

Prevalence and Factors Associated With HIV Self-testing Uptake Among Men Who Have Sex With Men in Ningbo, China: A Cross-sectional Study

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Research

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Abstract

Background

HIV testing and early linkage to care are critical for reducing the risk of HIV transmission. HIV self-testing (HIVST) is a useful tool for increasing HIV testing frequency. This study aimed to investigate HIVST rates among men who have sex with men (MSM), the characteristics of MSM who had HIVST, and factors associated with HIVST uptake among MSM in Ningbo, China.

Methods

A cross-sectional study was conducted from April to October 2019 in Ningbo, China. Participants were aged at least 18 years and having had sexual contact with men in the past year. Proportions were used for categorical variables. Adjusted Odds Ratio (AOR) and 95% Confidence Interval (CI) for characteristics associated with HIVST uptake was processed by multiple logistic regression models.

Results

Among a sample of 699 MSM recruited, 38.2% had reported previous use of an HIV self-test kit. A greater proportion of HIVST Users had a higher frequency of HIV testing (≥ 2 times: 70.0% versus 41.2%, $p < 0.001$) in the past one year. Factor associated with HIVST uptake was gay apps use (AOR=1.86, CI=1.13-3.05), multiple male sex partners (AOR=1.90, CI=1.29-2.80), frequency of male-male sexual contact ≥ 1 times per week (AOR=1.86, CI=1.30-2.66), syphilis infection (AOR=5.48, CI=2.53-11.88).

Conclusions

Further HIVST education should be strengthened for school-aged children and teenagers, and free HIVST kits may be provided to low-income high-risk MSM through gay apps and NGOs to achieve the increased HIV testing frequency.

Introduction

Globally, there were an estimated 37.9 million people are living with HIV (PLWH), with about 1.7 million people newly infected with HIV at the end of 2018¹. Men who have sex with men (MSM) has become the high-risk group of HIV acquisition.^{2,3} MSM accounted for an estimated 17% of new HIV infections globally, including more than half of new HIV infections in western and central Europe and North America⁴, and MSM was about 28 times more likely to be living with HIV than it was among all adult men in 2018⁵.

To end the AIDS epidemic by 2030, the "90-90-90" goal set up by UNAIDS in 2014 (90% of people with HIV infection diagnosed, 90% of people diagnosed on treatment, and 90% of people on treatment achieving virological suppression)⁶. However, it seems unlikely that many regions and countries would reach the 2020 target, especially the first 90%⁷. In China, an estimated less than 70% of PLWH were aware of their

HIV-positive status by the end of 2018⁸. HIV testing and early linkage to care are critical for reducing the risk of viral transmission from infected persons. However, key population groups including MSM were unwilling to seek voluntary HIV counseling and testing (VCT) in the hospital or Centers for Disease Control and Prevention (CDC) due to stigma and discrimination⁹⁻¹¹.

HIV self-testing (HIVST), testers take their blood sample to perform HIV rapid tests and interpret the result at the time and location of their choosing, has recommended being offered as an additional HIV testing approach by WHO in 2016¹². Several studies showed that HIVST had generally high sensitivity and specificity and was an acceptable and feasible testing approach due to the convenience, privacy, and ease of use¹³⁻¹⁵. These characteristics make it a potentially useful tool for increasing testing frequency and easy to reach first time and repeat testers for HIV^{16,17}.

Given the need to improve HIV testing rates and target the first of the United Nation's 90-90-90 HIV testing and treatment goals, the purpose of this study was to investigate HIVST uptake rates among MSM, the characteristics and factors associated with HIVST uptake among MSM in Ningbo, China.

Methods

Study design and participants

We conducted a cross-sectional survey from April 1 to October 30, 2019, in Ningbo. Ningbo is an eastern coastal city of China, nearby Shanghai, with an area of 9365 km² and a population of approximately 8.54 million people. Convenience sampling of participants was recruited through a mixed recruitment method of a venue-based method (3 parks, 2 bars, and 8 community events), web-based methods (internet invitations on gay websites and gay apps), and VCT clinic-based method. The survey was anonymous, with no identifying information obtained, and was self-administered. The criteria for recruiting were (1) being male, (2) aged at least 18 years, (3) having resided in Ningbo for at least 6 months, (4) having had sexual contact with men in the past year.

Questionnaire

All data were collected through self-administered questionnaires by trained project workers. The following variables were included: (1) demographic information including age, marital status, education level, duration of local residence, monthly income, and sexual orientation; (2) gay apps use including duration and frequency of apps use; (3) Sexual behaviors including role and frequency in sexual intercourse, multiple male sex partners, unprotected sex with men and syphilis infection in the past 6 months; (4) HIV testing including reasons for test, frequency of test, time since latest test and site of the latest test.

Statistical analysis

Characteristics of all participants were described by categorical variables presented as absolute values and percentages. The demographic information, gay apps use, sexual behaviors and HIV testing compared between HIVST users and Non-HIVST users were examined by chi-square tests. Univariate and multivariate logistic regression models were performed to examine risk factors associated with HIVST. The statistically significant was defined as $P < 0.05$. All statistical analyses were performed in SPSS (version 21.0, IBM, Armonk, NY, USA).

Ethical Considerations

This study protocol was reviewed and approved by the Institutional Review Board of the Ningbo CDC. Informed consent was asked to sign for all eligible participants when the survey was starting. Participants could receive a gift for prizes of up to 7 USD upon the completion of the survey.

Results

Participant Characteristics

Table 1 demonstrates the characteristics of the 699 MSM in Ningbo. The mean age was 31.9 (SD 8.8) years. Most participants (81.1%) were less than 30 years, 63.4% were single, 70.4% had a high school education or above, 77.7% had lived in Ningbo for at least two years, 62.9% had an income above 5000 China Yuan (CNY) per month, and 74.8% self-identified as gay.

Table 1

Characteristics of study participants and of HIVST users and Non-HIVST users in Ningbo, China, 2019

Characteristics	All participants n (%)	Subgroup comparison		
		HIVST users	Non-HIVST users	P-value ^c
		n (%)	n (%)	
Overall	699(100)	267(100)	432 (100)	
Demographics				
Age (years)				
18~	330(47.2)	155(58.1)	175(40.5)	< 0.001
30~	237(33.9)	92(34.5)	145(33.6)	
≥ 40	132(18.9)	20(7.5)	112(25.9)	
Marital status				
Single	443(63.4)	172 (64.4)	271 (62.7)	0.653
Married	256(36.6)	95(35.6)	161 (37.3)	
Education level				
Middle school or less	207(29.6)	65(24.3)	142(32.9)	0.022
High school	264(37.8)	101(37.8)	163(37.7)	
College or above	228(32.6)	101(37.8)	127(29.4)	
duration of local residence(years)				
< 2	156(22.3)	76(28.5)	80(18.5)	0.002
≥ 2	543(77.7)	191 (71.5)	352(81.5)	
Monthly income (CNY)				
<5000	259(37.1)	74(27.7)	185(42.8)	< 0.001
≥5000	440(62.9)	193(72.3)	247 (57.2)	
Sexual orientation				

^aIn the prior 6 months. ^b In the prior one year ^cSubgroups were compared using chi-square tests to generate P-values.

Characteristics	All participants n (%)	Subgroup comparison		
		HIVST users n (%)	Non-HIVST users n (%)	P-value ^c
Gay	523(74.8)	220 (82.4)	303(70.1)	0.001
Bisexual	135(19.3)	34 (12.7)	101 (23.4)	
Unknown/unsure	41(5.9)	13(4.9)	28(6.5)	
Gay apps usage				
Gay apps use				
Yes	583(83.4)	237(88.8)	346(80.1)	0.003
No	116(16.6)	30 (11.2)	86(19.9)	
Duration of gay apps use(years)				
< 1	83(14.2)	25(10.5)	58(16.8)	0.035
≥ 1	500(85.8)	212(89.5)	288(83.2)	
Missing(No use of gay apps)	116			
Frequency of gay apps use(times/day) ^a				
< 1	66(11.3)	22(9.3)	44(12.7)	0.036
1-	185(31.7)	65(27.4)	120(34.7)	
≥5	332(56.9)	150(63.3)	182(52.6)	
Missing(No use of gay apps)	116			
Sexual Behavior				
Role in sexual intercourse				
Insertive anal sex	191(27.3)	74(27.7)	117(27.1)	0.983
Receptive anal sex	155(22.2)	59(22.1)	96(22.2)	
Both	353(50.5)	134(50.2)	219(50.5)	
Frequency of male–male sexual contact (times/week) ^a				

^aIn the prior 6 months. ^b In the prior one year ^cSubgroups were compared using chi-square tests to generate P-values.

Characteristics	All participants n (%)	Subgroup comparison		
		HIVST users n (%)	Non-HIVST users n (%)	P-value ^c
<1	377 (53.9)	124 (46.4)	253 (58.6)	0.002
≥ 1	322 (46.1)	143 (53.6)	179 (41.4)	
Multiple male sex partners ^a				
Yes	196(28.0)	87(32.6)	109 (25.2)	0.035
No	503(72.0)	180 (67.4)	323 (74.8)	
Unprotected sex with men ^a				
Yes	190 (27.2)	64(24.0)	126 (29.2)	0.133
No	509 (72.8)	203 (76.0)	306(70.8)	
Syphilis Infection ^b				
Yes	44(6.3)	29(10.9)	15(3.5)	< 0.001
No	655(93.7)	238(89.1)	417(96.5)	
HIV testing				
Reason for HIV testing				
Regular HIV testing	432(71.5)	196(73.4)	236(70.0)	0.011
Had unprotected sexual behavior	60(9.9)	22(8.2)	38(11.3)	
Had suspicions symptoms of AIDS	47(7.8)	19(7.1)	28(8.3)	
Awareness of HIV testing results before sex	36(6.0)	10(3.7)	26(7.7)	
Repeated HIV testing	29(4.8)	20(7.5)	9(2.7)	
Missing(Had never HIV testing before)	95			
Frequency of HIV testing ^b				

^aIn the prior 6 months. ^b In the prior one year ^cSubgroups were compared using chi-square tests to generate P-values.

Characteristics	All participants n (%)	Subgroup comparison		
		HIVST users n (%)	Non-HIVST users n (%)	P-value ^c
0	114(16.3)	4(1.5)	110(25.5)	< 0.001
1	220(31.5)	76(28.5)	144(33.3)	
≥2	365(52.2)	187(70.0)	178(41.2)	
Time since latest HIV testing (months)				
1~	148(24.5)	81(30.3)	67(19.9)	0.005
4~	176(29.1)	77(28.8)	99(29.4)	
7~	92(15.2)	29(10.9)	63(18.7)	
13~	188(31.1)	80(30.0)	108(32.0)	
Missing(Had never HIV testing before)	95			
Site of the latest HIV testing				
CDC	211(34.9)	85(31.8)	126(37.4)	0.029
Hospital	43(7.1)	13(4.9)	30(8.9)	
NGO	304(50.3)	169(63.3)	181(53.4)	
Missing(Had never HIV testing before)	95			
^a In the prior 6 months. ^b In the prior one year ^c Subgroups were compared using chi-square tests to generate P-values.				

Most participants (83.4%) had used gay apps in the past 6 months. Of the 583 gay app users, 85.8% (500/583) had used gay apps for at least one year, 56.9% (332/583) used them at least 5 times a day. In terms of sexual practice, half of the participants were engaged in both insertive anal intercourse and receptive anal intercourse equally. 46.1% had sex with men for at least once per week in the prior 6 months. 72.0% had multiple male sex partners and 27.2% had unprotected sex with men in the prior 6 months.

Comparisons Of Characteristics Between Hivst Users And Non-hivst Users

Among all participants, 604(86.4%) reported having HIV testing at least once in their lifetimes, and 575(82.3%) had been tested in the past year. Table 1 describes that a total of 267 participants (of 699,

38.2%) reported having used an HIV self-test kit before, whereas 432 (61.8%) reported never having HIV self-test. Compared to non-HIVST users, a larger proportion of HIVST Users were aged between 18 ~ 29 years (58.1% versus 40.5%, $p < 0.001$), had college or above education level (37.8% versus 29.4%, $p = 0.022$), had lived in Ningbo less than two years (28.5% versus 18.5%, $p = 0.002$), had an income above 5000 China Yuan (CNY) per month (72.3% versus 57.2%, $p < 0.001$) and self-identified as gay (82.4% versus 70.1%, $p < 0.001$).

A larger proportion of HIVST Users reported having higher frequency of male-male sexual contact (≥ 1 time/week: 53.6% versus 41.4%, $p = 0.002$), having multiple male sex partners (32.6% versus 25.2%, $p = 0.035$), having had syphilis infection (10.9% versus 3.5%, $p < 0.001$) and having used gay apps (88.8% versus 80.1%, $p = 0.003$) in the prior 6 months. Among those who had used gay apps, a greater proportion of HIVST Users also had a higher frequency of gay apps use (≥ 5 times/day: 63.3% versus 52.6%, $p = 0.036$) in the prior 6 months and used gay apps over one year (89.5% versus 83.2%, $p = 0.035$).

A greater proportion of HIVST Users had a higher frequency of HIV testing (≥ 2 times: 70.0% versus 41.2%, $p < 0.001$) in the past one year. Among those who had HIV testing before, a greater proportion of HIVST Users reported having HIV testing regularly (73.4% versus 70.0%, $p = 0.011$), their most recent HIV testing had been within the prior 3 months (30.3% versus 19.9%, $p = 0.005$), the site of latest HIV testing was NGOs (63.3% versus 53.4%, $p = 0.029$).

Factor Associated With Hivst Uptake

As show in Table 2, multivariate logistic regression analyses found that HIVST were associated with older age (30–39 years: AOR = 0.49, CI = 0.32–0.76; more than 40 years: AOR = 0.07, CI = 0.04–0.14, compared to 18–29 years), higher education level (high school: AOR = 2.82, CI = 1.70–4.69, compared to middle school or less), bisexual (AOR = 0.49, CI = 0.29–0.84), gay apps use (AOR = 1.86, CI = 1.13–3.05), multiple male sex partners (AOR = 1.90, CI = 1.29–2.80), frequency of male–male sexual contact ≥ 1 times per week (AOR = 1.86, CI = 1.30–2.66), syphilis infection (AOR = 5.48, CI = 2.53–11.88).

Table 2
Factors associated with HIVST among study participants in Ningbo, China, 2019(n = 699)

Factor	Unadjusted OR (CI) ^b	P- value	Adjusted OR (CI) ^c	P- value
Age (years)				
18~	1.00		1.00	N/A
30~	0.72(0.51– 1.01)	0.054	0.49(0.32– 0.76)	0.001
≥ 40	0.20(0.12– 0.34)	< 0.001	0.07(0.04– 0.14)	< 0.001
Marital status				
Married	1.00		N/A	N/A
Single	1.08(0.78– 1.48)	0.653	N/A	0.006
Education level				
Middle school or less	1.00		1.00	N/A
High school	1.74(1.17– 2.57)	0.006	2.82(1.70– 4.69)	< 0.001
College or above	1.35(0.92– 1.99)	0.123	1.42(0.92– 2.20)	0.052
Local residence time				
< 2	1.00		1.00	N/A
≥ 2	0.57(0.40– 0.82)	0.002	0.66(0.44– 1.00)	0.052
Monthly income RMB(GBP)				
<5000(115)	1.00		1.00	N/A
≥5000(578)	1.95(1.41– 2.71)	< 0.001	1.35(0.94– 1.93)	0.100
Sexual orientation				
Gay	1.00		1.00	N/A
Bisexual	0.46(0.30– 0.71)	< 0.001	0.49(0.29– 0.84)	0.009

Univariate and multivariate regression analyses were used to generate odds ratios (ORs) and 95% confidence intervals (CIs).

Factor	Unadjusted OR (CI) ^b	P- value	Adjusted OR (CI) ^c	P- value
Unknown/unsure	0.64(0.32– 1.26)	0.198	0.71(0.34– 1.51)	0.379
Gay apps use				
No	1.00		1.00	N/A
Yes	1.96(1.26– 3.07)	0.003	1.86(1.13– 3.05)	0.014
Multiple male sex partners ^a				
No	1.00		1.00	N/A
Yes	1.43(1.02– 2.00)	0.036	1.90(1.29– 2.80)	0.001
Frequency of male–male sexual contact (times/week) ^a				
<1	1.00		1.00	N/A
≥1	1.63(1.20– 2.22)	0.002	1.86(1.30– 2.66)	0.001
Unprotected sex with men ^a				
No	1.00		N/A	N/A
Yes	0.77(0.54– 1.09)	0.134	N/A	N/A
Syphilis Infection				
No	1.00		1.00	N/A
Yes	3.39(1.78– 6.45)	< 0.001	5.48(2.53– 11.88)	< 0.001
Univariate and multivariate regression analyses were used to generate odds ratios (ORs) and 95% confidence intervals (CIs).				

Discussion

Globally, HIV testing had become an important strategy to end the HIV epidemic^{18,19}. HIVST is reliable, safe, and accurate, which can help increase serostatus awareness and ultimately linkage-to-care or prevention services among HIV high-risk populations^{20,21}. The proportion of HIV testing among MSM in the lifetimes and the past year in our analysis was higher than in other studies, but there is a certain distance to reach the first 90% targets by 2020^{7,19}. The study revealed that 38.2% of MSM had used

HIVST before in Ningbo, which was lower than the rates reported in studies from other areas^{22,23}. Our study's contribution to investigate factors associated with HIVST and help the government develop targeted strategies to improve HIV testing among MSM in China.

Our study showed that those MSM who were younger or high education levels were more likely to have had HIVST. It is possible that younger MSM had more worries about positive test results¹¹. Worldwide, about 32% of new HIV infections among adults aged 15 years and older have occurred in youth ages 15 to 24 years in 2018⁴. Therefore, HIVST education should be included as a part of comprehensive sexual and reproductive health education for school-age children and teenagers²¹. Moreover, a larger proportion of HIVST Users had a higher income in our study. It is possible that commercial HIVST kits can be easily bought by online shopping platform in China. But to avoid possible cost barriers, free HIVST kits might be provided to low-income high-risk populations to achieve the increased testing frequency¹⁷.

Gay apps were very popular among MSM in China²⁴. HIV prevention through gay apps was widely applied toward reducing high-risk behaviors and promoting HIV testing^{25,26}. Our results showed that HIVST Users had a higher frequency of gay apps use than Non-HIVST users in the prior 6 months. As with previous findings, the utility of mobile health interventions can engage MSM in HIVST in Heifei and Shenzhen, China^{27,28}, and increase rates of confirmed HIV diagnoses and linkage to clinical care in the UK²⁹. Furthermore, consistent with findings in other studies²², those who had high-risk sex behavior, including multiple male sex partners, frequency of male-male sexual contact more than once per week and syphilis infection were more likely to have had HIVST. It indicated that HIVST kits usage and offer can be conducted as a part of HIV prevention through gay apps to access to more high-risk populations in China.

This study demonstrated that HIVST users were more like to have a higher frequency of HIV testing and regular HIV testing compared to non-HIVST users. Regular HIV testing enables early identification and treatment of HIV among at-risk MSM³⁰. As mentioned, the US CDC recommends MSM to take up HIV testing every 3 to 6 months if they have additional HIV risk factors³¹. But most of these MSM have no HIV testing routines³². So some HIV interventions should be improved to encourage MSM to use HIVST regular after VCT or HIV risk assessment. The results also showed that two-thirds of MSM received HIVST kits form NGOs in the latest HIV testing. This indicated that NGOs had become an important role in HIV intervention in China. So the government might strengthen support to NGOs to promote HIVST uptake.

Limitations

The present study had several limitations. First, participants were relatively high-educated, had higher income, and our findings may not be generalizable in other contexts or settings. Second, some questions were asked in the prior 6 months. Despite implemented quality control measures, recall and social desirability bias might have existed. Finally, as this was a cross-sectional study, we are unable to establish a causal relationship.

Conclusions

The coverage of HIVST had a significant gap in Ningbo, China. It is necessary to make continued efforts to expand HIVST coverage among MSM. Further HIVST education should strengthen for school-age children and teenagers, HIV prevention should include HIVST kits usage and offer through gay apps and NGOs, and free HIVST kits might be provided to low-income high-risk MSM to accelerate achieve the "90-90-90" goal.

Abbreviations

HIVST

HIV self-testing

PLWH

people are living with HIV

VCT

voluntary HIV counseling and testing

CDC

Centers for Disease Control and Prevention

Declarations

Ethics approval and consent to participate

This study protocol was reviewed and approved by the Institutional Review Board of the Ningbo CDC. Informed consent was asked to sign for all eligible participants when the survey was starting. Participants could receive a gift for prizes of up to 7 USD upon the completion of the survey.

Availability of data and materials

The datasets used and/or analyzed during this study is not publicly available, but may be available from the corresponding author upon reasonable request, and with permission from Ningbo Municipal Center for Disease Control and Prevention.

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Author Contributions

HH and HS designed the study, HH and HD coordinated the study, HS and HJ collected the data, HH did the primary data analysis, HH and HS contributed to part of the analysis. HH, HS, and YS drafted the paper. All authors contributed to results interpretation interpreted the data, revised the article, and approved the final version and manuscript revision. YS had access to all the data and was responsible for the final decision to submit the manuscript for publication.

Competing interests

None declared.

References

1. World Health Organization. Global Health Observatory (GHO) data [Internet]. Geneva, Switzerland: WHO. 2017 [cited 2019 Dec 31]. Available from: <http://www.who.int/gho/hiv/en/>.
2. Dong M-J, Peng B, Liu Z-F, Ye Q-N, Liu H, Lu X-L, et al. The prevalence of HIV among MSM in China: a large-scale systematic analysis. *BMC Infect Dis*. 2019 Nov 27;19(1):1000.
3. Hessou PHS, Glele-Ahanhanzo Y, Adekpedjou R, Ahouada C, Johnson RC, Boko M, et al. Comparison of the prevalence rates of HIV infection between men who have sex with men (MSM) and men in the general population in sub-Saharan Africa: a systematic review and meta-analysis. *BMC Public Health*. 2019 Dec 4;19(1):1634.
4. UNAIDS. UNAIDS data 2019 [Internet]. 2019 [cited 2019 Dec 31]. Available from: <https://www.unaids.org/en/resources/documents/2019/2019-UNAIDS-data>.
5. UNAIDS. Miles to go—closing gaps, breaking barriers, righting injustices [Internet]. 2018 [cited 2020 Jan 2]. Available from: <https://www.unaids.org/en/resources/documents/2018/global-aids-update>.
6. UNAIDS
UNAIDS. Fast-Track. - Ending the AIDS epidemic by 2030 [Internet]. 2014 [cited 2020 Jan 13]. Available from: https://www.unaids.org/en/resources/documents/2014/JC2686_WAD2014report.
7. Marsh K, Eaton JW, Mahy M, Sabin K, Autenrieth CS, Wanyeki I, et al. Global, regional and country-level 90-90-90 estimates for 2018: assessing progress towards the 2020 target. *AIDS*. 2019 Dec 15;33 Suppl 3:S213–26.
8. Lyu F, Chen Fangfang. National HIV/AIDS epidemic estimation and interpretation in China. *Chinese Journal of Epidemiology*. 2019;40(10):1191–6.
9. Thapa S, Hannes K, Cargo M, Buve A, Peters S, Dauphin S, et al. Stigma reduction in relation to HIV test uptake in low- and middle-income countries: a realist review. *BMC Public Health*. 2018 Nov 20;18(1):1277.
10. Strömdahl S, Hoijer J, Eriksen J. Uptake of peer-led venue-based HIV testing sites in Sweden aimed at men who have sex with men (MSM) and trans persons: a cross-sectional survey. *Sex Transm Infect*. 2019;95(8):575–9.

11. Zhou J, Chen J, Goldsamt L, Wang H, Zhang C, Li X. HIV Testing and Associated Factors Among Men Who Have Sex with Men in Changsha, China. *J Assoc Nurses AIDS Care*. 2018 Dec;29(6):932–41.
12. World Health Organization. Guidelines on HIV self-testing and partner notification: supplement to consolidated guidelines on HIV testing services [Internet]. Geneva, Switzerland: WHO. 2016. World Health Organization; [cited 2020 Aug 30]. Available from: <http://www.who.int/hiv/pub/self-testing/hiv-self-testing-guidelines/en/>.
13. Johnson CC, Kennedy C, Fonner V, Siegfried N, Figueroa C, Dalal S, et al. Examining the effects of HIV self-testing compared to standard HIV testing services: a systematic review and meta-analysis. *J Int AIDS Soc* [Internet]. 2017 May 15 [cited 2020 Jul 9];20(1). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5515051/>.
14. Stevens DR, Vrana CJ, Dlin RE, Korte JE. A Global Review of HIV Self-testing: Themes and Implications. *AIDS Behav*. 2018 Feb;22(2):497–512.
15. Harichund C, Moshabela M. Acceptability of HIV Self-Testing in Sub-Saharan Africa: Scoping Study. *AIDS Behav*. 2018;22(2):560–8.
16. Harichund C, Kunene P, Moshabela M. Feasibility of HIV self-testing: experiences of people seeking HIV testing in rural and urban KwaZulu-Natal, South Africa. *Afr J AIDS Res*. 2019 Jul;18(2):115–22.
17. Katz DA, Golden MR, Hughes JP, Farquhar C, Stekler JD. HIV Self-Testing Increases HIV Testing Frequency in High-Risk Men Who Have Sex With Men: A Randomized Controlled Trial. *J Acquir Immune Defic Syndr*. 2018;15(5):505–12. 78(.
18. Sharma M, Ying R, Tarr G, Barnabas R. Systematic review and meta-analysis of community and facility-based HIV testing to address linkage to care gaps in sub-Saharan Africa. *Nature*. 2015 Dec 3;528(7580):S77-85.
19. Stannah J, Dale E, Elmes J, Staunton R, Beyrer C, Mitchell KM, et al. HIV testing and engagement with the HIV treatment cascade among men who have sex with men in Africa: a systematic review and meta-analysis. *Lancet HIV*. 2019;6(11):e769–87.
20. Pittalis S, Orchi N, De Carli G, Navarra A, Chiaradia G, Puro V, et al. HIV Self-Testing in Italy. *J Acquir Immune Defic Syndr*. 2017;01(3):e84–5. 76(.
21. Kojima N, Klausner JD. Accelerating epidemic control: the role of HIV self-testing. *Lancet HIV*. 2018;5(6):e266–7.
22. Ren XL, Wu ZY, Mi GD, McGoogan J, Rou KM, Zhao Y. Uptake of HIV Self-testing among Men Who have Sex with Men in Beijing, China: a Cross-sectional Study. *Biomed Environ Sci*. 2017 Jun;30(6):407–17.
23. Tun W, Vu L, Dirisu O, Sekoni A, Shoyemi E, Njab J, et al. Uptake of HIV self-testing and linkage to treatment among men who have sex with men (MSM) in Nigeria: A pilot programme using key opinion leaders to reach MSM. *J Int AIDS Soc* [Internet]. 2018 Jul 22 [cited 2020 Jul 21];21(Suppl Suppl 5). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6055125/>.
24. Hong H, Xu J, McGoogan J, Dong H, Xu G, Wu Z. Relationship between the use of gay mobile phone applications and HIV infection among men who have sex with men in Ningbo, China: a cross-

- sectional study. *Int J STD AIDS*. 2018;29(5):491–7.
25. Yan J, Zhang A, Zhou L, Huang Z, Zhang P, Yang G. Development and effectiveness of a mobile phone application conducting health behavioral intervention among men who have sex with men, a randomized controlled trial: study protocol. *BMC Public Health*. 2017 24;17(1):355.
 26. SESH Study Group. Tucker JD. Crowdsourcing to promote HIV testing among MSM in China: study protocol for a stepped wedge randomized controlled trial. *Trials*. 2017 Oct 2;18(1):447.
 27. Zhao Y, Zhu X, Pérez AE, Zhang W, Shi A, Zhang Z, et al. MHealth approach to promote Oral HIV self-testing among men who have sex with men in China: a qualitative description. *BMC Public Health [Internet]*. 2018 Sep 27 [cited 2020 Jul 20];18. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6161330/>.
 28. Zhu X, Zhang W, Operario D, Zhao Y, Shi A, Zhang Z, et al. Effects of a Mobile Health Intervention to Promote HIV Self-testing with MSM in China: A Randomized Controlled Trial. *AIDS Behav*. 2019;23(11):3129–39.
 29. Gabriel MM, Dunn DT, Speakman A, McCabe L, Ward D, Witzel TC, et al. Protocol, rationale and design of SELPHI: a randomised controlled trial assessing whether offering free HIV self-testing kits via the internet increases the rate of HIV diagnosis. *BMC Infect Dis [Internet]*. 2018 Oct 23 [cited 2020 Jul 20];18. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6199717/>.
 30. Noble M, Jones AM, Bowles K, DiNenno EA, Tregear SJ. HIV Testing Among Internet-Using MSM in the United States: Systematic Review. *AIDS Behav*. 2017 Feb;21(2):561–75.
 31. DiNenno EA, Prejean J, Irwin K, Delaney KP, Bowles K, Martin T, et al. Recommendations for HIV Screening of Gay, Bisexual, and Other Men Who Have Sex with Men - United States, 2017. *MMWR Morb Mortal Wkly Rep*. 2017 Aug 11;66(31):830–2.
 32. Adam PCG, de Wit JBF, Bourne CP, Knox D, Purchas J. Promoting regular testing: an examination of HIV and STI testing routines and associated socio-demographic, behavioral and social-cognitive factors among men who have sex with men in New South Wales, Australia. *AIDS Behav*. 2014 May;18(5):921–32.