Title: Social media-based secondary distribution of HIV/syphilis self-testing among Chinese men who have sex with men

Dan Wu, PhD[1,2,3§], Yi Zhou, MPH[4,§], Nancy Yang, MSc[5], Shanzi Huang, BS[4], Xi He, BS[6], Joseph Tucker, PhD[1,7], Xiaofeng Li, BS[4], KumiM Smith, PhD[8],TiarneyRitchwood, MD[9], XiaohuiJiang[10], Xuan Liu, MSc[7], Yehua Wang, MSc[7], Wenting Huang, MSc[11], Jason Ong, PhD[1], Hongyun Fu, PhD[12], Huanyu Bao, MSc[7], Stephen Pan, PhD[13], Wencan Dai, MPH[3,*], Weiming Tang, PhD[2,3,7,*]

1. Department of Clinical Research, London School of Hygiene & Tropical Medicine, London, the United Kingdom
2. Insititute of Global Health and STI Research, Southern Medical University, Guangzhou, China
3. Dermatology Hospital, Southern Medical University, Guangzhou, China
4. Zhuhai Center for Diseases Control and Prevention, Zhuhai, China
5. University of Minnesota-Twin Cities, Minneapolis, United States
6. Zhuhai Xutong Voluntary Services Center, Zhuhai, China
7. University of North Carolina Project-China, Guangzhou, China
8. Division of Epidemiology and Community Health, University of Minnesota Twin Cities, Minneapolis, United States
9. Family Medicine and Community Health, Duke University, Durham, Untied States
10. Health Commission of Zhuhai, Zhuhai, China
11. Behavioral Sciences and Health Education, Emory University, Georgia, United States
12. Eastern Virginia Medical School, Norfolk, VA, United States
13. Department of Health and Environmental Sciences, Xi'an Jiaotong Liverpool University, Suzhou, China

§ These authors contributed equally to this manuscript.

* These authors contributed equally to this manuscript.

Correspondence to:

Dr. Weiming Tang, Dermatology Hospital, Southern Medical University, and the University of North Carolina at Chapel Hill Project-China, 2 Lujing Road, Guangzhou, 510095, China; Email: Weiming_tang@med.unc.edu. Tel: 8615920567132

Main point summary: Compared to index men, significantly more alters who received an HIV self-test from an index were naïve HIV testers and HIV reactive, suggesting the potential for a social media-based secondary distribution strategy in improving HIV testing and case identification.

Abstract

Background

Social media and secondary distribution (distributing self-testing kits by indexes through their networks) both show strong promise to improve HIV self-testing uptake. We assessed an implementation program in Zhuhai, China, which focused on the secondary distribution of HIV/syphilis self-test kits among men who have sex with men (MSM) via social media.

Methods

Men of age 16 or above, born biologically male, and ever had sex with another man were recruited as indexes. Banner ads on a social media platform invited the participants to apply for up to five self-test kits every three-months. Index men paid a deposit of 15 USD/kit refundable upon submitting a photograph of a completed test result via an online submission system. They were informed that they could distribute the kits to others (referred to as "alters").

Results

A total of 371 unique index men applied for 1150 kits (mean age=28.7±6.9), of which 1141 test results were returned (99%). Among them, 1099 were valid test results, 810 (74%) were from 331 unique index men, and 289 tests (26%) were from 281 unique alters. Compared to index men, a higher proportion of alters were naïve HIV testers (40% VS. 21%, $P<0.001$). The total HIV self-test reactivity rate was 3%, with alters having a significantly higher rate than indexes(5% VS 2%, P=0.008). A total of 21 people (3%) had a reactive syphilis test result.

Conclusions

Integrating social media with the secondary distribution of self-test kits may hold promise to increase HIV/syphilis testing coverage and case identification among MSM.

Keywords: HIV; Self-testing; Secondary distribution; Social media; Men who have sex with men, MSM

Background

As the entry point into the HIV care continuum[1] and a critical step in the *Treat All* strategy[2], HIV testing remains a cornerstone of HIV prevention and control. However, about 25% of people living with HIV (PLWH) around the world do not know their serological status.[3] This is even worse among key populations in China, as nearly half of men who have sex with men (MSM) have never tested for HIV.[4-6] Syphilis testing is also key to HIV prevention, yet 70% of Chinese MSM have never tested for syphilis.[7] Serostatus unawareness plays a key role in ongoing transmission of HIV and syphilis; therefore, interventions must reach PLWH who are unaware of their status. Though wider availability of facility-based HIV testing services helped increase testing coverage, innovative interventions are needed to enhance coverage of harder-to-reach MSM[8, 9] , especially those not receiving testing from a health facility.[10]

The development of self-testing services will support HIV and Syphillis control.. Self-testing is the process whereby a person collects a specimen, performs the test, and interprets the result themselves.[11, 12] Dual HIV/syphilis self-testing is a promising approach for expanding HIV and syphilis testing that enables individuals to perform rapid HIV/syphilis antibody tests simultaneously and privately.[13] The World Health Organizationrecommends that dual HIV/syphilis rapid tests be offered to screen at-risk populations.[11, 14] By July 2019, 77 countries had adopted policies or guidelines for implementation and support of HIV self-testing (HIVST).[15]In China, the demand for and acceptability of HIVST among MSM has been high, and many Chinese local community-based-organizations (CBOs) are working with health bureaus in piloting HIVST among MSM.[16, 17] No policies or guidelines are in place to improve integrative syphilis testing for MSM in China; only one cross-sectional survey study with Chinese MSMfound that 92.5% of syphilis self-testers did HIVST at the same time,demonstrating the feasibility of integrating syphilis self-testing into HIV self-testing services.[18]Nevertheless, this study did not explore strategies for further expanding testing uptake.

While dual HIV/syphilis self-testing is a promising strategy for expanding testing coverage, it is critical to develop and evaluate outreach and distribution strategies for self-tests, such as secondary distribution.[19] Secondary distribution is a social network based approach which involves giving one individual (index) multiple self-testing kits for distribution to people within their social networks (alters).[20] Two studies conducted in Kenya have shown that secondary distribution has strong potential to promote HIV testing among the male sexual partners of women seeking antenatal and postpartum care.[21, 22] Three other cohort studies showed feasibility and effectiveness of secondary distribution of HIVST among male fishermen in Uganda, female sex

workers, and women seeking perinatal care,as well as MSM in South Africa.[20, 23, 24] However, most previous studies in low- and middle-income countries (LMICs) focused on the sexual network of the index participants. One study in United States revealed that 59% of alters who received a self-test were friends of the index MSM.[25] This indicates that we can further use this opportunityto leverage MSM's non-sexual social contacts and reach more people who have high risk but have not been reached by conventional services in LMIC settings. In addition, the testing results of the alters in most of the previous studies were self-reported by the index participants, which raise concerns about privacy and reliability of the test results. None have explored secondary distribution of syphilis self-testing as an integrated service into existing HIV self-testing programs. A social media-based secondary distribution of dual HIV/syphilis self-tests may hold potential in overcoming these barriers and add value to existing literature.

In this study, we evaluated a social media-based secondary distribution of HIV/syphilis self-testing among Chinese MSM. We defined the "social media-based secondary distribution" as the implementation of the secondary distribution (including participants recruitment, screening, survey, kits application and results returning) is based on social media pltafroms. By leveraging the social contacts of participants, we explored whether this enhanced model can expand the coverage of HIV testing and help identify new HIV/syphilis cases. We assessed the feasibility of having the testers upload photographs of their completed self-tests for verification by study staff, and evaluated alters' sexual intercourse with an index at the point of self-testing.

Methods

Study setting and infrastructure establishment

This implementation study was conducted in Zhuhai, Southern China with an estimated 17,000 MSM living in the city. It has an HIV prevalence of 7% among MSM and was one of the first sites to pilot HIVST among MSM in China.[26] Zhuhai Center for Diseases Control (CDC) and a gay community-led organization (Zhuhai Xutong Voluntary Services Center, hereafter, Xutong),initiated a social-media based online system in 2016 for MSM to apply for free dual HIV/syphilis self-testkits. MSM were able to apply for HIVST kits using Xutong's publicWeChat account. WeChat is a multi-functional social app which can be used for messaging, public surveys, and monetary transactions.

Secondary distribution

Beginning on June 17, 2018, index men could request up to five HIV/syphilis self-test kits (HIV/Syphilis Duo, Standard Diagnostics, Inc.) per application (with a limit of one application per three-month period). Figure 1 shows the secondary distribution model of the program. Test kits were mailed to index men after they paid the deposit (15 USD/kit) and provided shipping information. All test kit packages mailed to a participant were packed in one parcel and assigned an identical numerical ID number. Each dual test kit package contained instructions and a WeChat QR code for the tester to upload a photograph of the test result anonymously. Index MSM were informed that they could distribute the kits to other social contacts, including partners or friends (referred to as "alters"). Following the instructive notes, alters were encouraged to upload an anonymous photograph of the test result themselves. Upon receiving a photographed test result, the deposit was immediately refunded to index men through WeChat.

Consented MSM participants provided their mobile numbers for follow-ups. Volunteers at Xutong, mostly gay men, were trained as lay health workers to verify the photographed test results. Once participants' test results were verified as reactive for HIV and/or syphilis, our CBO volunteers contacted and suggested participants with a reactive result seek timely confirmatory testing and treatment services at a local health facility via telephone calls.These participants were provided with information about locations and open hours of local health facilities for MSM-friendly sexual health care.

Survey instruments and data collection

Inclusion criteria for index participants included 1)men who were 16 or older, 2)born biologically male, 3)ever had sex with another man, 4)were willing to provide a contact number, and 5) agreed to participate in a follow-up survey in three months. Eligible index participants completed a baseline online survey which collected information about the indexes' socio-demographic characteristics(including age, education, income, marital status, residence, and occupation), sexual biography (including gender identity, sexual orientation, sexual orientation disclosure), and HIV testing history.

Index men were followed up three months after the recruitment which collected information about their process of distributing dual test kits to individuals within their social networks. A short online survey was also administered to alters upon uploading their photographic evidence of a completed test. A small incentive of 3

USD was provided to all participants who completed a questionnaire.

Outcomes

Primary outcomes included proportion of new testers (defined as naïve HIV testers) among unique indexes and alters, HIV and syphilis reactivity rates among unique indexes and alters. Those who had a reactive result (for either HIV or syphilis or both)were followed-up via telephone calls by the CBO volunteers. and recommended to seek confirmatory testing and medical treatment at local facilities (i.e., linkage-to-care services). We also calculated the rate of returning a photograph of the completed test within 30 days after receiving the test kit(s).Additionally, among those who reported a sexual relationship with the index, we measured their sexual intercourse at the point of testing, aiming to understand how participants used HIVST to inform their sexual behaviours.

Statistical analyses

Duplicate applications were identified by duplicate mobile numbers used for the application and assumed to be from the same index participant, and only the baseline characteristics from the first application by calendar date were included for analysis for each index. We conducted descriptive analyses of the outcomes for both the unique index and the alter participants. Chi-square or Fishers' Exact tests were used to assess differences in proportion of naïveHIV testers and HIV/syphilis reactivity rates between indexes and alters, and to compare alters' reports of sexual decisions based on whether alters shared their HIV test result with their index (the alter shared a reactive result, a non-reactive result, the alter did not share the result). Statistical analyses were conducted using SPSS (Version 25, IBM, New York).

Ethical Statement

The study protocol was approved by the Zhuhai Center for Diseases Control and Prevention. Informed consent was collected from each participant online.

Results

Test kit application and distribution

This study was conducted between June 17, 2018, and November 12, 2019. Figure 2 shows the flowchart of the number of applications and dual test kits distributed. Overall, there were 851 application attempts, of which 649 applications met eligibility criteria, and 1150 test kits were distributed to 371 unique index men,with48% of indexes requesting two or more kits.

Return of photographed test results

In total, 1141 test results were returned with photographic evidence, resulting in an overall return rate of 99%(1141/1150) (Fig 2).A total of 1099 test results were valid, among which 810(74%) were from 331 unique index men, and 289(26%) were from 281 unique alter testers.On average, each index successfully reached 0.85(281/331) alters.

Participant characteristics

Table 1 shows the characteristics of study participants. The mean age for indexes and alters was 28.7 (SD=6.9) and 29.4 (SD=7.0) years, respectively. Proportions of testers who obtained university or higher education were similar between the two groups. More index men than alter men (70% vs.60%) have disclosed their same-sex behavior to individuals other than their sexual partners. There were no significant differences in socio-demographic characteristics between index men who returned a result and those who did not (Table 2).

HIV/syphilis test results

Overall, 20 of 612 unique testers (3%) had a reactive HIV self-test result. Fifteen of them were alters, and five were indexes. HIV reactive rate among alters (15/281, 5%) was significantly higher than that among indexes (5/331, 2%) (P=0.008). All men who had reactive results were first-time testers. Four of five index cases (80%) and 12 of 15 (80%) alter cases who had a reactive result were linked to facility-based confirmatory testing and enrolled in HIV treatment.

Twenty-one of 612 (3%) testers had a reactive syphilis result, with 13 among 331 (4%) indexes and eight among

281 (3%) alters with no significant difference. One index participant (0.3%)was found to be reactive for both HIV and syphilis. Among all syphilis reactive participants, eight reported to be previously diagnosed with and formally treated for syphilis, eight were newly syphilis reactive and referred to confirmatory testing at a local facility. The remaining five were lost to follow-up.

Alters' testing experiences

Among 281 alters who returned their test results, 268(95%) completed an online survey, among whom 264 (98%) were male and four (2%) werefemale. Of the 264 male alters,114(43%) were a sexual partner of the index. The remaining150 alters self-reported to be non-sexual contacts: 130 (49%) identified as a gay friend of the index, 13 (5%)as a family member, and four (2%) as a straight friend. Of the264 male alters, 106(40%) were new testers, compared to only 77 of 371 (21%) index men (P<0.001) (Supplement Figure 1). Among the 114 alters who reported a sexual relationship with the index, 33 (29%) were new testers, while the 150 non-sexual contacts had a higher proportion of new testers at 49% (P=0.001).

Sex with the index at the point of self-testing

Of the 114 male alters who were sexual partners of the index, 108 (95%) reported that they shared their test results with the index, including 5 reactive and 103 non-reactive results (Table 3). Sixty-one of the 114 alters(54%) reported having sexual intercourse with the index on the day of performing the self-test, of which 41of 61 alters (67%) reported using a condom with intercourse.

Discussion

Effective strategies to promote HIV/syphilis dual self-test uptake are underexplored. We introduced a socialmedia-based secondary distribution modelto expand dual HIV/syphilis testing among Chinese MSM. Our study breaks new ground by assessing the feasibility andeffectiveness of an integrated social media-based secondary distribution model to expand HIV/syphilis testing coverage,findingnew HIV/syphilis cases, and testing the feasibility of test verification by returning of photographed self-test results.

Our model demonstrated two important benefits over previously studied offline models of HIVST secondary

distribution. First, a high results return rate demonstrated the feasibility of the model.Verifying self-test results is often challenging[27], but important for ensuring the accuracy of HIV case reporting and linking reactive testers tocare further.We addressed this issue through three components of our model: a gay community-led organization, anonymous upload of test results followed by free telephone counseling services for reactive cases, and a refundable costlevel deposit mechanism. These components created a trusting relationship between testers and lay health providers, protect testers' privacy and against unwanted disclosure of HIV status, and monetarily incentivize positive behavior. Second, this modified model was one of the few secondary distribution studies which included a direct assessment of alters' test results and experiences. This was mainly possible due to the social media component of our model, which allowed us to reach alters directly and provide them an electronic channel to participate in the study via individually packed test kits.

Overall, less than 40% of the index men distributed self-tests to their social contacts.This percentage is lower than reported in previous interventional studies.[20, 22] This is likely because we assessed index MSM's voluntary distributing behaviors. However, the study demonstrated that our model reached those who never tested for HIV, identified reactive HIV cases and facilitated linkage to facility-based care.The rate of first-time testers among alters reached in our study (40%) was significantly higher than that of an earlier secondary distribution study among fishermen (26%) in Uganda.[24] The study results suggest that, by tapping into the existing influence of MSM within their own social networks, a socialmedia-based platform holds promise to lower the barrier for hard-to-reach MSM to access the HIV testing and care continuum.

We found that a high proportion of the alters (95%) who had a sexual relationship with the index shared their test results with the index man.Over half of alters had sexual intercourse at the point-of-self-testing. However, concerns have been raised about sex at point-of-self-testing because of the inability of HIV self-testing to detect the HIV infection status within a window period and thus promote unprotected sex between discordant partners at the time of highest infectivity.[28] More research and efforts are needed to understand the role of self-tests in sexual decision making, especially in the early stage of introducing self-tests into Chinese settings.[16]

Our study also demonstrated that secondary distribution is a feasible approach for promoting syphilis self-testing among MSM with a combined HIV/syphilis testing kit. Integrating syphilis testing into existing HIV testing services has been recommended by the WHO[14, 29], however, few studies have examined effective strategies to accelerate the uptake of syphilis self-testing integrated with rapid HIV self-tests.While recent evidence showed that integrating syphilis self-testing into HIV self-testing services may be a feasible strategy to

improve syphilis test uptake among MSM[18, 30], secondary distribution of a dual HIV/syphilis test kit is a promising strategy for further expanding syphilis test coverage among this at-risk population.The model may also have implications for integrating multiple STIs self-testing services into HIVST secondary distribution programs.

Our study findings have implications. We demonstrated that a social media-based secondary distribution model was feasible and acceptable, with significant potential to expand HIV/syphilis testing among this hard-to-reach sub-group. Furthermore, our study captured the potential of MSM for promoting test behaviors among their social networks. Collecting verifiable HIV/STI self-test results has proven to be challenging, and our model provides a successful example of obtaining test result photographs for better result verification and follow-up care. Since index men were refunded their deposit only when the alters returned a test result, a refundable deposit mechanism may incentivize index men to encourage alters to upload their test result photos. This may be an important strategy for encouraging alters, who were significantly more likely to be new testers, to report their test results. Being led and maintained by a gay community organization as well as supported by health authorities, our collaborative platform empowered the community, gained trust, and secured financial sustainability, showing promise of replicability and scalability in other similar settings.

The study has several limitations. First, our study was an evaluation of an implementation project and did not include a comparison group. Second, this study recruited participants who are relatively well-educated with higher than average income levels. This may limit the generalizability of the study, and further exploration of feasibility and acceptability of secondary distribution among MSM with lower economic payment capacity should be considered for future research. Finally, there was a possibility of alters further distributing the kits within their social networks and these data were not captured in this study.

Conclusions

This study demonstrated that a social media-based secondary distribution of HIV/syphilis testing model is feasible and acceptable among MSM. It can be used to identify first-time testers,promote HIV/syphilis case identification, and linkage to care.Further implementation studies are needed that expand this service model among MSM and other key populations.

Acknowledgments

We are very grateful to all the participants who participated in this study.

Financial support

This work was supported by the National Key Research and Development Program of China [grant number 2017YFE0103800];Academy of Medical Sciences and the Newton Fund [grant number NIF\R1\181020];the National Institutes of Health [grant numbers NIAID 1R01AI114310-01, NIAID K24AI143471, R25 AI140495]; UNC Center for AIDS Research [grant number NIAID 5P30AI050410];National Science and Technology Major Project of China[grant number 2018ZX10101-001-001-003]; the National Nature Science Foundation of China [grant numbers 81903371, 81772240]; and Zhuhai Medical and Health Science and Technology Plan Project [grant number 20181117A010064].

Conflicts of interests

All authors have declared no conflicts of interests.

References

1. Kilmarx PH, Mutasa-Apollo T. Patching a leaky pipe: the cascade of HIV care. Curr Opin HIV AIDS,**2013**; 8(1): 59-64.
2. UNAIDS. 90-90-90: An ambitious treatment target to help end the AIDS epidemic. Geneva: UNAIDS;2017. https://www.unaids.org/en/resources/documents/2017/90-90-90. Accessed 9 Mar 2020.
3. WHO. Fact Sheets about HIV/AIDS. Available at: http://www.who.int/news-room/fact-sheets/detail/hiv-aids. Accessed 9 Mar 2020.
4. Best J, Tang W, Zhang Y, et al. Sexual behaviors and HIV/syphilis testing among transgender individuals in China: implications for expanding HIV testing services. Sex Transm Dis,**2015**; 42(5): 281-5.
5. Chow EP, Wilson DP, Zhang L. The rate of HIV testing is increasing among men who have sex with men in China. HIV Med,**2012**; 13(5): 255-63.
6. Zou H, Hu N, Xin Q, Beck J. HIV testing among men who have sex with men in China: a systematic review and meta-analysis. AIDS Behav, **2012**; 16(7): 1717-28.
7. Ong JJ, Fu H, Pan S, et al. Missed Opportunities for Human Immunodeficiency Virus and Syphilis Testing Among Men Who Have Sex With Men in China: A Cross-Sectional Study. Sex Transm Dis,**2018**; 45(6): 382-6.
8. Higa DH, Crepaz N, Marshall KJ, et al. A systematic review to identify challenges of demonstrating efficacy of HIV behavioral interventions for gay, bisexual, and other men who have sex with men (MSM). AIDS Behav,**2013**; 17(4): 1231-44.
9. Estem KS, Catania J, Klausner JD. HIV Self-Testing: a Review of Current Implementation and Fidelity. Curr HIV/AIDS Rep,**2016**; 13(2): 107-15.
10. Stahlman S, Lyons C, Sullivan P, et al. HIV Incidence among Gay Men and Other Men who Have Sex with Men in 2020: Where is the Epidemic Heading? Sex Health,**2017**; 14(1): 15-7.
11. WHO. Guidelines on HIV self-testing and partner notification Supplement to consolidated guidelines on HIV testing services. Available at: https://www.who.int/hiv/pub/self-testing/hiv-self-testing-guidelines/en/. Accessed 9 Mar 2020.
12. Ong JJ, Fu H, Smith MK, Tucker JD. Expanding syphilis testing: a scoping review of syphilis testing interventions among key populations. Expert Rev Anti Infect Ther,**2018**; 16(5): 423-32.
13. Jamil MS, Prestage G, Fairley CK, et al. Effect of availability of HIV self-testing on HIV testing frequency in gay and bisexual men at high risk of infection (FORTH): a waiting-list randomised controlled trial. Lancet HIV,**2017**; 4(6): e241-e50.
14. WHO. WHO information note on the use of dual HIV/syphilis rapid diagnostic tests (RDT). Available at: https://www.who.int/reproductivehealth/publications/rtis/dual-hiv-syphilis-diagnostic-tests/en/. Accessed 9 Mar 2020.
15. WHO. Status of HIV self-testing (HIVST) in national policies (situation as of July 2019). Available at: https://www.who.int/hiv/topics/self-testing/HIVST-policy_map-jul2019-a.png?ua=1. Accessed 9 Mar 2020.
16. Tang W, Wu D. Opportunities and challenges for HIV self-testing in China. Lancet HIV,**2018**; 5(11): e611-e2.
17. Jin X, Xu J, Smith MK, et al. An Internet-Based Self-Testing Model (Easy Test): Cross-Sectional Survey Targeting Men Who Have Sex With Men Who Never Tested for HIV in 14 Provinces of China. J Med Internet Res,**2019**; 21(5): e11854.
18. Wang C, Cheng W, Li C, et al. Syphilis self-testing: a nationwide pragmatic study among men who have sex with men in China. Clin Infect Dis,**2019**.
19. Operario D, Smith CD, Arnold E, Kegeles S. The Bruthas Project: evaluation of a community-based HIV prevention intervention for African American men who have sex with men and women. AIDS Educ Prev,**2010**; 22(1): 37-48.
20. Thirumurthy H, Masters SH, Mavedzenge SN, Maman S, Omanga E, Agot K. Promoting male partner HIV testing and safer sexual decision making through secondary distribution of self-tests by HIV-negative female sex workers and women receiving antenatal and post-

partum care in Kenya: a cohort study. Lancet HIV,**2016**; 3(6): e266-e74.
21. Masters SH, Agot K, Obonyo B, Mavedzenge SN, Maman S, Thirumurthy H. Promoting partner testing and couples testing through secondary distribution of HIV self-tests: a randomized clinical trial. PLoS Med,**2016**; 13(11): e1002166.
22. Gichangi A, Wambua J, Mutwiwa S, et al. Impact of HIV Self-Test Distribution to Male Partners of ANC Clients: Results of a Randomized Controlled Trial in Kenya. J Acquir Immune Defic Syndr,**2018**; 79(4): 467-73.
23. Lippman SA, Lane T, Rabede O, et al. High Acceptability and Increased HIV-Testing Frequency After Introduction of HIV Self-Testing and Network Distribution Among South African MSM. J Acquir Immune Defic Syndr,**2018**; 77(3): 279-87.
24. Choko AT, Nanfuka M, Birungi J, Taasi G, Kisembo P, Helleringer S. A pilot trial of the peer-based distribution of HIV self-test kits among fishermen in Bulisa, Uganda. PLoS One,**2018**; 13(11): e0208191.
25. Wesolowski L, Chavez P, Sullivan P, et al. Distribution of HIV Self-tests by HIV-Positive Men Who Have Sex with Men to Social and Sexual Contacts. AIDS Behav.**2019**; 23(4): 893-9.
26. Zhou Y, Liu Y, He X, Huang S, Li X, Dai W. An estimate of the MSM population in Zhuhai. Chinese Journal of AIDS & STDs,**2017**; 23(8): 730-3.
27. Christopoulos KA, Das M, Colfax GN. Linkage and retention in HIV care among men who have sex with men in the United States. Clin Infect Dis,**2011**; 52 Suppl 2: S214-22.
28. Wood BR, Ballenger C, Stekler JD. Arguments for and against HIV self-testing. HIV AIDS (Auckl),**2014**; 6: 117-26.
29. UNITAID. Market and Technology Landscape: HIV Rapid Diagnostic Tests For Self-Testing, 4th Edition, July 2018. Available at: https://unitaid.org/assets/HIVST-landscape-report.pdf. Accessed 9 Mar 2020.
30. Ong JJ, Liao M, Lee A, et al. Bridging the HIV-syphilis testing gap: dual testing among men who have sex with men living in China. Sexually Transm Infect,**2019**; 95(4): 251-3.

Tables

Table 1: Characteristics of the 371 index men and 281 alters in China, 2018-2019 (N=652)

Variables		Unique index men N=371 (%)	Unique alters ¶ N=281 (%)	P value#
Age in years (Mean, SD)		28.7(6.9)	29.4(7)	
Sex	Male	371(100)	264(98)	
	Female	-	4(2)	
Marital status	Never married	312(84)	191(72)	
	Engaged or married	51(14)	60(22)	
	Separated, divorced or widowed	8(2)	16(6)	
Residence	Rural	164(44)	91(34)	
	Urban	207(56)	177(66)	
Ethnicity	Han	367(99)	260(97)	
	Other minorities	4(1)	8(3)	
Highest education	High school/below	74(20)	64(24)	
	Some college	99(27)	62(23)	
	University	198(53)	142(53)	
Employment status	Employed	283(79)	227(81)	
	Unemployed	74(21)	52(19)	
Annual income levels (in USD)	<2518	48(13)	33(12)	
	2518-5038	42(11)	27(10)	
	5038-8393	99(27)	77(29)	
	8393-13430	103(28)	81(30)	
	>13430	79(21)	50(19)	
Gender identity§	Male	358(96)	254(96)	
	Female	3(1)	7(3)	
	Transgender	6(2)	1(0.4)	
	Unsure/other	4(1)	2(1)	
Sexual orientation§	Gay	259(70)	178(67)	
	Heterosexual	2(0.5)	13(5)	
	Bisexual	91(24)	56(21)	
	Unsure	19(5)	17(6)	
Disclosed same-sex behavior with another man to others§	Yes	260(70)	158(60)	.007
Anal sex with a male partner in the past 6 months§	Yes	314(85)	181(69)	<0.001
Consistent condom use	Yes	184(59)	103(57)	0.71

Used a condom during last sexual intercourse with a male partner	Yes	262(83)	146(81)	0.43
Sex with a female partner in the past 6 months[§]	Yes	31(8)	35(13)	.046
Consistent condom use	Yes	13(42)	13(37)	0.69
Used a condom during last sexual intercourse with a female partner	Yes	18(58)	15(43)	0.22
Ever tested for HIV before[§]	Yes	294(79)	158(60)	<0.001

[¶]Total unique alter testers, including male and female participants. Responses of variables may not add up to the total due to missing values, and valid percentages were calculated.

[§] Male participants only

[#]Chi-square tests

Table 2: Characteristics of index men who returned a result and who did not return a result in China, 2018-2019

		Did not return a result N=40(%)	Returned a result N=331(%)	*P* value
Age in years (Mean, SD)		28.5(7.8)	28.7 (6.8)	0.87
Marital status	Never married	33(82)	279(84)	0.49
	Engaged or married	7(18)	44(13)	
	Separated, divorced or widowed	0(0)	8(2)	
Residence	Rural	15(38)	149(45)	0.40
	Urban	25(62)	182(55)	
Highest education	High school/below	7(18)	67(20)	0.92
	Some college	11(28)	88(27)	
	University	22(55)	176(53)	
Employment status	Student	8(20)	54(16)	0.51
	Non-student	32(80)	277(84)	
Annual income levels (in USD)	<2518	7(18)	41(12)	0.50
	2518-5038	5(12)	37(11)	
	5038-8393	7(18)	92(28)	
	8393-13430	14(35)	89(27)	
	>13430	7(18)	72(22)	

Table 3 Sexual decision making among male alters who reported a sexual relationship with the index, based on alters' sharing status of an HIV self-test result in China, 2018-2019 (n=114)

		Total, N (%)	Alters' test result sharing status with the index, N=114 (%)		
			Shared a reactive result (n=5)	Shared a non-reactive result (n=103)	Not shared (n=6)
Did you have sex with the index on the day of testing?	Yes	61(54)	3(60)	58(56)	0(0)
	No	53(46)	2(40)	45(44)	6(100)
If you had sex with the index on the day of testing, when was it?	Before the test	27(44)	2(67)	25(43)	-
	After the test	34(56)	1(33)	33(57)	-
Did you or your partner use a condom during the sexual encounter?	Yes	41(67)	3(100)	38(66)	-
	No	20(33)	0(0.0)	20(34)	-

Figure 1: The social media-based secondary distribution model in Zhuhai, China, 2018-2019

Figure 2: Flowchart of the number of application attempts, HIV/syphilis self-test kits distributed, test results returned and completed follow-up surveys in China, 2018-2019

Figure 1

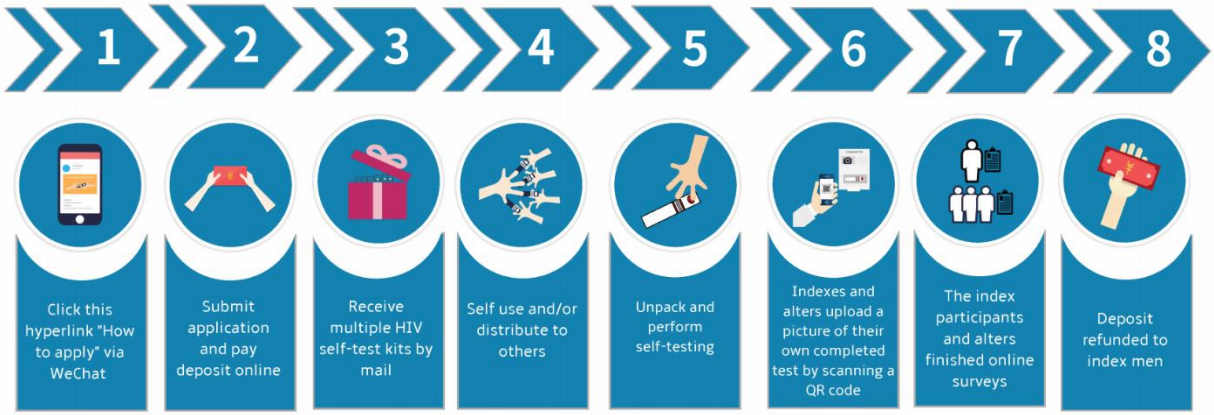

Figure 2