing more using SNS testing compared to older adults: age 15–19 years [exp (0.71), P=.01], age 20–24 years [exp (1.58), P<.0001], age 25–29 years [exp (1.55), P<.0001], age 30–34 years [exp (1.23), P=.0002], age 35–39 years [exp (0.60), P=.003] (Table 4).

SNS testing scale-up performance trend

From the beginning of the analysis period, the quarter October – December 2021 to the quarter January – March 2023, SNS tests increased by 11.5-fold (43,058/3,739). SNS testing increased faster in facilities compared to community venues during the same

period (SNS tests: 7.6-fold community, 40.2-fold facility (Figure 1). Quarterly trend of positivity rate declined, from 11.0% in the quarter October – December 2021 to 5.9% in the quarter January – March 2023, while the number of HIV positives identified through SNS testing increased by 6.1-fold (2522/411) (Figure 2), with 4.8-fold increase in community (1,940/406), and 116.4-fold increase in facility (582/5) (Figure 3). The positivity rates trend showed variations by setting: >7.7% in community and <4.0% in facility (Figure 4).

SNS implementation coverage

Index testing is a HTS modality implemented extensively across all community and facility sites in Tanzania. SNS testing is expected to follow the footprint of index testing in terms of sites coverage, therefore, number of index testing sites were used as benchmark to measure the scale-up of SNS testing (Figure 5 & 6). Between quarters October – December 2021 and January – March 2023 community sites that reported at least 1 SNS test increased by 4.2-fold from 265 sites to 1,119 sites, which is equivalent to 27.3% and 76.1% of all community sites implementing index testing, respectively (Figure 5). Figure 6 shows two benchmarks PEPFAR Tanzania used to measure SNS testing coverage in facility setting, one is total number of PEPFAR Tanzania supported health facilities, and the other is facilities that reported at least 1 index test. Facility coverage of SNS testing against index testing facilities increased from 15.5% in October – December 2021 quarter to 72% by Jan-Mar 2023 quarter and from 9% to 58% against PEPFAR supported facilities for PEPFAR fiscal year 2023 (Figure 6). Correspondingly, the proportion of HIV positives identified from SNS out of all HIV positive diagnoses increased from 1% in the quarter October – December 2021 to 5.4% in quarter January – March 2023 (Figure 7).

DISCUSSION

This analysis highlighted the potential role of SNS testing, which showed exponential growth in identifying previously undiagnosed individuals over six quarters. Though not fully implemented across community and facility sites, the contribution of HIV-positives from SNS testing increased more than five times between quarters October – December 2021 and January – March 2023. The positivity rate from SNS testing was >6%, higher than the average positivity rate from the overall HTS program in Tanzania (~4%)(NACP, 2019), implying effectiveness of this model.

Community SNS testing contribution is higher compared to facility most probably because the implementation started in the communities compared to facility. The facility implementation rolled-out in phased approach that started with high-volume facilities (hospitals), down to lower-volume facilities i.e., health centers and dispensaries, which is why uptake of SNS testing in hospitals equals community. More females reached by SNS testing compared to males correlates with the overall Tanzania HTS program performance. The higher positivity rate of >10% among women aged >35 years and men aged >45 years (>15%), is consistent with results seen with the index testing modality.

SNS testing has been shown to be integrated well with other HIV case finding modalities, particularly index testing and HIV self-testing, as well as DREAMS and PrEP (Denisiuk et al., 2023; Farquhar et al., 2022; Girault et al., 2015; Kwan et al., 2023). SNS testing was

used to reach unelicited sexual partners from index testing as social contacts and showed effectiveness on diagnosing new HIV infections among Adolescent Girls and Young Women (AGYW) in facility settings (i.e., 1,512 HIV-positive females aged 15–24 years identified through SNS testing with the positivity rate of >3% - more than average yield for AGYW) (NACP, 2017). These findings have potential benefits and opportunities to reduce new HIV infections in this priority age group.

Although children were not the target population for SNS testing, they were part of elicited social networks at risk of HIV. A total of 20 children living with HIV (CLHIV) aged 15 years were identified through SNS testing from 241 pediatric social contacts tested. The observed high positivity rate of 8.3% for identified CLHIV is about four times higher than the average rate for this population in Tanzania (~2%) (NACP, 2019). These findings prompted review of the program and data to better understand and apply SNS testing for HIV case finding among pediatric and adolescents.

Lack of systems that can support reporting of SNS testing and SNS testing outputs by sub-population type are observed limitations of this modality. These should be considered in prospective reviews of standardized national data recording and reporting tools as they are essential components for SNS testing program oversight and impact measurement.

This analysis investigated SNS testing implementation in both communities and health facilities targeting KVP. Much of the published literature on SNS globally and in SSA has focused on Key Populations (Boyer et al., 2013; Farquhar et al., 2022; Girault et al., 2015; Kwan et al., 2023; Maina et al., 2018; McCree et al., 2013). The increased HIV identification as the model was scaled-up underscores the potential of this HIV case-finding approach in Tanzania. The findings from this analysis suggested that there are still potential opportunities to further scale-up SNS testing in both communities and facilities, providing a solid signal to inspire full SNS testing roll-out, and closer monitoring of the program impact.

CONCLUSION:

SNS testing demonstrated its effectiveness in reaching high-risk individuals who would otherwise not been reached through existing HTS modalities in Tanzania. The program implementation coverage thus far indicated that there are still opportunities to scale up this modality in both community and facility settings. Nonetheless, closer tracking of facility implementation is needed to ensure fidelity to the SNS model due to the persistent lower positivity rate. For useful and impactful oversight of the program, HTS systems should be enabled to capture beneficiaries' population type and cascade of SNS testing. As Tanzania heads toward HIV epidemic control, the integration of innovative case-finding modalities as this is crucial to enhance identification of the undiagnosed PLHIV, and back-up the existing effective strategies like index testing.

Acknowledgments

DISCLAIMER:

The findings and conclusions in this manuscript are those of the authors and do not necessarily represent the official position of the funding agencies.

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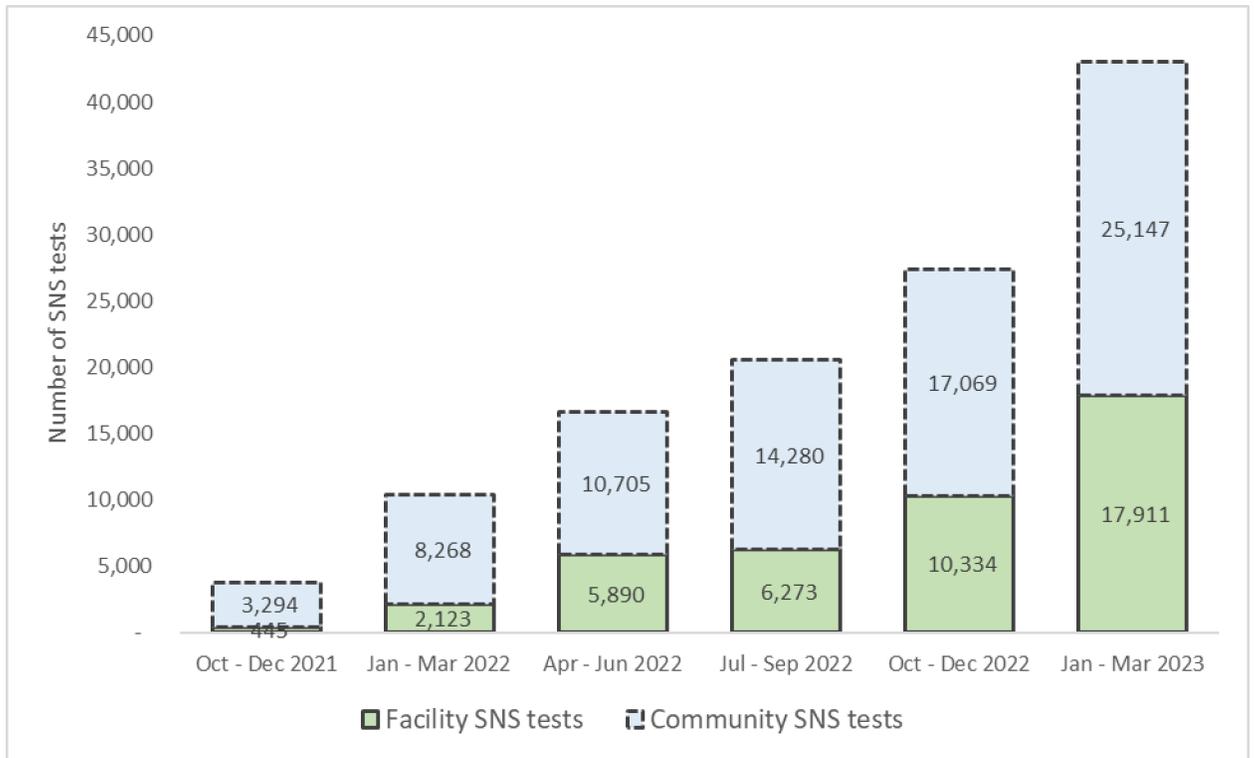


Figure 1: Quarterly trend of SNS tests disaggregated by community and facility, in PEPFAR-supported sites in Tanzania between October 2021 to March 2023.

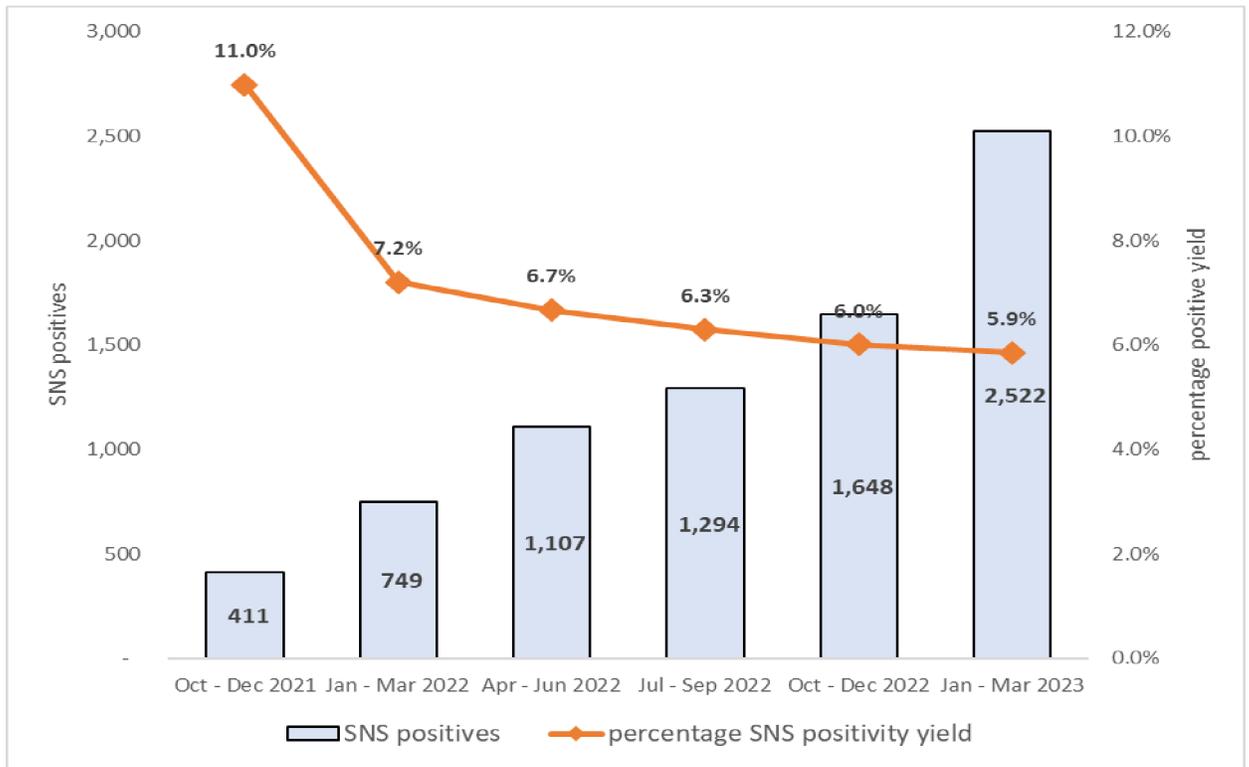


Figure 2: Quarterly trend of SNS testing HIV positives and percentage positivity yield, in PEPFAR-supported sites in Tanzania between October 2021 to March 2023

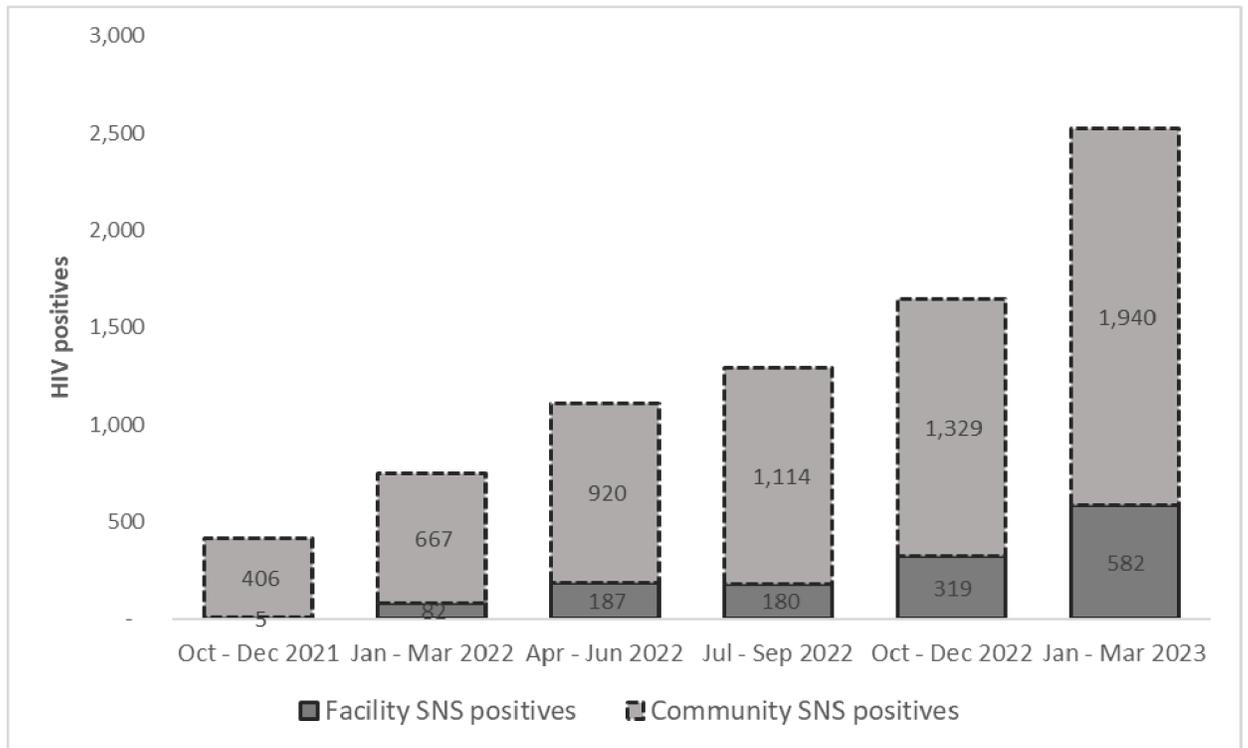


Figure 3: Quarterly trend of SNS testing HIV positives by community and facility settings, in PEPFAR-supported sites in Tanzania between October 2021 to March 2023

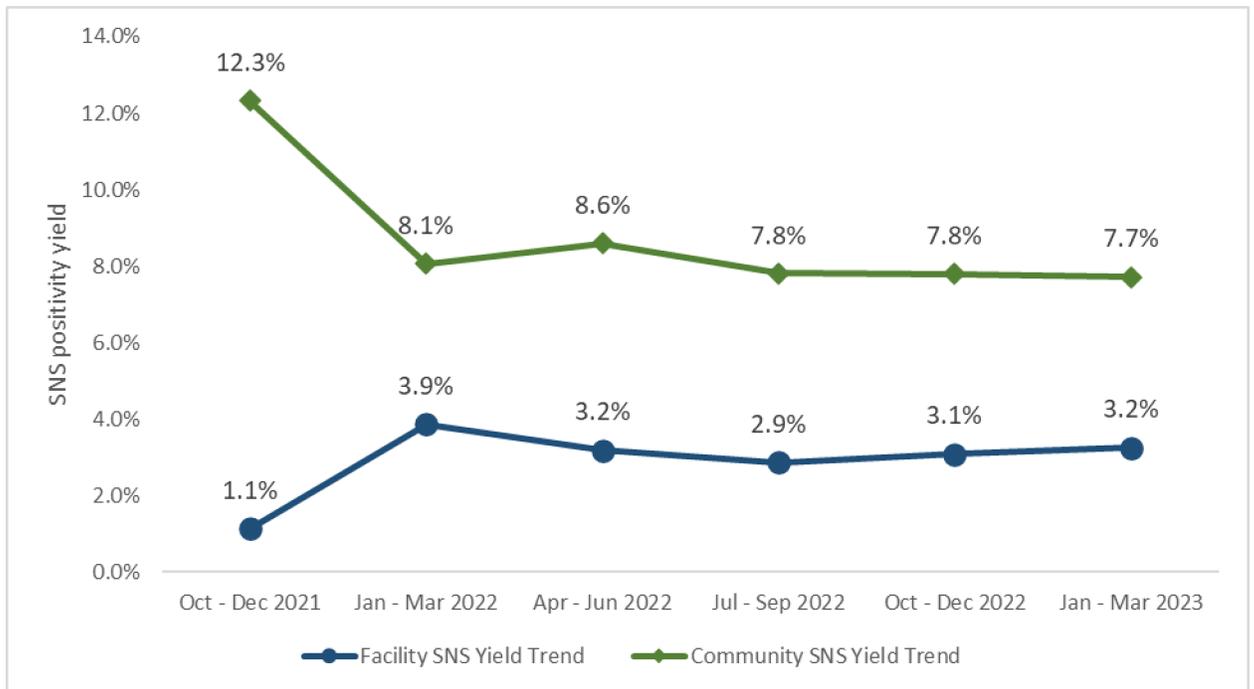


Figure 4: Quarterly trend of SNS positivity yield for community and facility settings, in PEPFAR-supported sites in Tanzania between October 2021 to March 2023

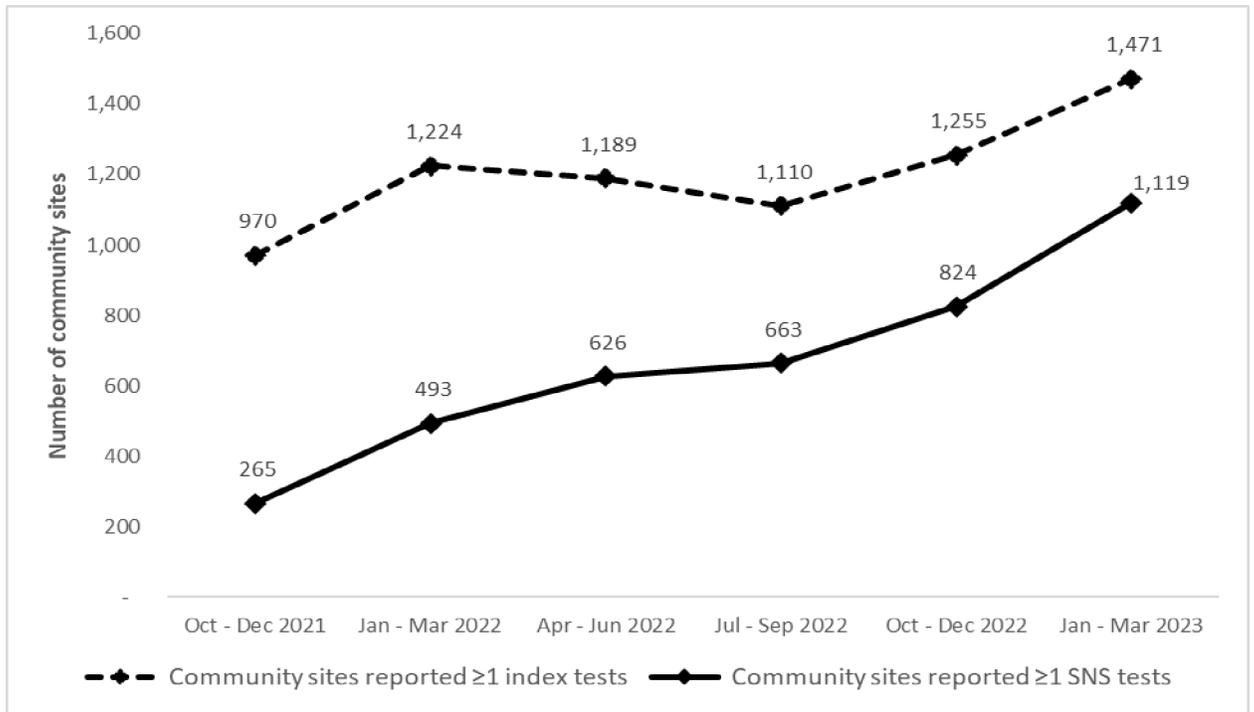


Figure 5: The quarterly trend of the number of community sites reported SNS tests against community sites which reported at least 1 index tests, in PEPFAR-supported sites in Tanzania between October 2021 to March 2023

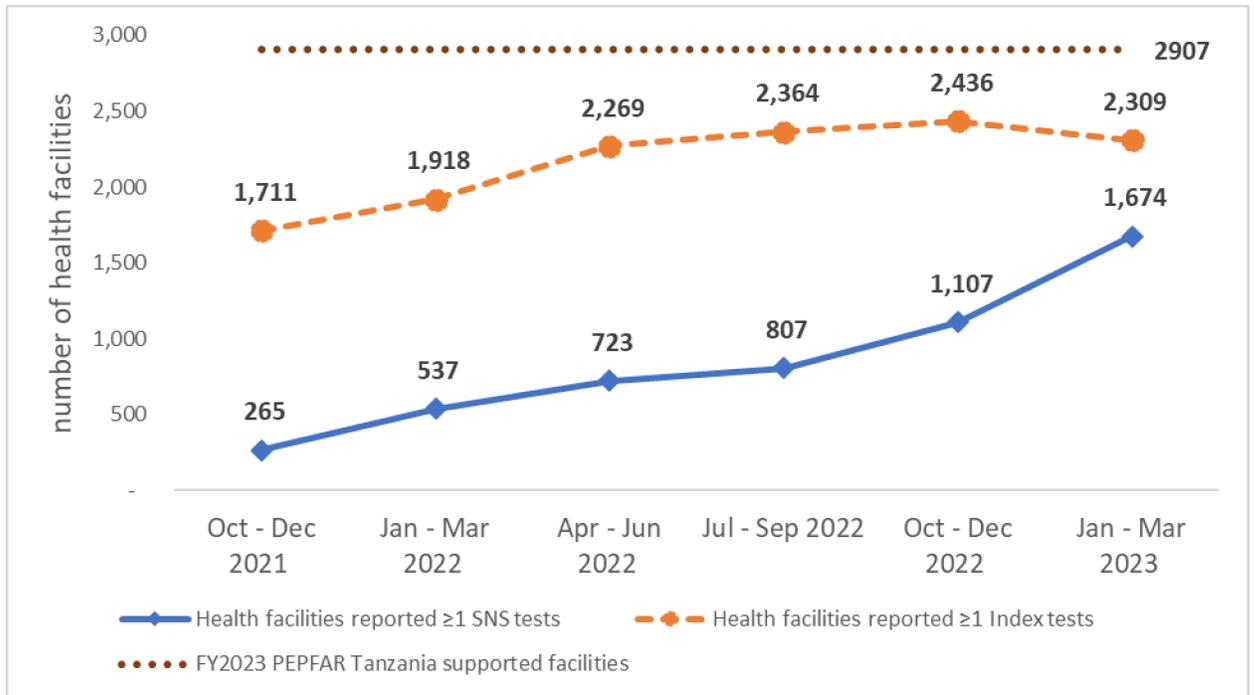


Figure 6: Quarterly trend of the number of health facilities reported SNS tests against PEPFAR supported facilities and facilities reported at least 1 index tests, in PEPFAR-supported sites in Tanzania between October 2021 to March 2023

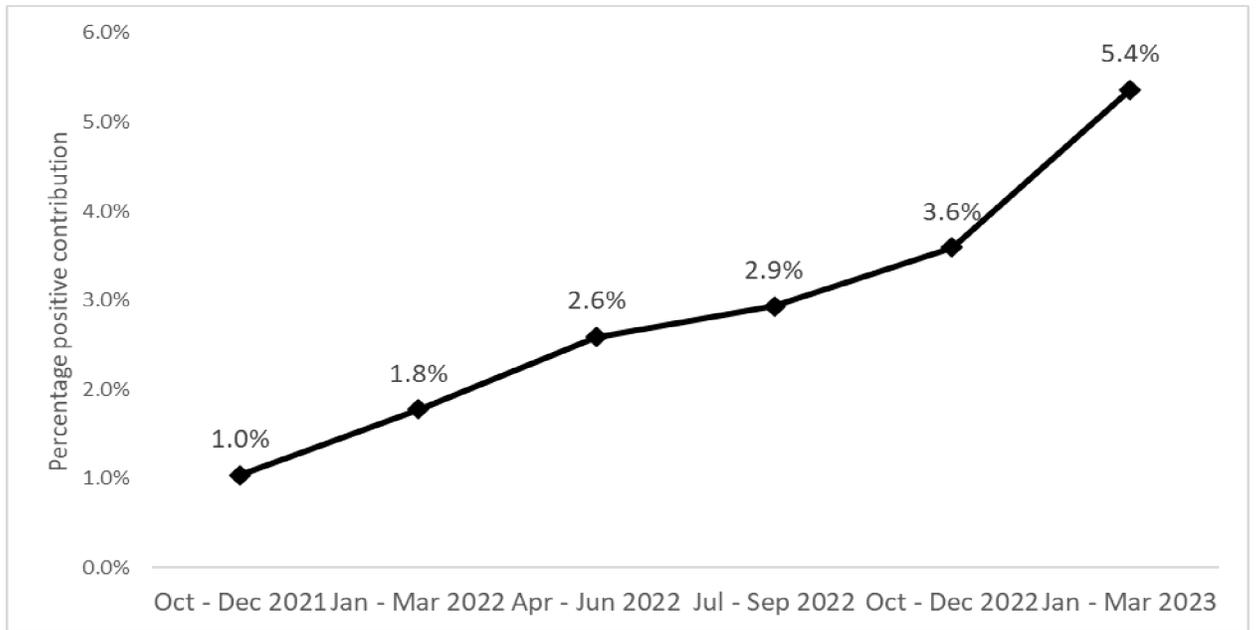


Figure 7:
The quarterly trend of proportion of new positives identified from SNS testing modality to all positives, in PEPFAR-supported sites in Tanzania between October 2021 to March 2023

Table 1:

HIV testing modalities and performance on new HIV cases identification, percentage positive yield and percentage of total HIV diagnoses, U.S. President's Emergency Program for AIDS Relief (PEPFAR) funded sites in Tanzania, October 2021 to March 2023

HTS modality group	HTS Modality	HIV Tests	Tested positives	Percentage positive Yield	Percentage contribution of Tests	Percentage contribution of Positives
Case finding	Index testing	1,045,418	139,600	13.4%	18%	53.4%
	TB Clinic	87,928	5,730	6.5%	2%	2.2%
	Community mobile testing	420,717	24,203	5.8%	7%	9.3%
	optimized PITC	1,940,914	67,632	3.5%	33%	25.9%
	SNS testing	121,739	7,731	6.4%	2%	3.0%
Prevention monitoring	Testing at antenatal clinic (ANC)	1,816,467	16,003	0.9%	31%	6.1%
	Maternal retesting	423,277	567	0.1%	7%	0.2%
TOTAL		5,856,460	261,466	4%	100%	100%

Table 2:

Performance of social network strategy (SNS) testing, stratified by testing setting, gender, and age bands, in PEPFAR-supported sites in Tanzania between October 2021 to March 2023

Category	Social contacts tested	Social contacts tested positive	Percentage positive yield	Percentage contribution of SNS tests	Percentage contribution of SNS positives
Settings:					
Community	78,763	6,376	8.1%	64.7%	82.5%
Facility	42,976	1,355	3.2%	35.3%	17.5%
Total	121,739	7,731	6.4%	100.0%	100.0%
Sex:					
Male	23,611	1591	6.7%	19.4%	20.6%
Female	98,128	6140	6.3%	80.6%	79.4%
Total	121,739	7,731	6.4%	100.0%	100.0%
Course age bands (years):					
<15	241	20	8.3%	0.2%	0.3%
15+	121,483	7,711	6.3%	99.8%	99.7%
Unknown Age *	15	-	0.0%	0.0%	0.0%
Total	121,739	7,731	6.4%	100.0%	100.0%
Finer age bands (years):					
01–04	40	2	5.0%	0.0%	0.0%
05–09	27	1	3.7%	0.0%	0.0%
10–14	174	17	9.8%	0.1%	0.2%
15–19	10,201	329	3.2%	8.4%	4.3%
20–24	32,054	1,356	4.2%	26.3%	17.5%
25–29	34,089	1,751	5.1%	28.0%	22.6%
30–34	23,146	1,597	6.9%	19.0%	20.7%
35–39	10,629	1,034	9.7%	8.7%	13.4%
40–44	6,230	733	11.8%	5.1%	9.5%
45–49	2,583	476	18.4%	2.1%	6.2%
50+	2,551	435	17.1%	2.1%	5.6%
Unknown Age *	15	-	0.0%	0.0%	0.0%
Total	121,739	7,731	6.4%	100.0%	100.0%

* Unknown age: Age related data is not fully collected

Table 3:

SNS testing by finer age bands and sex, in PEPFAR-supported sites in Tanzania between October 2021 to March 2023

age bands	HTS_TST		HTS_TST_POS		YIELD	
	Female	Male	Female	Male	Female	Male
01–04	19	21	2	-	10.5%	0.0%
05–09	18	9	1	-	5.6%	0.0%
10–14	108	66	2	15	1.9%	22.7%
15–19	9,271	930	286	43	3.1%	4.6%
20–24	28,512	3,542	1,226	130	4.3%	3.7%
25–29	28,240	5,849	1,463	288	5.2%	4.9%
30–34	18,032	5,114	1,310	287	7.3%	5.6%
35–39	7,437	3,192	801	233	10.8%	7.3%
40–44	3,772	2,458	511	222	13.5%	9.0%
45–49	1,416	1,167	295	181	20.8%	15.5%
50+	1,294	1,257	243	192	18.8%	15.3%
Unknown Age*	9	6	-	-	0.0%	0.0%
Total	98,128	23,611	6,140	1,591	6.3%	6.7%

* Unknown age: Age related data is not fully collected

Table 4:

Poisson Log-Linear Model showing characteristics associated with clients who received HIV/Testing through SNS testing, in PEPFAR-supported sites in Tanzania between October 2021 to March 2023

Factors	Crude Estimates	P-value	Adjusted Estimates	P-value
Sex:				
Male	Ref		Ref	
Female	0.92(0.71–1.12)	<.0001	0.83(0.59–1.07)	<.0001
Age:				
15–19	0.89(0.41,1.37)	0.0003	0.71(0.19,1.23)	0.01
20–24	1.64(1.04,2.23)	<.0001	1.58(0.92,2.23)	<.0001
25–29	1.58(0.99,2.16)	<.0001	1.55(0.90,2.21)	<.0001
30–34	1.27(0.66,1.88)	<.0001	1.23(0.58,1.88)	0.0002
35–39	0.68(0.15,1.21)	0.01	0.60(0.06,1.14)	0.03
40–44	0.40(–0.07,0.88)	0.1	0.30(–0.14,0.74)	0.18
45–49	–0.11(–0.53,0.31)	0.62	–0.23(–0.59,0.14)	0.23
50+	Ref		Ref	
Facility level:				
Dispensary	–0.33(–0.43, –0.23)	<.0001	–0.66(–0.76, –0.56)	<.0001
Health Centers	–0.08(–0.20,0.04)	0.18	–0.15(–0.27, –0.02)	0.02
Hospital	0.02(–0.12,0.16)	0.81	0.15(–0.01,0.31)	0.06
Community	Ref		Ref	

* Adjusted for region population size (census 2022), and implementation mechanisms