Original Article

Sexual Practices and the Prevalence of HIV and Syphilis among Men Who Have Sex with Men in Lanzhou, China

Wenlong Gao^{1*}, Zhiqiang Li², Ying Li², and Xiaowei Qiao²

¹*Department of Epidemiology and Health Statistics, School of Public Health, Lanzhou University, Gansu; and*

²*Lanzhou Center for Disease Control and Prevention, Gansu, China*

SUMMARY: We aimed to assess the risk of infections caused by sexual practices and determine the factors affecting the prevalence of human immunodeficiency virus (HIV) and syphilis among men who have sex with men (MSM) in Lanzhou, China. A survey including 600 MSM was conducted from March 2008 to December 2009. Demographic and sexual behavior data were collected using the snowball sampling technology, and blood samples were obtained. Multivariate logistic regression models were used to determine the predictors of HIV and syphilis infection. The seroprevalence of HIV, syphilis, HCV, and co-infection of HIV with syphilis was 6.0%, 18.0%, 1.3%, and 2.5%, respectively. Use of condoms was more inconsistent in vaginal sex than that in anal sex, buying sex or selling sex. Multivariate analysis showed that MSM with syphilis infection, MSM from other provinces, and MSM of Han ethnicity were more likely to have HIV infection. Further, MSM with HIV infection, inconsistent condom use, and less knowledge about AIDS prevention were more likely to have syphilis infection. Their social background, habit of condom use, and infection status may affect the prevalence of HIV or syphilis. These findings may have important implications for further behavioral interventions among this population.

INTRODUCTION

By the end of 2009, approximately 740,000 people had been affected by human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) in China, of whom 14.7% were infected through male homosexual transmission (1). This number, compared with the one in 2007 and that in 2005, increased by 3.7% and 7.4%. Furthermore, it is estimated that 48,000 people have been newly infected with HIV, of whom more than 30% are infected via male homosexual transmission. These data indicate a rapid spread of the HIV epidemic among men who have sex with men (MSM) in China (2). Among the high-risk groups of HIV infection, MSM play an important role in transmitting HIV and other sexually transmitted infections (STIs) from their high-risk male sexual partners to their low-risk female partners (2), and unprotected sexual behaviors facilitate this transmission. MSM are highly vulnerable to HIV infection and other STIs owing to their high-risk behaviors, which have been documented in different countries worldwide, including China (3). To control the transmission of STIs in China, diverse interventions such as community-based peer interventions, interventions to increase condom use and HIV testing, healthcare provider interventions, internet-based interventions, integrated HIV-prevention interventions, and

peer-led interventions, have been conducted (4–8).

A few studies reported disproportionate co-infection with other pathogens including syphilis and Hepatitis C virus (HCV) in HIV-infected patients (9–12). Genital ulcerative diseases have a much greater risk of co-infection with HIV (9,13). Although HIV co-infections involve a very complex mechanism, they may reveal the common risk and provide new information for the development of effective prevention and intervention strategies.

In this study, we aimed to assess different types of sexual behaviors, and the prevalence of HIV, syphilis, and HCV, and explore the determinants of HIV and syphilis among MSM to provide insights into the prevention of HIV and STIs among MSM.

MATERIALS AND METHODS

Setting and sampling: The survey was conducted from March 2008 to June 2009 in Lanzhou, China, where the prevention and control of AIDS among MSM had just started; it was difficult to gain access to this target group by traditional household-oriented or venue-based methods (14). Therefore, the snowball technique was employed to recruit all participants from the MSM population in Lanzhou. Six volunteers recruited by the MSM community personnel were the “seeds”. Appointment cards containing details of the survey were distributed to the volunteers’ friends among the subpopulation. The HIV voluntary counseling and testing clinic affiliated to the Lanzhou Center for Disease Control and Prevention was designated as a main appointment center. For MSM who had an appointment but were reluctant to go to the clinic, some flexible strategies such as the interviewer-doorstep, in-the-bar-of-MSM interview, were adopted.

All the participants were initially included if they met

Received January 7, 2014. Accepted November 17, 2014.
J-STAGE Advance Publication March 13, 2015.

DOI: 10.7883/yoken.JJID.2013.477

*Corresponding author: Mailing address: Department of Epidemiology and Health Statistics, School of Public Health, Lanzhou University, Lanzhou, Gansu 730000, China. Tel: +86-931-8915-008, Fax: +86-931-8915-008, E-mail: gaowl06@aliyun.com

the following eligibility criteria: (i) age >18 years and (ii) history of sex with other men. At the beginning of the survey, the interviewer briefly introduced himself and helped the participant to complete all formalities involved, including the importance and nature of confidentiality, issues related to the collection of information, the right not to participate and to withdraw from participation, incentive distribution, referral information related to sexual health issues, and access to the final report. To all participants who were eligible and willing to participate in the study after providing written informed consent, a trained interviewer administered a questionnaire that took approximately 30 minutes to complete and involved information on demographics (age, education, employment, marital status, residence, income, and self-identity), engagement in risky behaviors (first insertive sex, commercial bisexual behavior, heterosexual behavior, number of sex partners, condom use, and history of STI symptoms), history of HIV testing, experience of accepted intervention, and knowledge of AIDS. Each of them was paid 40 RMB Yuan (approximately US \$6.0) after the interview. The study was reviewed and approved by the Ethics Committee at Lanzhou Center for Disease Control and Prevention.

Sample collections: Data were collected through an interviewer-administered questionnaire on the basis of a one-on-one interview. Each participant was assigned a unique and confidential identification code for the questionnaire and specimens. The collected demographic information included age, ethnicity, education, employment, current marital status, income, residence, and places for seeking sex partners frequently. Questions pertaining to behavior and practices included self-identified sexual orientation, age of first sex, especially with men, and total number of male partners. The questions also enquired about paying or selling sex and heterosexual behaviors over the past 6 months as well as condom use in sexual behaviors. At the end of each interview, whole blood samples (5ml) were collected in blood collection tubes of negative pressure by laboratory personnel who were accompanied by the interviewers. All the samples were transferred to the laboratory within 6 hours after collection for HIV, syphilis, and HCV tests.

Sera testing: All assays were carried out according to the manufacturer's instructions. HIV was first tested using enzyme-linked immunoassay (ELISA) kits (Hangzhou ACON, Hangzhou, China) in the Lanzhou Center for Disease Control and Prevention and positive samples were sent to the AIDS Central Laboratory of Gansu Center for Disease Control and Prevention for confirmation by western blot (WB; Beijing Wantai, Beijing, China). Rapid plasma reagin kits (RPR; Beijing Jinhao, Beijing, China) were used to screen for syphilis, and positive samples were confirmed by *Treponema pallidum* particle agglutination test (TPPA; Shanghai Xinran, Shanghai, China). A positive RPR test (at any titer) and TPPA test confirmed the presence of a syphilis infection. HCV was tested by ELISA (Shanghai Branch, Shanghai, China). All serum samples were assayed in duplicate.

Measurements: The outcome variables of interest included the occurrences of HIV and syphilis infection. An indicator of knowledge about HIV prevention proposed by the United Nations General Assembly Spe-

cial Session (UNGASS) on HIV/AIDS was adopted in the study (15). If a respondent could provide correct answers (HIV can be avoided by having sex with only one faithful uninfected partner, HIV can be avoided by using condoms, a healthy-looking person can have HIV, a person can get HIV from mosquito bites, and a person can get HIV by sharing a meal with someone who is infected) to all the 5 questions, he was considered to have knowledge of AIDS prevention. If a participant did not use or occasionally used condoms for vaginal or anal sex every time in the last six months, he was considered an inconsistent user. Among 6 items of the accepted intervention services within the last 6 months (condom, lubricants, peer education, Sexually Transmitted Diseases (STD) screening, and treatment, HIV counseling or testing, and AIDS and STD promotional materials), use of more than 2 items was considered as effective intervention.

Statistical analysis: EpiData 3.1 software (EpiData Association, Odense, Denmark) was used for dual data entry, and statistical analyses were performed using SPSS ver. 17.0 (SPSS, Chicago, IL, USA). A chi-square test was used to compare the proportion of categorical variables. Multivariate logistic regression models were employed to identify the predictors of the outcome variables. All possible influencing factors were entered together into their corresponding model. The level of significance of analysis was set at 0.05.

RESULTS

Background characteristics of participants: Table 1 shows the socio-demographic characteristics and behavior-related factors among MSM. The study included 317 self-identified homosexual men, 258 self-identified bisexual men, and a few self-identified heterosexual or unsure men. Of the participants, more than one-third were businessmen, and their average age was 30 years; moreover, almost all participants were below the age of 45 years. The overwhelming majority (93%) had an above primary-school degree. Nearly two thirds (64.17%) were unmarried men. More than half of them were from the city, and 85% were of Han ethnicity. Recreation, bathing facilities, and internet were the main sources of their seeking partners. Most of them (90.34%) earned less than 3000 RMB Yuan per month. Of the 6 accepted intervention services, 72.16% accepted condoms but only 24.5% underwent STD screening and treatment. Slightly more than two-thirds of them accepted more than 2 items of these services. In the last 12 months, over one-third of them underwent HIV-test at least once, and most of them knew their test results. Slightly more than half (52%) of the participants had knowledge of AIDS prevention. Further, only 1.33% of them ever used addictive drugs.

Sexual practices: Table 2 depicted anal homosexual behavior, commercial homosexual behavior, and heterosexual behavior among MSM. Of the participants, a larger proportion had their first sex with women rather than with men. A little more than 10% of the men who had their first sex with men were aged below 18 years. The average age was 22.85 years. Most of the participants (84.83%) had anal sex with men at least once in the past 6 months (88.54% in self-identified homosex-

Table 1. Socio-demographic characteristics and behavior-related factors among MSM

Characteristic	Number (n = 600)	%
Self-identified sexual orientation		
Homosexual	317	52.83
Bisexual	258	43.00
Others	25	4.17
Occupation		
Businessman	214	35.67
Unemployed	100	16.67
Worker	86	14.33
Cadres of staff	59	9.83
Student	49	8.17
Catering and food industry	33	5.50
Migrant worker	20	3.33
Teacher	16	2.67
Farmer	13	2.17
Doctor	10	1.67
Age when surveyed		
< 25	212	35.33
25–35	209	34.83
35–45	131	21.84
> 45	48	8.00
Mean (SD) [Range] ¹⁾	30.0 (8.9) [18–67]	
Education level		
Illiteracy/Primary	42	7.00
Junior	130	21.67
Senior	207	34.50
College and above	221	36.83
Marital status		
Unmarried	385	64.17
Married	190	31.67
Cohabitation/Divorce	25	4.16
Residence		
Local city	320	53.33
Other cities in the province	137	22.83
Other provinces	143	23.84
Ethnicity		
Han	510	85.00
Non-Han	90	15.00
Places of seeking partners		
Bath/sauna/foot massage	262	43.67
Bar/dance halls/tea/club	212	35.33
Internet	98	16.33
Parks/public toilets/lawn	13	2.17
Others	15	2.50
Income per a month (RMB)		
None	91	15.17
≤1000	149	24.83
1001–2000	184	30.67
2001–3000	118	19.67
≥3001	58	9.66
Intervention service		
Condom	433	72.16
Lubricants	426	71.00
Peer education	327	54.50
STD screening and treatment	147	24.50
HIV counseling or testing	317	52.83
AIDS and STD promotional materials	348	58.00
More than 2 items	404	67.33
HIV-test in recent 12 months	228	38.00
Knowing testing results	209	91.67
Knowing about AIDS prevention	312	52.00
Addictive drugs	8	1.33

¹⁾: SD, standard deviation; Range, interquartile range.

Table 2. Anal homosexual behaviors, commercial homosexual behaviors and heterosexual behaviors among MSM

Sexual behavior	Number (n = 600)	%
Anal homosexual behavior		
Gender of first insertive sex partner (male)	269	44.83
Age at first insertive sex with men		
< 18	76	12.67
18–24	343	57.17
> 24	181	30.17
Mean (SD) [Range] ¹⁾	22.85 (6.07) [15–50]	
Anal sex with men within the last six months	509	84.83
Number of male partners		
1	163	32.02
2	130	25.54
3–5	117	22.99
≥6	99	19.45
Mean (SD) [Range]	5.40 (14.17) [1–200]	
Condom non-use in a last sex with men	113	22.20
Inconsistent condom use	228	44.80
Self-identified sexual orientation		
Homosexual men	278	88.54 ²⁾
Bisexual men	212	82.17 ²⁾
Others	17	77.27 ²⁾
Commercial homosexual behavior		
Paying sex within the last six months	22	4.32
Number of paying sex partners		
1	9	40.91
2	9	40.91
≥3	4	18.18
Mean (SD) [Range]	2.19 (1.97) [1–10]	
Condom non-use in a last paying sex	5	22.73
Inconsistent condom use during paying sex	7	31.82
Selling sex within the last six months	63	12.38
Number of the partners of paid sex		
1	10	15.87
2	13	20.63
≥3	40	63.49
Mean (SD) [Range]	20.92 (67.21) [1–500]	
Condom non-use in a last selling sex	6	9.52
Inconsistent condom use during selling sex	15	23.81
Heterosexual behavior		
Vaginal sex in last six months	215	35.83
Number of female partners		
1	166	74.88
2	22	10.23
≥3	27	12.56
Mean (SD) [Range]	1.90 (2.88) [1–24]	
Condom non-use in a last vaginal sex	108	50.24
Inconsistent condom use during vaginal sex	134	62.33
Self-identified sexual orientation		
Homosexual men	58	18.30 ²⁾
Bisexual men	149	57.75 ²⁾
Others	7	30.43 ²⁾

¹⁾: SD, standard deviation; Range, interquartile range.

²⁾: Ratio to each number of self-identified sexual orientation.

uals and 82.17% in self-identified bisexuals), but only one-fifth had this type of sex with more than 6 men. The highest number of male partners one had in the last 6 months was 200. Nearly one-fourth of the participants did not use a condom during the last anal sex with a

Table 3. Prevalence of HIV, syphilis, their co-infections, and HCV among MSM

Prevalence	%	95% CI
HIV	6.00	4.10–10.10
Syphilis	18.0	14.93–32.93
Co-infection of HIV with syphilis	2.50	1.25–3.75
HCV	1.33	0.42–1.75

¹⁾: CI, credible interval.

men, and a little less than half (44.8%) did not use a condom consistently during this type of sex. Less than 5% paid for sex with men, and most of them (81.82%) paid for sex with two men at most. Of the men who paid for sex, 22.73% did not use a condom during the last sexual encounter, and 31.82% used a condom inconsistently in the past 6 months. However, 12.38% of the participants sold sex to men. Different from those paying for sex, less than two-thirds of them (63.49%) had sex with 3 or more men and some had sex with as many as 500 men in the past 6 months. Fortunately, only 9.52% did not use a condom during their last sex-selling experiments, and slightly more than a quarter did not use a condom consistently in the past 6 months. Approximately one-third of the participants (35.83%) had vaginal sex with women (18.3% in self-identified homosexuals and 57.75% in self-identified bisexuals). More than three-quarters of the participants had sex with two women at most. About half of the participants (50.24%) did not use a condom during their last sexual encounter, and more than a ratio of 6 to 10 (62.33%) did not use a condom consistently in the recent 6 months. In terms of inconsistent condom use in different types of sex behaviors, vaginal sex was more likely to be unprotected than anal sex with men ($\chi^2 = 18.74$, $P < 0.001$), paying sex ($\chi^2 = 7.97$, $P < 0.01$), and selling sex ($\chi^2 = 25.21$, $P < 0.001$). Men in selling sex ($\chi^2 = 7.57$, $P < 0.01$) seemed to use condoms inconsistently less than those having anal sex with male partners, who were different from the men paying for sex ($\chi^2 = 1.53$, $P > 0.05$) in the condom use category.

HIV, syphilis, HCV, and their co-infection: Table 3 depicts the prevalence of HIV, syphilis, their co-infection, and HCV among MSM. WB results showed that 36 participants were confirmed with HIV infection, and its seroprevalence rate was 6%. The dual test of RPR and TPPA showed that 108 participants had syphilis, and its seroprevalence rate was 18%. ELISA results showed that 8 participants were positive for HCV infection, and its seroprevalence rate was 1.33%. Of all participants, 15 were co-infected with HIV and syphilis, and the seroprevalence rate of their co-infection was 2.5%, which accounted for 41.67% of the HIV-positive and 13.89% of the syphilis-positive participants. No participant was co-infected with HCV and syphilis or HIV.

Predictors of HIV and syphilis: Table 4 shows the predictors of HIV and syphilis among MSM. After adjustments for potential confounders, MSM with syphilis infection (OR = 4.03, 95% CI: 1.73–9.38) or of the Han ethnicity (OR = 8.30, 95% CI: 1.06–65.05) or from other provinces (OR = 2.60, 95% CI: 1.11–6.09) were more likely to have an HIV infection. MSM

Table 4. Predictors of HIV and syphilis infection among MSM

	Univariate ¹⁾		Multivariate	
	uOR ²⁾	95% CI ²⁾	aOR ²⁾	95% CI
HIV				
Syphilis infection	3.62	1.80–7.27	4.03	1.73–9.38
Han ethnicity	6.56	0.89–48.49	8.30	1.06–65.05
From other provinces	1.65	0.80–3.40	2.60	1.11–6.09
Syphilis				
Inconsistent condom use	1.76	1.12–2.78	2.00	1.09–3.66
Knowing less about AIDS prevention	0.69	0.45–1.05	0.56	0.33–0.95
HIV infection	3.62	1.80–7.27	3.89	1.74–8.71

¹⁾: Only predictors at 5% of multivariate analysis model are listed.

²⁾: uOR, unadjusted odds ratio; aOR, adjusted odds ratio; CI, credible interval.

with HIV infection (OR = 3.89, 95% CI: 1.74–8.71), use condoms inconsistently (OR = 2.00, 95% CI: 1.09–3.66) or knowing less about AIDS prevention (OR = 0.56, 95% CI: 0.33–0.95) were more likely to have syphilis infection.

DISCUSSION

In our study, 35.83% of all participants had vaginal sex with female partners, of whom 62.33% did not use protection consistently. Several behavioral studies found that a high proportion of MSM who had female partners, of whom many were married (16). Furthermore, our study showed that the proportion of inconsistent condom users among MSM who were engaging in vaginal sex with female partners was much higher than that among MSM who were engaging in anal sex, paying sex or selling sex with male partners. A possible reason was that almost all intervention services among MSM emphasized that unprotected anal sex has the highest risk of transmission of HIV and other sexually transmitted infections, which may misinform them of the risk of HIV transmission to their female partners via unprotected vaginal sex. In addition, condom use during sex with young husbands and wives is low in China because condom use during vaginal sex may be considered as mutual distrust and seems to reduce sensation. Less condom use may increase the risk of HIV transmission from MSM to the female population. Therefore, preventive strategies should emphasize a comprehensive understanding of safe sex and protective capability of condoms in all kinds of sexual behaviors among the population (17).

In the current study, the data about sex with female partners showed that 18.3% of self-identified homosexual men had sex with women in the last 6 months and 42.25% of self-identified bisexual men did not have sex with women in that duration. Therefore, self-identified sexual orientation did not accurately define behavior (18). In fact, MSM behaviors are highly unacceptable in China as well as other countries worldwide. Strong social pressure and the exclusion of MSM behaviors by the family have forced MSM to conceal their sexual orientation and engage unwillingly in heterosexual relationships (3,13,19). Some MSM even used marriage to disguise their MSM behaviors (3). However, there is an

additional risk of the HIV-transmitted infections to the women with whom the MSM are involved. Relevant advocacy efforts for social acceptance and family understanding of homosexuality are needed to reduce the disguising marriages or unwilling heterosexual behaviors, which may prevent additional heterosexual transmission of HIV.

In this study, we found a moderate seroprevalence of HIV (6%), a high seroprevalence of syphilis (18%), and a low seroprevalence of HCV (1.3%) among MSM. As compared with those of the other cities of China, the prevalence of HIV was higher than 1.5% and that of syphilis was lower than 0.8% in Beijing (10), and both of which were lower than the rates (10.8% and 26.7%, respectively) in Nanjing (2). The prevalence of HCV was slightly higher than 0.9% in Beijing (10) and 1.0% in Nanjing (2). The seroprevalence of co-infection with HIV and syphilis was 2.5%, higher than 1.1% reported in Beijing (11). Lanzhou is always considered a city with low prevalence of HIV and other STIs in western China. As such, the epidemics of HIV and other STIs among the population in cities with a presumed low-prevalence of HIV or STIs should be carefully monitored. Thus comprehensive programs of prevention and control for HIV and other STIs are critical among this population.

Many studies had revealed a positive relation between HIV and syphilis (10,13,20–24). The current study supported this observation. Since syphilis and HIV mutually promote the risk of both and are transmitted sexually, a substantial number of people were expected to be infected with both agents (9,25,26). In the current study, 41.67% of the HIV-positive patients were infected with syphilis. Multivariate analysis showed that inconsistent condom use can significantly increase syphilis infection. Compared with the minority ethnicities, the Han ethnicity had a higher risk of HIV probably because of the lack of constraints of religious belief in risk behaviors. Further intervention measures are urgently needed for MSM who come from other provinces and are of the Han ethnicity. Measures should be taken to enable effective surveillance of HIV and STIs and reasonable management for unsafe sexual behaviors. However, it is also important to spread the knowledge about AIDS prevention because a higher level of awareness was found to be associated with a reduction in the risk of syphilis infection. However, we did not find any association between the knowledge of AIDS prevention or inconsistent condom use and HIV infection in the study, possibly because the lower infection rate of HIV as compared with syphilis reduced the power of statistical testing in the same sample size.

Despite our important findings, our study has a few limitations that need to be acknowledged. Selection bias is inherent for the snowball sampling technology, and the study included active and visible MSM in many hot spots. Thus, they may not appropriately represent the entire MSM population (27). All the information about demographic characteristics and behavioral factors was obtained by self-reporting. Therefore, responses may be subjected to reporting bias because of social desirability (28–30). Such a bias may underestimate the prevalence of unprotected sex. Although the study took commercial sex into consideration, only a few participants responded to these questions. However, these data may

not be sufficient to clarify some important issues of commercial sex among MSM. In addition, the information on receptive anal intercourse, commercial bisexual behavior, and heterosexual non-reproductive sex was not collected in the study, which may have affected the deep analysis.

In conclusion, the rate of inconsistent condom use in vaginal sex with female partners was much higher than that in anal sex with male partners among MSM, whose culture and life background and condom use, together with infection itself, may affect the prevalence of HIV or syphilis. These findings may have important implications for further behavioral interventions in this population.

Acknowledgments The authors sincerely thank the Chinese Center for Disease Control and Prevention for financial support and technical guidance. We are also grateful to all interviewers for their participation in data collection. The funding came from the AIDS epidemic survey project sponsored by Chinese Center for Disease Control and Prevention.

Conflict of interest None to declare.

REFERENCES

1. Ministry of Health, China/World Health Organization (WHO). 2009 estimates for the HIV/AIDS epidemic in China. WHO; 2010.
2. Guo H, Wei JF, Yang H, et al. Rapidly increasing prevalence of HIV and syphilis and HIV-1 subtype characterization among men who have sex with men in Jiangsu, China. *Sex Transm Dis*. 2009; 36:120-5.
3. Lau JT, Wang M, Wong HN, et al. Prevalence of bisexual behaviors among men who have sex with men (MSM) in China and associations between condom use in MSM and heterosexual behaviors. *Sex Trans Dis*. 2008;35:406-13.
4. Duan Y, Zhang H, Wang J, et al. Community-based peer intervention to reduce HIV risk among men who have sex with men in Sichuan province, China. *AIDS Educ Prev*. 2013;25:38-48.
5. Huang Z, Wang M, Fu L, et al. Intervention to increase condom use and HIV testing among men who have sex with men in China: a meta-analysis. *AIDS Res Hum Retroviruses*. 2013;29:441-8.
6. Berg CJ, Neill EJ, Wang X, et al. Healthcare provider intervention on smoking and quit attempts among HIV-positive versus HIV-negative MSM smokers in Chengdu, China. *AIDS Care*. 2014;26:1201-7.
7. Lau JT, Lau M, Cheung A, et al. A randomized controlled study to evaluate the efficacy of an internet-based intervention in reducing HIV risk behaviors among men who have sex with men in Hong Kong. *AIDS Care*. 2008;20:820-8.
8. Ye S, Yin L, Amico R, et al. Efficacy of peer-led interventions to reduce unprotected anal intercourse among men who have sex with men: a meta-analysis. *PLoS One*. 2014;9:e90788.
9. Lynn WA, Lightman S. Syphilis and HIV: a dangerous combination. *Lancet Infect Dis*. 2004;4:456-8.
10. Ruan Y, Luo F, Jia Y, et al. Risk factors for syphilis and prevalence of HIV, hepatitis B and C among men who have sex with men in Beijing, China: implications for HIV prevention. *AIDS Behav*. 2009;13:663-70.
11. Zhang X, Wang C, Wang H, et al. Risk factors of HIV infection and prevalence of co-infections among men who have sex with men in Beijing, China. *AIDS*. 2007; 21:53-7.
12. Chan DJ. Syphilis and HIV co-infection: when is lumbar puncture indicated? *Curr HIV Res*. 2005;3:95-8.
13. Ruan Y, Li X, Qian HZ, et al. Relationship between syphilis and HIV infections among men who have sex with men in Beijing, China. *Sex Transm Dis*. 2007;34:592-7.
14. Valleroy LA, Mackellar DA, Karon JM, et al. HIV prevalence and associated risks in young men who have sex with men. *JAMA*. 2000;284:198-204.
15. Barbosa-Junior A, Pascom AR, Szwarcwald CL, et al. Proposed UNGASS indicators and the monitoring of the AIDS epidemic in

- Brazil. *Rev Saude Publica*. 2006;40:94-100.
16. Smith AD, Tapsoba P, Peshu N, et al. Men who have sex with men and HIV/AIDS in sub-Saharan Africa. *Lancet*. 2009;374:416-22.
17. Kerr-Pontes LR, Gondim R, Mota RS, et al. Self-reported sexual behavior and HIV risk taking among men who have sex with men in Fortaleza, Brazil. *AIDS* 1999;13:709-16.
18. Evans BA, Bond RA, Macrae KD. Heterosexual behaviour, risk factors and sexually transmitted infections among self-classified homosexual and bisexual men. *Int J STD AIDS*. 1998;9:129-33.
19. Liu H, Yang H, Li X, et al. Men who have sex with men and human immunodeficiency virus/sexually transmitted disease control in China. *Sex Transm Dis*. 2006;33:68-76.
20. Drummond F, Guy R, Kaldor JM, et al. The intersection between HIV and syphilis in men who have sex with men: some fresh perspectives. *HIV Ther*. 2010;4:661-73. DOI:10.2217/HIV.10.55
21. Hook EW 3rd. Syphilis and HIV infection. *J Infect Dis*. 1989;160:530-41.
22. Zetola NM, Klausner JD. Syphilis and HIV infection: an update. *Clin Infect Dis*. 2007;44:1222-8.
23. Pialoux G, Vimont S, Moulinier A, et al. Effect of HIV infection on the course of syphilis. *AIDS Rev*. 2008;10:85-92.
24. Kofoed K, Gerstoft J, Mathiesen LR, et al. Syphilis and human immunodeficiency virus (HIV)-1 coinfection: influence on CD4 T-cell count, HIV-1 viral load, and treatment response. *Sex Transm Dis*. 2006;33:143-8.
25. Wester CW, Bussmann H, Moyo S, et al. Serological evidence of HIV-associated infection among HIV-1-infected adults in Botswana. *Clin Infect Dis*. 2006;43:1612-5.
26. Branger J, van der Meer JT, van Kesteren RJ, et al. High incidence of asymptomatic syphilis in HIV-infected MSM justifies routine screening. *Sex Transm Dis*. 2009;36:84-5.
27. Brahman GN, Kodavalla V, Rajkumar H, et al. Sexual practices, HIV and sexually transmitted infections among self-identified men who have sex with men in four high HIV prevalence states of India. *AIDS*. 2008;22:45-57.
28. Koblin BA, Husnik MJ, Colfax G, et al. Risk factors for HIV infection among men who have sex with men. *AIDS*. 2006;20:731-9.
29. Dandona L, Dandona R, Gutierrez JP, et al. Sex behavior of men who have sex with men and risk of HIV in Andhra Pradesh, India. *AIDS*. 2005;19:611-9.
30. Marcus U, Bremer V, Hamouda O, et al. Understanding recent increases in the incidence of sexually transmitted infections in men having sex with men: changes in risk behavior from risk avoidance to risk reduction. *Sex Transm Dis*. 2006;33:11-7.