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Correlates of recent HIV infection among men who have sex with men recruited through the internet in Huzhou City, Eastern China

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Abstract

Objective: To identify factors associated with recent HIV infection among men who have sex with men (MSM) in Huzhou City, Eastern China, who seek sexual partners via the internet.

Methods: Adult members of Tencent QQ instant messaging software, who completed a face-to-face interview questionnaire and serological HIV testing at baseline, were enrolled into this prospective cohort study. Questionnaires and serological testing were also completed at 6 and 12 months. Cox proportional hazards was used for initial bivariate analyses of differences between participants with or without recent HIV infection, and for subsequent forward stepwise multiple regression of statistically significant variables.

Results: Out of 415 baseline participants, 283 completed the 12-month follow-up (25 with recent HIV infection and 258 without; recent HIV infection rate, 8.20 per 100 person-years). Recent HIV infection was shown to be significantly associated with $\leq$ high school education (versus college/university), registered residence outside Huzhou City (versus within Huzhou City), having $\geq$ two male sexual partners, and syphilis infection.

Conclusions: Improving education levels, treating syphilis promptly, and reducing the number of male sexual partners may reduce HIV transmission among MSM in Eastern China.

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Introduction

Human immunodeficiency virus (HIV) infection among men who have sex with men (MSM) is a major public health problem in China.[1–3] Out of groups at risk, the prevalence of HIV in China is growing fastest in MSM,[4,5] and in 2015, MSM accounted for 28% of all new reported HIV infections in China.[6] Huzhou City in Eastern China has a relatively low prevalence of acquired immune deficiency syndrome (AIDS),[7] but the rate of new HIV diagnoses among MSM increased from 4.1% in 2009 to 41.7% in 2014.[8]

There is a high risk of HIV transmission among MSM, which is mainly associated with some MSM having multiple sexual partners and unfixed sexual partners, and engaging in unprotected anal intercourse (i.e. inconsistent condom use).[7,9] Unlike previously, most MSM are now more inclined to seek sexual partners through the internet than through fixed locations.[10–13] Several surveys have reported factors, such as multiple sexual partners and inconsistent condom use, as associated with recent HIV infection among MSM;[14–19] however, the rate of recent HIV infection and associated risk factors among MSM who seek male sexual partners through the internet remains unclear. Thus, the aim of the present prospective cohort study was to evaluate the correlates of recent HIV infection in MSM recruited through the internet in Huzhou City, Eastern China.

Participants and methods

Study population and data collection

This prospective cohort study included MSM aged 20–60 years recruited through convenience sampling in Huzhou City, Zhejiang Province, Eastern China. Males who used Tencent QQ instant messaging software (Shenzhen Tencent Computer System Co., Ltd, Shenzhen, China) were invited to participate via 18 MSM-oriented Tencent QQ 'making friends' groups.[7,16,17] Individuals who agreed to enrol in this study, and who subsequently completed a baseline questionnaire and who were found to be negative for HIV antibodies following baseline serological testing, were enrolled. Participants then completed two further questionnaires and underwent serological HIV tests at 6- and 12-month follow-up appointments.

Study participants were assured of privacy for the follow-up interviews and strict anonymity in order to decrease reporting bias. Questionnaires were completed by individual face-to-face interviews, conducted within a 30 min radius of Huzhou City, that were performed by four well-trained interviewers (ZY, JL, ZD, MJ) between October 2014 and January 2016. Serological tests were performed by obtaining 5 ml blood samples from participants at voluntary counselling and testing clinics. Blood samples were allowed to stand for clotting, then centrifuged to obtain serum. Serum samples were stored at –80°C prior to testing for HIV by enzyme-linked immunosorbent assay (ELISA) (HIV ELISA kit; Beijing Wantai, Beijing, China) and samples that were positive using the ELISA screening test were confirmed using a more specific Western blot immunoassay (HIV-2 BLOT 1.2 kit; MP Biomedicals Asia Pacific PTE Ltd., Singapore). Both types of test were performed according to the manufacturer's instructions.

All baseline surveys and serological tests were conducted between October 2014 and January 2015, and 12-month follow-up surveys and serological tests were conducted between October 2015 and January 2016. Following the 12-month follow-up, participants were divided into a control group (without HIV infection) and HIV group (HIV infection detected at the 6- or 12-month follow-up serological test) for statistical analyses of factors associated with HIV infection.

The study protocol was approved by the Ethics Review Committees of the Huzhou Center for Disease Control and Prevention and each participant provided written informed consent.

Questionnaire measurements

Self-reported data on marriage status (unmarried, divorced, married, or cohabiting), registered residence (within Huzhou City, outside of Huzhou City), age, duration of residence in Huzhou City ($\leq$2 years or $>$ 2 years), education level, monthly income, sexual orientation (bisexual, uncertain or exclusively homosexual), number of male sexual partners in the last 6 months, and number of anal sex experiences with a man in the last month, were obtained. All participants were asked whether they had sex with steady male partners; whether they had received HIV prevention services (such as HIV publicity materials, condoms, consulting services, and training seminars) in the last year; whether they had previously been tested for HIV; whether they had used condoms every time they engaged in anal sex with a man in the last 6 months; whether they drank alcohol or took drugs (including for sexual enhancement, erectile dysfunction, or premature/delayed ejaculation), or used aphrodisiacs (to increase libido) during sex with a man; and whether they had a current syphilis infection. Knowledge of HIV was evaluated by inquiring about eight HIV-related issues as previously described;[7] an individual was considered to have comprehensive knowledge of HIV if he responded to $\geq$ six questions correctly.[7] The rate of HIV infection was calculated as the number of participants with newly diagnosed HIV infection divided by the total number of person-years at the end of the 12-month follow-up period.

Statistical analyses

Data are presented as mean $\pm$ SD or *n* (%) prevalence for each parameter. Cox proportional hazards was used for initial bivariate analyses of the association between each parameter and participants with or without HIV infection. Variables that exhibited statistically significant differences (considered to be indicated by $P < 0.1$) were included in a forward stepwise multiple Cox proportional hazards regression model to identify variables independently associated with recent HIV infection. All statistical analyses were performed using SPSS software, version 19.0 (SPSS Inc., Chicago, IL, USA) for Windows, and a P value <0.05 was considered to indicate statistical significance.

Results

Background characteristics and initial bivariate analysis

A total of 902 MSM were invited to take part in the study, and nearly half agreed to enrol (response rate, 46%). A total of 415 MSM respondents were finally enrolled following completion of baseline questionnaire and negative baseline HIV test result. Of these, 327 and 283 completed the 6- and 12-month follow-ups, respectively, resulting in a 68.2% (283/415) continuation rate at 12 months. Of the 31.8% of participants who had dropped out by the 12-month follow-up, follow-up losses were due to

being absent from Huzhou City, a deactivated contact phone number or QQ number, and refusal to continue participation in the study. Potential reporting biases were investigated by comparing the analysis group who completed the follow-ups, and the group of participants who did not complete follow-ups. Statistical analysis (Cox proportional hazards) of the general characteristics between these two groups revealed no statistically significant differences.

At the 12-month follow-up, 25 cases of recent HIV infection were reported, equating to a rate of 8.20 per 100 person-years (95% CI 5.6 per 100 person-years, 10.9 per 100 person-years). Using 6- and 12-month follow-up data, the control group comprised 258 MSM without HIV infection and the HIV group (with recent HIV infection) comprised 25 cases (Table 1).

Overall mean age was 29.8 ± 6.1 years in the control group and 30.2 ± 8.3 years in the HIV group, and there was no between-group statistically significant difference in age. Initial bivariate analyses revealed that education level, residence location, number of male sexual partners, consistent use of condoms, use of alcohol and drugs during sex, previous tests for HIV and current syphilis infection were significantly different between the control and HIV groups (Table 1).

Approximately half (137/283 [48.4%]) of respondents reported that they had used condoms every time they had engaged in anal sex with a man in the last 6 months, and 4.4% (6/137) of participants who had used condoms every time during anal sex with a man in the last 6 months were positive for recent HIV infection compared with 13.0% (19/146) of respondents who had not used condoms every time ($P = 0.016$). Nearly two-thirds (188/283 [66.4%]) of respondents had ever been tested for HIV, 12/188 (6.4%) of whom had acquired recent HIV infection compared with 13/95 (13.7%) of respondents who had not undergone HIV testing ($P = 0.048$). Present syphilis infection was reported in 38/283 (13.4%) of respondents. A higher proportion of respondents with syphilis were positive for recent HIV infection (7/38 [18.4%]) compared with respondents without syphilis infection (18/245 [7.3%]; $P = 0.027$) (Table 1). In addition, having a lower education level ($P = 0.024$), registered residence outside Huzhou City ($P = 0.020$), $\geq$ two sexual partners ($P = 0.019$) and consuming alcohol and/or drugs during sex ($P = 0.072$) were significantly associated with increased rates of recent HIV infection (Table 1).

Multiple regression model

Stepwise multiple regression analyses using Cox proportional hazards (Table 2) showed that respondents who had completed college/university education were significantly less likely to be diagnosed with recent HIV infection than those who had not (HR 0.399, 95% CI 0.172, 0.926; $P < 0.05$). Respondents were significantly more likely to be diagnosed with recent HIV infection if their registered residence was outside Huzhou City versus within Huzhou City (HR 2.930, 95% CI 1.196, 7.180; $P < 0.05$); if they had $\geq$ two male sexual partners in the previous 6 months versus $<$ two male sexual partners (HR 2.773, 95% CI 1.150, 6.687; $P < 0.05$), and if they had a present syphilis infection versus those without syphilis (HR 3.174, 95% CI 1.259, 8.002; $P < 0.05$).

Discussion

Together with paid blood donors and intravenous drug users, MSM are a focus of AIDS prevention and control in China, due to increased risk of HIV, mainly as a result of many having multiple sexual partners and engaging in unprotected anal intercourse.[8,20,21] The rate of recent HIV infection in the present study was 8.20 per 100 person-years (95% CI 5.6 per

Table 1. Bivariate Cox proportional hazards analyses of variables associated with recent HIV infection, acquired during a 12-month follow-up, in men who have sex with men recruited via the internet in Huzhou City, China

Variable	Study group		HR (95% CI)	Statistical significance
	Control group ($n = 258$)	HIV group ($n = 25$)		
Age group				
≤29	131 (91.6)	12 (8.4)	1.110 (0.506, 2.432)	NS
>30	127 (90.7)	13 (9.3)		
Education level				
≤High school	102 (86.4)	16 (13.6)	0.391 (0.173, 0.885)	$P = 0.024$
≥College/university	156 (94.5)	9 (5.5)		
Marriage status with female				
Unmarried or divorced	204 (92.3)	17 (7.7)	1.709 (0.737, 3.960)	NS
Married or cohabitating	54 (87.1)	8 (12.9)		
Registered Residence				
Huzhou city	139 (95.2)	7 (4.8)	2.821 (1.178, 6.755)	$P = 0.020$
Outside of Huzhou city	119 (86.9)	18 (13.1)		
Residence duration in Huzhou city				
≤2 years	45 (88.2)	6 (11.8)	0.687 (0.274, 1.720)	NS
>2 years	213 (91.8)	19 (8.2)		
Monthly income				
<4000 RMB	185 (90.2)	20 (9.8)	0.634 (0.238, 1.690)	NS
≥4000 RMB	73 (93.6)	5 (6.4)		
Sexual orientation				
Bisexual or uncertain	85 (93.4)	6 (6.6)	1.506 (0.601, 3.770)	NS
Exclusively homosexual	173 (90.1)	19 (9.9)		
Had sex with steady male partners				
No	132 (92.3)	11 (7.7)	1.312 (0.596, 2.891)	NS
Yes	126 (90.0)	14 (10.0)		
Comprehensive knowledge of HIV				
No	50 (89.3)	6 (10.7)	0.773 (0.309, 1.935)	NS
Yes	208 (91.6)	19 (8.4)		
Number of male sexual partners in the last 6 months				
<2	157 (94.6)	9 (5.4)	2.655 (1.173, 6.008)	$P = 0.019$
≥2	101 (86.3)	16 (13.7)		
Had anal sex with a man in the last 6 months				
No	43 (93.5)	3 (6.5)	1.457 (0.436, 4.868)	NS
Yes	215 (90.7)	22 (9.3)		
Number of times had anal sex with a man in the last month				
<4	197 (90.8)	20 (9.2)	0.811 (0.304, 2.161)	NS
≥4	61 (92.4)	5 (7.6)		
Used condom during last anal sex with a man				
No	97 (93.3)	7 (6.7)	1.520 (0.635, 3.639)	NS
Yes	161 (89.9)	18 (10.1)		
Used condoms every time during anal sex with a man in the last 6 months				
No	127 (87.0)	19 (13.0)	0.322 (0.129, 0.806)	$P = 0.016$

(continued)

Table 1. Continued

Variable	Study group		HR (95% CI)	Statistical significance
	Control group ($n = 258$)	HIV group ($n = 25$)		
Yes	131 (95.6)	6 (4.4)		
Had commercial anal sex with a man				
No	211 (90.9)	21 (9.1)	0.856 (0.294, 2.493)	NS
Yes	47 (92.2)	4 (7.8)		
Had sex with a female				
No	146 (91.8)	13 (8.2)	1.193 (0.544, 2.614)	NS
Yes	112 (90.3)	12 (9.7)		
Seek male sexual partners by internet				
No	68 (93.2)	5 (6.8)	1.388 (0.521, 3.699)	NS
Yes	190 (90.5)	20 (9.5)		
Consumed alcohol, drugs, or used aphrodisiacs during sex with a man				
No	215 (92.7)	17 (7.3)	2.163 (0.933, 5.011)	$P = 0.072$
Yes	43 (84.3)	8 (15.7)		
Had group-sex or sex-party with men				
No	141 (92.8)	11 (7.2)	1.499 (0.681, 3.302)	NS
Yes	117 (89.3)	14 (10.7)		
Doubt yourself infected with sexually transmitted diseases				
No	146 (91.8)	13 (8.2)	1.194 (0.545, 2.618)	NS
Yes	112 (90.3)	12 (9.7)		
Have ever been diagnosed with a sexually transmitted disease				
No	205 (91.1)	20 (8.9)	1.003 (0.377, 2.673)	NS
Yes	53 (91.4)	5 (8.6)		
Have ever been tested for HIV				
No	82 (86.3)	13 (13.7)	0.453 (0.207, 0.993)	$P = 0.048$
Yes	176 (93.6)	12 (6.4)		
Received HIV prevention services (HIV publicity materials, condoms, consulting services, training seminars) in last year				
No	109 (91.6)	10 (8.4)	1.087 (0.488, 2.419)	NS
Yes	149 (90.9)	15 (9.1)		
Present syphilis infection				
No	227 (92.7)	18 (7.3)	2.684 (1.121, 6.427)	$P = 0.027$
Yes	31 (81.6)	7 (18.4)		

Data presented as *n*(%) prevalence for each variable.

HR, hazard ratio; CI, confidence interval; RMB, renminbi.

NS, no statistically significant between-group difference ($P > 0.1$; Cox proportional hazards).

100 person-years, 10.9 per 100 person-years), which is higher than reported for young Chinese MSM (6.7 per 100 person-years)[22] and MSM in Beijing (7.8 per 100 person-years).[23]

As there are no MSM bars, bathrooms or clubs in Huzhou City, MSM are most likely to seek dating or sexual encounters with men via online resources.[24]

Of the present study cohort, 68.2% completed both the 6- and 12-month follow-ups, equating to a relatively high drop-out rate of 31.8%, which may have affected the study results. Losses to follow-up were

Table 2. Multiple regression analyses of factors independently associated with recent HIV infection, acquired during a 12-month follow-up, in in men who have sex with men ($n = 283$) recruited via the internet in Huzhou City, China[a]

	Statistical result				
Variable	*B*	*SE*	*Wald*	Statistical significance	HR (95% CI)
Education level					
≤High school	–	–	–	–	1.0
≥College/university	–0.919	0.430	4.570	$P = 0.033$	0.399 (0.172, 0.926)
Registered Residence					
Huzhou city	–	–	–	–	1.0
Outside of Huzhou city	1.075	0.457	5.529	$P = 0.019$	2.930 (1.196, 7.180)
Number of male sexual partners in the last 6 months					
<2	–	–	–	–	1.0
≥2	1.020	0.449	5.158	$P = 0.023$	2.773 (1.150, 6.687)
Used condoms every time during anal sex with a man in the last 6 months					
No	–	–	–	–	1.0
Yes	–0.713	0.493	2.088	NS	0.490 (0.186, 1.289)
Consumed alcohol, drugs, or used aphrodisiacs during sex with a man					
No	–	–	–	–	1.0
Yes	0.267	0.468	0.326	NS	1.306 (0.522, 3.264)
Have ever been tested for HIV					
No	–	–	–	–	1.0
Yes	–0.592	0.412	2.059	NS	0.553 (0.247, 1.242)
Present syphilis infection					
No	–	–	–	–	1.0
Yes	1.155	0.472	5.992	$P = 0.014$	3.174 (1.259, 8.002)

[a]All statistically significant variables from the initial bivariate analyses were included in a forward stepwise multiple regression Cox proportional hazards model.
HR, hazards ratio; CI, confidence interval.
NS, no statistically significant independent association ($P > 0.05$; Cox proportional hazards).

attributed to being absent from Huzhou City, a deactivated contact phone number or QQ number, and refusal to continue participation. Respondents whose registered residences were outside of Huzhou City were found to be significantly more likely to have recent HIV infections, emphasising the importance of AIDS prevention work among migrant workers.

The present study showed that respondents who had completed college/university education were significantly less likely to be positive for recent HIV infections than those with lower education levels (HR 0.399, 95% CI 0.172, 0.926), and concurred with the results of other published studies showing that higher education levels were associated with significantly lower rates of recent HIV infection.[25] Therefore, the importance of HIV testing should be emphasised to MSM who have a low level of education. Core knowledge about AIDS has been shown to be associated with lower rates of HIV infection,[8] thus AIDS health education may promote behavioural change among MSM. However, there is a serious HIV/AIDS-prevention knowledge gap in MSM who engage in high-risk sexual behaviour,[20,26]

and reducing this knowledge gap is a challenge to HIV/AIDS health education.

The results of the present survey indicate that participants who had two or more male sexual partners and those with syphilis were more likely to have recent HIV infections than the corresponding comparator group, and several published studies have shown that syphilis infection, multiple sexual partners, and unprotected anal intercourse are major risk factors for recent HIV infection.[8,27–29] The importance of using condoms consistently during sexual activity, and reducing the number of sexual partners, should be stressed during HIV/AIDS intervention work targeting high-risk behaviour.

The present study has several limitations. First, it was dependent on self-reporting of risky behaviour and was thus subject to reporting bias, primarily social desirability bias and recall bias,[7] however, respondents were assured of privacy for the follow-up interviews and strict anonymity to decrease reporting bias. The potential reporting biases would exist between the analysis group who completed the follow-ups, and the group of participants who did not complete follow-ups, and statistical analysis of the general characteristics between these two groups revealed no statistically significant differences. Secondly, estimates of risky sexual behaviour in participants recruited through the internet may result in overestimation of the level of high-risk sexual behaviour among the entire MSM population.[30] Finally, respondents were recruited by convenience sampling from MSM-oriented Tencent QQ 'making friends' groups, which would not represent a completely randomized sample. Therefore, the findings of the present study need to be verified in a larger study population or through further investigations of MSM recruited through the internet, to identify the correlates of recent HIV infection in MSM who seek sexual partners via the internet.

In conclusion, published HIV infection rates among MSM have been estimated using prospective cohort studies or laboratory methods and show that MSM are at high risk of HIV infection. HIV infection rates differ between regions and over time, but the overall situation appears bleak. In MSM recruited in Huzhou, Eastern China, who seek sexual partners through the internet, the rate of recent HIV infection was associated with education level, registered residence, current syphilis infection and number of male sexual partners. Thus, strategies to improve academic qualifications, treat syphilis promptly, and reduce the number of male sexual partners may help to reduce transmission of HIV in this high-risk population. Prevention and control strategies and measures specific to each country are required to enhance awareness of AIDS and reduce transmission of HIV.

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Declaration of conflicting interests

The authors declare that there are no conflicts of interest.

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References

1. Zhang D, Lu H, Zhuang M, et al. Enhancing HIV testing and treatment among men who have sex with men in China: a pilot model with two-rapid tests,

single blood draw session, and intensified case management in six cities in 2013. *PloS One* 2016; 11: e0166812.
2. Zhao J, Chen L, Chaillon A, et al. The dynamics of the HIV epidemic among men who have sex with men (MSM) from 2005 to 2012 in Shenzhen, China. *Sci Rep* 2016; 6: 28703.
3. Chen Y, Li N, Zhang T, et al. Comprehensive characterization of the transmitted/founder env genes from a single MSM cohort in China. *J Acquir Immune Defic Syndr* 2015; 69: 403–412.
4. Li X, Zhang B, Li Y, et al. Mental health and suicidal ideation among Chinese women who have sex with men who have sex with men (MSM). *Women Health* 2016; 56: 940–956.
5. Ibragimov U, Harnisch JA, Nehl EJ, et al. Estimating self-reported sex practices, drug use, depression, and intimate partner violence among MSM in China: a comparison of three recruitment methods. *AIDS care* 2017; 29: 125–131.
6. NCAIDS, NCSTD and China CDC. Update on the AIDS/STD epidemic in China and main response in control and prevention in December, 2015. *China J AIDS STD* 2016; 22: 69 [In Chinese].
7. Jin M, Yang Z, Dong Z, et al. Correlates of consistent condom use among men who have sex with men recruited through the Internet in Huzhou city: a cross-sectional survey. *BMC Public Health* 2013; 13: 1101.
8. Yang Z, Huang Z, Dong Z, et al. Risk factors for HIV diagnosis among men who have sex with men: results of a case-control study in one sample of Eastern China. *AIDS Res Hum Retroviruses* 2016; 32: 1163–1168.
9. Bien CH, Best JM, Muessig KE, et al. Gay apps for seeking sex partners in china: implications for MSM sexual health. *AIDS Behav* 2015; 19: 941–946.
10. Vaughan AS, Kramer MR, Cooper HL, et al. Completeness and reliability of location data collected on the web: assessing the quality of self-reported locations in an internet sample of men who have sex with men. *J Med Internet Res* 2016; 18: e142.
11. Downing MJ, Jr. Using the internet in pursuit of public sexual encounters: is frequency of use associated with risk behavior among MSM? *Am J Mens Health* 2012; 6: 18–27.
12. Stahlman S, Nowak RG, Liu H, et al. Online sex-seeking among men who have sex with men in Nigeria: implications for online intervention. *AIDS Behav* 2017; 21: 3068–3077.
13. Sanchez T, Zlotorzynska M, Sineath C, et al. The annual American men's internet survey of behaviors of men who have sex with men in the United States: 2014 key indicators report. *JMIR Public Health Surveill* 2016; 2: e23.
14. Vallabhaneni S, McConnell JJ, Loeb L, et al. Changes in seroadaptive practices from before to after diagnosis of recent HIV infection among men who have sex with men. *PloS One* 2013; 8: e55397.
15. Thiede H, Jenkins RA, Carey JW, et al. Determinants of recent HIV infection among Seattle-area men who have sex with men. *Am J Public Health* 2009; 99(Suppl 1): S157–S164.
16. Santos-Hovener C, Zimmermann R, Kucherer C, et al. Conversation about serostatus decreases risk of acquiring HIV: results from a case control study comparing MSM with recent HIV infection and HIV negative controls. *BMC Public Health* 2014; 14: 453.
17. Drumright LN, Little SJ, Strathdee SA, et al. Unprotected anal intercourse and substance use among men who have sex with men with recent HIV infection. *J Acquir Immune Defic Syndr* 2006; 43: 344–350.
18. Drumright LN, Gorbach PM, Little SJ, et al. Associations between substance use, erectile dysfunction medication and recent HIV infection among men who have sex with men. *AIDS Behav* 2009; 13: 328–336.
19. Carey JW, Mejia R, Bingham T, et al. Drug use, high-risk sex behaviors, and increased risk for recent HIV infection among men who have sex with men in Chicago and Los Angeles. *AIDS Behav* 2009; 13: 1084–1096.
20. Ren XL, Wu ZY, Mi GD, et al. HIV care-seeking behaviour after HIV self-testing among men who have sex with men in Beijing, China: a cross-sectional study. *Infect Dis Poverty* 2017; 6: 112.
21. Zhang L, Chow EP, Jing J, et al. HIV prevalence in China: integration of surveillance

data and a systematic review. *Lancet Infect Dis* 2013; 13: 955–963.
22. Dong Z, Xu J, Zhang H, et al. HIV incidence and risk factors in Chinese young men who have sex with men–a prospective cohort study. *PloS One* 2014; 9: e97527.
23. Mao H, Ma W, Lu H, et al. High incidence of HIV and syphilis among migrant men who have sex with men in Beijing, China: a prospective cohort study. *BMJ Open* 2014; 4: e005351.
24. Yang Z, Zhang S, Dong Z, et al. Prevalence of unprotected anal intercourse in men who have sex with men recruited online versus offline: a meta-analysis. *BMC Public Health* 2014; 14: 508.
25. Mutagoma M, Nyirazinyoye L, Sebuhoro D, et al. Syphilis and HIV prevalence and associated factors to their co-infection, hepatitis B and hepatitis C viruses prevalence among female sex workers in Rwanda. *BMC Infect Dis* 2017; 17: 525.
26. Wu Z, Xu J, Liu E, et al. HIV and syphilis prevalence among men who have sex with men: a cross-sectional survey of 61 cities in China. *Clin Infect Dis* 2013; 57: 298–309.
27. Schumacher CM, Fields E, Chandran A, et al. Investigation of early syphilis trends among men who have sex with men to identify gaps in screening and case-finding in Baltimore City, Maryland. *Sex Transm Dis* 2018; 45: 69–74.
28. Xu JJ, Tang WM, Zou HC, et al. High HIV incidence epidemic among men who have sex with men in China: results from a multi-site cross-sectional study. *Infect Dis Poverty* 2016; 5: 82.
29. Liu Y, Ruan Y, Strauss SM, et al. Alcohol misuse, risky sexual behaviors, and HIV or syphilis infections among Chinese men who have sex with men. *Drug Alcohol Depend* 2016; 168: 239–246.
30. Evans AR, Wiggins RD, Mercer CH, et al. Men who have sex with men in Great Britain: comparison of a self-selected internet sample with a national probability sample. *Sex Transm Infect* 2007; 83: 200–205; discussion 205.