Syphilis self-testing: a nationwide pragmatic study among men who have sex with men in China

Cheng Wang[1,2,3,a], Weibin Cheng[1,2,a], Changchang Li[1,2], Weiming Tang[1,2,3], Jason J. Ong[4,5], M. Kumi Smith[7], Hongyun Fu[6], Michael Marks[4], Juan Nie[1,2], Heping Zheng[1,2,3], Joseph D. Tucker[3,4,8,b] , Bin Yang[1,2,b]

1. Dermatology Hospital of Southern Medical University, Guangzhou, Guangdong, China

2. Guangdong Center for Skin Diseases and STI Control, Guangzhou, Guangdong, China

3. University of North Carolina Project-China, Guangzhou, Guangdong, China

4. Faculty of Infectious and Tropical Diseases, London School of Hygiene and Tropical Medicine, London, UK

5. Central Clinical School, Monash University, Victoria, Melbourne, Australia

6. Division of Community Health and Research, Eastern Virginia Medical School, Norfolk, Virginia, USA

7. Division of Epidemiology and Community Health, University of Minnesota Twin Cities, Minneapolis, USA

8. Institute for Global Health and Infectious Diseases, School of Medicine, University of North Carolina at Chapel Hill, Chapel Hill, USA

[a] C.W. and W. C contributed equally to this work.

[b] J. D. T. and B. Y. contributed equally to this work.

Corresponding author:

Joseph D. Tucker, MD, PhD, AM

Associate Professor of Medicine

Director of UNC Project-China

Institute of Global Health and Infectious Diseases

University of North Carolina at Chapel Hill

Number 2 Lujing Road, Guangzhou, China, 510095

Tel: (86) 13560294997

Email: jdtucker@med.unc.edu

Summary

A substantial number of men reported syphilis self-testing, including men who had never received a traditional facility-based syphilis test. Nearly all men who used syphilis self-testing also received an HIV self-test kit, suggesting the potential for integrated syphilis/HIV self-testing.

ABSTRACT

Background: Syphilis self-testing may help expand syphilis testing among men who have sex with men (MSM). China has rapidly scaled up HIV self-testing, creating an opportunity for integrated syphilis self-testing. However, there is a limited literature on implementing syphilis self-testing.

Methods: A cross-sectional online survey was conducted among Chinese MSM in 2018. Participants completed a survey instrument including socio-demographic characteristics, sexual behaviors, syphilis self-testing, and HIV self-testing history. Multivariable logistic regression was conducted to identify correlates of syphilis self-testing. We also recorded potential harms associated with syphilis self-testing.

Results: Six hundred ninety-nine MSM from 89 cities in 21 provinces in China completed the study. A total of 361/699 (51.7%) men tested for syphilis, of whom 174/699 (24.9%) men used syphilis self-testing. Among 174 who had self-tested, 90 (51.7%) reported that the self-test was their first syphilis test, and 161 (92.5%) reported that they undertook syphilis self-testing together with HIV self-testing. After adjusting for covariates, syphilis self-testing was correlated with disclosure of sexual orientation to family or friends (aOR: 1.90, 95%CI: 1.32-2.73), reporting two to five male sexual partners (aOR: 1.81, 95%CI: 1.04-3.16), HIV self-testing (aOR: 39.90, 95%CI: 17.00-93.61), and never tested for syphilis in the hospital (aOR: 2.96, 95%CI: 1.86-4.72). Self-reported harms associated with syphilis self-testing were minimal.

Conclusions: Scaling up syphilis self-testing could complement facility-based testing in China among MSM. Self-testing may increase first-time testing and has limited harms. Our findings suggest that syphilis self-testing could be integrated into HIV self-testing services.

Keywords: Syphilis; Self-testing; men who have sex with men, MSM

INTRODUCTION

Syphilis remains an urgent public health priority worldwide. In 2012, over 17 million syphilis cases were reported among individuals aged 15-49 worldwide [1]. Men who have sex with men (MSM) are disproportionately affected by syphilis [2-5]. Expanding syphilis testing is a cornerstone of syphilis control [6, 7]. However, syphilis testing uptake remains low among MSM in low- and middle-income countries (LMICs). Studies suggest that only 30% of Chinese MSM has ever received a syphilis test [8, 9].

Barriers preventing MSM from accessing to syphilis testing include inconvenient testing systems [10], lack of privacy [11], and stigma associated with syphilis testing [12]. Many clinics, including sexually transmitted disease (STD) clinics, are not able to perform non-treponemal syphilis tests in China [13]. Clinics that do provide syphilis testing are not financially reimbursed when compared to reimbursements related to HIV testing [14].

Syphilis self-testing may help improve test uptake among key populations. Self-testing is the process whereby a person collects a specimen, performs the test, and interprets the result themselves [9]. HIV self-testing programs have already introduced the concept of self-testing to MSM in many countries, creating an infrastructure to distribute and measure uptake of self-testing [15, 16]. A total of 59 countries globally have policies supporting HIV self-testing.[17] Sensitive and specific syphilis self-test kits, and dual HIV/syphilis self-test kits are available in China and can be used to screen for syphilis [18], similar to treponemal serological assay commonly used in clinics [19]. Self-testing allows users to choose the location, time and setting of testing, providing an opportunity for decentralized testing [18, 20]

and alternative service delivery models [21, 22]. Self-testing may also be associated with decreased test-associated stigma [23]. China has scaled up HIV self-testing among MSM [18, 24]. A large number of MSM in China regularly use HIV self-testing, creating an opportunity to integrate syphilis self-testing. However, there is a limited literature on syphilis self-testing [18, 25]. The purpose of this cross-sectional nationwide survey was to examine syphilis self-testing experience and its determinants among MSM in China.

METHODS

Study design and participants

An online cross-sectional survey was conducted between July 14 and 28, 2018. Links to the online survey were disseminated to potential participants by local health departments and community-based organizations through Weibo (a microblogging platform) and WeChat (a messaging app). Participants entered the survey by clicking a link, which directed them to a survey website hosted by WenJuanXing (Changsha Haoxing Information Technology Co., Ltd., China).

All participants who clicked the link for the survey were screened for eligibility. Inclusion criteria included: born biologically as a male, aged 16 or over, and engaged in anal or oral sex with a man at least once during their lifetime.

To minimize the risk of participants taking the survey multiple times, we utilized a mobile phone code verification process in the survey. The survey was restricted to one phone number and a single device. Each phone number was able to receive a verification code once and

each device could only access the survey once.

Syphilis self-testing process in China

Syphilis self-testing kits can be accessed on e-commence platforms or through existing HIV self-testing programs in China.[18] We searched the available syphilis self-testing kits sold on the two largest e-commerce platforms in China (Taobao and Jingdong). There were ten brands of syphilis self-testing kits available online. All the kits are blood-based rapid testing kits using a colloidal gold method, which detect treponemal-specific antibodies and cannot distinguish between current and past infection. All the kits were certified by the China Food and Drug Administration (CFDA). The sensitivity and specificity are excellent (Supplementary Table S1). Several HIV/syphilis self-testing programs are supported by the Chinese government. The cost of per test kit ranges from 2.5 US dollars to 15 US dollars. The procedure of blood-based syphilis self-testing is similar to the procedure for blood-based HIV self-testing.

Measures

Social-demographic and behavioral variables

Socio-demographic information included: age, marital status, education, income, sexual orientation, and disclosure of sexuality orientation to healthcare providers or family or friends. Behavioral variables included: number of male sexual partners and female sexual partner in the past 3 months, condom used in the past 3 months, illicit substance use, group sex, and

commercial sex with men, HIV and syphilis testing history.

Syphilis self-testing history

Syphilis self-testing history included: location where the kit was obtained, type of test kit used (single or in combination with HIV), whether the individual performed self-testing along or together with a sexual partner (including both regular and casual partner), syphilis self-test results, post-test health care seeking behaviors and subsequent changes in syphilis testing frequency after initial use of a self-test kit.

Experiences of being pressured to take a syphilis self-testing were also assessed, a known issue in the use of HIV self-test kits [26, 27]. Pressured testing was defined as being forced to take a syphilis testing against one's will through physical, verbal, or psychological pressure. Categories of pressure were defined as physical violence (e.g. pushing, slapping, punching, kicks), threats of violence, verbal abuse (e.g., being shouted at), psychological pressure (e.g., being neglected, being discriminated), excessive control of activities (e.g., not being allowed to leave the house), withholding of household resources, and threats to end a relationship [27].

For participants who reported past experience of syphilis self-testing, we requested one of the following three items to confirm their self-testing: a photograph of the receipt of purchase for a self-test kit, screenshot of the transaction record showing the purchase of a self-test kit, or a photograph of their used syphilis self-test kit.

The questionnaire is provided in the online (Supplementary Table S2).

Statistical analysis

We report descriptive statistics for the distribution of the sample regarding background characteristics, substance use, sexual behaviors, HIV and syphilis testing.

Univariable and multivariable logistic regression were conducted to explore sociodemographic and behavioral variables associated with syphilis self-testing. In the multivariable model we adjusted for age, legal marital status, educational attainment, annual income, and sexual orientation. We performed a sub-analysis to explore correlates of syphilis self-testing restricted to participants who had ever used HIV self-testing. Statistical significance was defined as $p<0.05$. Analyses were performed using IBM SPSS Statistics (Version 22).

RESULTS

Overall, the survey link was clicked 1814 times. Of these, 1036 withdrew from the survey prior to reading the consent form and five were excluded for not signing the consent form. Among the remaining 773 men, 59 did not meet eligibility requirements (13 were female, 2 were less than 16 years old, and 44 did not engage in anal or oral sex with a man during their lifetime), and 15 duplicates were excluded. A total of 699 men completed the online survey. These individuals were in 103 cities of 29 provinces (Supplementary Table S3). Among them, 361 (51.7%) had ever tested for syphilis, of whom 174 (48.2%) had ever used syphilis self-testing. 540 (77.3%) had ever tested for HIV, of whom 406 (75.2%) had ever used HIV

self-testing. (Figure 1)

The majority of participants were between 16 and 35 years old (90.7%), were never married (84.7%), self-identified as gay (70.0%), had a college degree or higher (78%), and had an annual income less than $USD 9000 (63%). The sociodemographic characteristics of respondents who ever used syphilis self-testing were comparable to men who never used syphilis self-testing (Table 1).

Of participants who had ever tested for syphilis, 12.2% (44/361) reported that their most recent test result was positive and 80.3% (290/361) reported a negative result. Among those reporting ever using syphilis self-testing, 37.4% (65/174) participants uploaded valid proof materials. Sociodemographic characteristics were similar between individuals who had uploaded proof materials and those did not, except for legal marital status (Supplementary Table S4).

Syphilis self-testing experience

Among the 174 individuals who had self-tested for syphilis, more than half reported that the self-test was their first ever syphilis test (51.7%, 90/174) and self-tested together with their regular partner (52.9%, 92/174). Most syphilis self-testing (92.5%, 161/174) was undertaken in conjunction with HIV self-testing, and around half (53.1%, 85/161) reported that they used separate self-test kits for HIV and syphilis in their most recent self-testing. The most common place to obtain syphilis self-test kit was from community-based organization (67.2%, 117/174), followed by purchase from an online vendor (33.3%, 58/174). Twenty-two

individuals (12.6%, 22/174) reported a reactive result in their most recent syphilis self-test. Twenty-five men (83.3%, 25/30) sought care following syphilis self-testing including three who reported an indeterminate result. The majority (72%, 18/25) sought care within one month of self-testing, and three-quarters (72%, 18/25) sought care either in a general hospital or at a specialty sexually transmitted infections (STI) clinic. A minority of participants (28.2%, 49/174) reported increasing their syphilis test frequency after first using syphilis self-testing (Table 2).

Amongst individuals who had self-tested, 30 men (17.2%, 30/174) reported ever experiencing pressure to undertake syphilis self-testing, 25 men (69.4%, 25/36) reported that their most recent experience of being pressured were from regular male sexual partner. The most common forms of pressure were verbal abuse (33.3%, 10/30) and being threatened for a relationship to end (33.3%, 10/30). Physical violence was reported by six men (3.4%) (Table 2).

Factors correlated with syphilis self-testing

In the multivariable model adjusted for age, legal marital status, educational attainment, annual income, and sexual orientation, five factors were positively associated with uptake of syphilis self-testing: disclosure of sexual orientation to family or friends (aOR: 1.90, 95%CI: 1.32-2.73), reporting two to five male sexual partners in the last three months (aOR: 1.81, 95%CI: 1.04-3.16), past HIV testing (aOR: 20.07, 95%CI: 7.20-55.97), past HIV self-testing (aOR: 39.90, 95%CI: 17.00-93.61), and never tested for syphilis in the hospital (aOR: 2.96,

95%CI: 1.86-4.72). In the subgroup analysis of individuals who had ever used HIV self-testing, four factors were positively associated with uptake of syphilis self-testing: having a female sexual partner in the past three months (aOR: 2.11, 95%CI: 1.02-4.34), having ever paid for commercial sex (aOR: 2.18, 95%CI: 1.22-3.92), having ever sold sex to men (aOR: 3.14, 95%CI: 1.65-5.96), and never tested for syphilis in the hospital (aOR: 3.30, 95%CI: 1.91-5.71) (Table 3) .

Difficulties and reasons for performing syphilis self-testing

Overall, 39.1% (68/174) of self-testers reported some forms of difficulty in performing self-testing. The most commonly reported difficulty was pricking the finger to obtain a blood sample (31.5%, 53/68). The most common reasons for not using syphilis self-testing was lack of knowledge of where to obtain a self-test kit (21.2%, 199/525) or lack of knowledge of the availability of syphilis self-testing (20.6%, 193/525). The most common reason for performing syphilis self-testing was men reporting that they wish to know their infection status (41.6%, 96/174) (Supplementary Table S5).

DISCUSSION

Syphilis self-testing may reach people who do not seek testing in a facility-based setting. Our data suggest that potential harms associated with syphilis self-testing are minimal. This study expands the literature by collecting data from MSM in many Chinese cities, focusing on syphilis self-testing, and exploring benefits and harms of using syphilis self-testing. Findings

from this study provide insights for implementation of syphilis self-testing programs and research among MSM in China.

We found that many Chinese MSM used syphilis self-testing. This rate of syphilis self-testing is higher than previously reported in the Netherlands [25] and several cities in China [18]. The high rate of syphilis self-testing may be related to widespread HIV self-testing,[18] the high burden of syphilis in China,[3] or the increasing availability of online syphilis self-testing kits [18]. Additionally, we found that men who had never received a facility-based syphilis test were more likely to syphilis self-test. It suggests self-testing has potential to reach populations that facility-based strategies do not [28]. However, three-quarters of MSM in our sample had never used syphilis self-testing, suggesting that there is room for improvement on expanding coverage of syphilis self-testing services.

Our data suggest that nearly all of the syphilis self-testing was done alongside HIV self-testing. This is consistent with previous studies [18, 25] suggesting that implementation of HIV self-testing program could provide opportunities to encourage syphilis self-testing among MSM. However, among HIV self-testers in our study, only 40% of participants reported ever self-testing for syphilis. HIV self-testing has already created extensive infrastructure and public health pathways, including online testing programs, integration of public health and community-based organization programs, verification methods, and educational materials [29-31]. Given the syndemic of HIV and syphilis among MSM [32, 33], our data suggest syphilis self-testing could be integrated into existing HIV self-testing platforms, organizations, and projects [9].

Currently, there are three main ways of disseminating self-testing kits, including through community-based organizations, e-commerce platforms, and pharmacies.. In many low- and middle- income countries,[20] community-based organizations and public health programs are the main way of obtaining self-testing kits. This method is used in China,[18] Zambia,[34] Uganda[35] and Kenya.[36] E-commerce websites are another way of accessing self-test kits. This method is used in the United States (Amazon, Ebay), [37] China (Taobao, Jingdong),[37] and the Netherlands.[25] The third way is from pharmacies and this is done in the United States,[38] the Netherlands,[25] and the United Kingdom.[39] Although there are a number of ways of getting access to self-test kits, lack of linkage to counseling, treatment and care for self-test users who test positive are concerns for various stakeholders.[40, 41]

Our study found minimal potential harms associated with syphilis self-testing. The frequency of pressured testing, violence and coercion after testing observed in our sample was similar to that reported in HIV self-testing in Malawi [42] and in China [26-28]. Though the experience of being pressured to take STI tests was perceived to be negative, it could potentially lead to positive change and the adoption of risk-mitigation behaviors. A prior study documented that HIV testing frequency subsequently increased for the majority of participants who reported that they had been pressured to take an HIV test [27].

We used an online method to recruit participants for this study and our sample is more likely to be educated, younger, and have Internet access.[43, 44] However, online technologies have been rapidly growing in use for sex partners seeking among MSM.[45] Around 61.0% MSM use online methods to seek sex partners in China.[46, 47] Online

methods are increasingly used because they can efficiently recruit large samples [43] and have some automation processes which facilitate study implementation.[48, 49] Our findings may not be generalizable to older MSM or other subgroups who are less often online. Nevertheless, we applied inverse probability of sampling weights and the G-formula to investigate the generalizability of results of a previous Chinese online MSM survey. We found that the results were similar when the previous online survey was quantitatively generalized to a national, cross-sectional survey dataset on MSM in China.[50] However, we do not know whether the online results can be transported to a completely non-overlapping population. Future research may focus on this issue to provide more evidence for policy makers and practitioners.[51]

Our study has several limitations. First, there might be selection bias in our study. Participants were recruited exclusively online. This sample might have been frequent exposed to HIV programs and studies, which had higher rates of HIV testing and self-testing compared with other surveys [52-54]. In addition, we did not collect the information on the reasons of participants refusing to attend the study. Those who refused to join the study may different from the participants, which may lead to selection bias. Second, all the data was obtained through self-reported, which may be prone to information bias. However, in this study, we introduced a validation procedure for syphilis self-testing by verifying the proof of images uploaded by testers. We found similar characteristics between those had uploaded validated images and not (Supplementary Table S4). Third, we have data from treponemal test results, but not non-treponemal serologies, clinical data, or treatment history which are

important for differentiating new and old cases.

Our findings have implications for implementing syphilis self-testing among Chinese MSM. First, syphilis self-testing could be useful to help expand syphilis testing among MSM in China and in other countries that have established HIV self-testing infrastructure. Second, self-testing might help facilitate couple-based testing services, which has been proved effective in reducing in HIV transmission risk, including among Chinese MSM [55, 56]. Third, incorporating syphilis self-testing into HIV self-testing service has potential to achieve the maximum benefits of dual elimination of HIV and syphilis among MSM [57].

In conclusion, syphilis self-testing could be incorporated in China as a complement to facility-based testing services. Though the current syphilis testing rate is relatively low in MSM in China, this decentralized testing method could reach men and help expand syphilis testing. Syphilis self-testing can be integrated within HIV self-testing services to achieve further public health impact. Future studies to assess the effectiveness of syphilis self-testing in promoting syphilis prevention and control among MSM are warranted.

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Conflict of Interest

All authors have declared no conflicts of interest.

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Figure Legends

Figure 1: Flowchart diagram of study population.

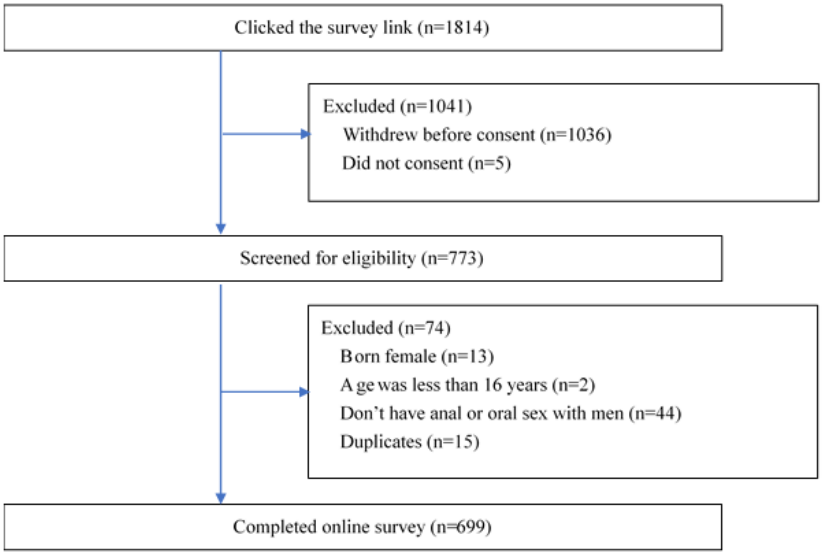

Table 1 Social demographic and sexual behavioral characteristics of participants among men who have sex with men (MSM), a national wide cross-sectional survey in China, 2018

Characteristics	Total (n=699)	Self-tester (n=174)	Facility-teste r (n=191)	Non-tester (n=334)
	n (%)			
Age (years)				
16~25	318(45.5)	72(41.4)	72(37.7)	174(52.1)
26~35	316(45.2)	85(48.9)	91(47.6)	140(41.9)
36~45	47(6.7)	13(7.5)	21(11.0)	13(3.9)
>45	18(2.6)	4(2.3)	7(3.7)	7(2.1)
Legal marital status				
Never married	592(84.7)	141(81.0)	169(88.5)	282(84.4)
Ever married/engaged	107(15.3)	33(19.0)	2(11.5)	52(15.6)
Highest educational attainment				
High school or below	154(22.0)	38(21.8)	44(23.0)	72(21.6)
Some college	180(25.8)	45(25.9)	51(26.7)	84(25.1)
Bachelor's degree and above	365(52.2)	91(52.3)	96(50.3)	178(53.3)
Annual income (USD)*				
<5000 （low level）	208(29.8)	47(27.0)	55(28.8)	106(31.7)
5001~9000 (lower-middle	233(33.3)	57(32.8)	67(35.1)	109(32.6)

level)				
9001~14000 (upper-middle level)	153(21.9)	34(19.5)	41(21.5)	78(23.4)
>14000 (high level)	105(15.0)	36(20.7)	28(14.7)	41(12.3)
Sexual orientation				
Gay	489(70.0)	132(75.9)	139(72.8)	218(65.3)
Bisexual	178(25.4)	35(20.1)	43(22.5)	100(29.9)
other	32(4.6)	7(4.0)	9(4.7)	16(4.8)
Disclosure of sexual orientation to Health provider	307(43.9)	80(46.0)	93(48.7)	134(40.1)
Disclosure of sexual orientation to family or friends	358(51.2)	111(63.8)	139(72.8)	108(32.3)
Number of male sex partners in the past three months				
0	117(16.7)	21(12.1)	33(17.3)	63(18.9)
1	284(40.6)	67(38.5)	70(36.6)	147(44.0)
2~5	276(39.5)	80(46.0)	78(40.8)	118(35.3)
6~	22(3.2)	6(3.4)	10(5.2)	6(1.8)
Condomless anal intercourse in the past three months	316(45.2)	79(45.4)	85(44.5)	152(45.5)

Female sex partner in the past three months	109(15.6)	26(14.9)	14(7.3)	69(20.7)
Ever used substances before or during sex	355(50.8)	96(55.2)	98(51.3)	161(48.2)
Ever had group sex	171(24.5)	41(23.6)	53(27.7)	77(23.1)
Ever had commercial sex (paid)	130(18.6)	40(23.0)	24(12.6)	66(19.8)
Ever had commercial sex (sold)	112(16.0)	36(20.7)	14(7.3)	62(18.6)
Ever had HIV testing	540(77.3)	170(97.7)	185(96.9)	185(55.4)
Ever had HIV self-testing	406(58.1)	168(96.6)	101(52.9)	137(41.0)
Ever tested for syphilis in hospital[+]	130(36.0)	39(22.9)	91(47.6)	-
Ever tested for syphilis in the community[+]	118(32.7)	56(32.9)	62(32.5)	-

+ This analysis was restricted to participants who had ever tested for syphilis

SD: standard deviation; USD: United States dollar

* The level of annual income (low, lower-middle, upper-middle, and high) was categorized by the standard from the National Bureau of Statistics. https://www.guancha.cn/politics/2019_01_25_488206_1.shtml

Table 2 Past syphilis self-test experience, post-test health services utilization, and potential harms of self-testing among Chinese MSM**, N=174.**

Attributes	**n**	**%**
Characteristics of syphilis self-testing		
Location where syphilis self-test kit was obtained		
Community-based organization	117	67.2
Online drug store	58	33.3
Hospital	25	14.4
Friend	11	6.3
Pharmacy	6	3.5
Syphilis self-testing results (last self-test)		
Reactive	22	12.6
Not sure	8	4.6
Negative	144	82.8
Post-test actions		
Sought care following reactive/uncertain syphilis self-testing result (*N*=30)	25	83.3
Time since reactive/uncertain syphilis self-testing result to seeking care (*N*=25)		
0-2 weeks	11	44.0
2-4 weeks	7	28.0
1-3 months	6	24.0
>3 months	1	4.0

Location for seeking care (N=25)		
General hospital	9	36.0
Specialist STI service	9	36.0
CDC	3	12.0
Pharmacy/ Online counseling/others	4	16.0
Benefits		
Self-test as their first-time syphilis test	90	51.7
Tested together with regular male sex partner	92	52.9
Joined with HIV self-testing	161	92.5
Increased syphilis testing uptake after first self-test	49	28.2
Adverse events		
Pressured testing	30	17.2
Types of pressure		
Physical violence	6	3.4
Threats of violence	7	4.0
Verbal abuse	10	5.7
Psychological pressure	6	3.4
Excessive control of activities	5	2.9
Withholding of household resources	3	1.7
Threatening to end a relationship	10	5.7

MSM: men who have sex with men; CDC: center for disease control and prevention; STI: sexual

transmitted infection.

Table3 Factors correlated with syphilis self-testing among Chinese MSM, 2018.

Characteristics	Model 1 (N=699)			Model 2*(N=406)		
	n (%)	cOR(95%CI)	aOR(95%CI)#	*n* (%)	cOR(95% CI)	aOR(95% CI)#
Disclosure of sexual orientation to health provider						
Yes	80(26.1)	1.12(0.79-1.58)	1.07(0.74-1.53)	79(43.4)	1.16(0.78-1.73)	1.23(0.80-1.88)
No	94(24.0)	*ref*	*ref*	89(39.7)	*ref*	*ref*
Disclosure of sexual orientation to family or friends						
Yes	111(31.0)	**1.98(1.39-2.82)****	**1.90(1.32-2.73)****	110(46.2)	**1.63(1.08-2.45)****	1.48(0.96-2.28)
No	63(18.5)	*ref*	*ref*	58(34.5)	*ref*	*ref*
Number of male sex partners in the last three months						
0	21(17	*ref*	*ref*	20(31	*ref*	*ref*

	.9)			.7)		
	67(23	1.41(0.82-2.4	1.43(0.80-2.4	66(40	1.43(0.78-	1.43(0.75-2
1	.6)	4)	5)	.0)	2.65)	.71)
	80(29	**1.87(1.09-3.2**	**1.81(1.04-3.1**	76(46	**1.84(1.00-**	1.78(0.94-3
2~5	.0)	**0)***	**6)***	.1)	**3.39)***	.39)
	6(27.	1.71(0.60-4.9	1.67(0.57-4.8	6(46.	1.84(0.55-	1.54(0.43-5
6~	3)	0)	8)	2)	6.20)	.51)
Condomless anal intercourse in the past three months						
	79(25	1.01(0.72-1.4	1.02(0.71-1.4	75(41	1.04(0.70-	1.08(0.70-1
Yes	.0)	3)	5)	.9)	1.55)	.64)
	95(24			93(41		*ref*
No	.8)	*ref*	*ref*	.0)	*ref*	
Female sex partner in the past three months						
	26(23	0.94(0.58-1.5	0.96(0.55-1.6	24(57	**2.04(1.07-**	**2.11(1.02-4**
Yes	.9)	1)	8)	.1)	**3.89)***	**.34)***
	148(2			144(3		*ref*
No	5.1)	*ref*	*ref*	9.6)	*ref*	
Ever had substance used before or during						

sex						
Yes	96(27.0)	1.26(0.90-1.78)	1.23(0.87-1.76)	93(44.1)	1.26(0.85-1.87)	1.10(0.72-.66)
No	78(22.7)	*ref*	*ref*	75(38.5)	*ref*	*ref*
Ever had group sex						
Yes	41(4.0)	0.94(0.63-1.40)	0.87(0.57-1.32)	127(41.0)	1.07(0.68-1.71)	0.92(0.56-1.49)
No	133(25.2)	*ref*	*ref*	41(42.7)	*ref*	*ref*
Ever had commercial sex (paid)						
Yes	40(30.8)	1.44(0.95-2.20)	1.41(0.90-2.21)	39(60.9)	**2.58(1.49-4.45)****	**2.18(1.22-3.92)****
No	134(23.6)	*ref*	*ref*	129(37.7)	*ref*	*ref*
Ever had commercial sex (sold)						

Yes	36(32.1)	1.54(0.99-3.29)	1.51(0.95-2.41)	36(67.9)	**3.54(1.92-6.56)*****	**3.14(1.65-5.96)*****
No	138(23.5)	*ref*	*ref*	132(37.4)	*ref*	*ref*
Ever had HIV testing						
Yes	170(31.5)	**17.80(6.49-48.84)*****	**20.07(7.20-55.97)*****	-		
No	4(2.5)	*ref*	*ref*	-		
Ever had HIV self-testing						
Yes	168(41.4)	**33.77(14.69-77.61)*****	**39.90(17.00-93.61)*****	-		
No	6(2.0)	*ref*	*ref*	-		
Ever tested for syphilis in hospital^{+}	N=361			N=267		
Yes	39(30.0)	**0.33(0.21-0.52)*****	**0.34(0.21-0.54)*****	38(42.1)	**0.29(0.17-0.50)*****	**0.30(0.18-0.52)*****
No	131(56.7)	*ref*	*ref*	128(71.9)	*ref*	*ref*

Ever tested for syphilis in the community[+]	N=361			N=267		
Yes	56(47.5)	1.02(0.66-1.29)	1.01(0.64-1.59)	55(64.7)	1.17(0.69-2.00)	1.22(0.70-2.15)
No	114(46.9)	*ref*	*ref*	111(61.0)	*ref*	*ref*

* Model 2 presents subanalysis results of correlated with syphilis self-testing among those participants who had ever used HIV self-testing.

[#] Multivariate logistic regression adjusted with age, legal marital status, educational attainment, monthly income, and sexual orientation.

+ This analysis was restricted to participants who had ever tested for syphilis.

*< 0.05; ** <0.01, ***<0.001.

MSM: men who have sex with men; cOR: crude odd ratio; aOR: adjusted odd ratio; CI: confidence interval.