

RESEARCH ARTICLE

Open Access



Gonorrhoea and chlamydia prevalence in different anatomical sites among men who have sex with men: a cross-sectional study in Guangzhou, China

Li-Gang Yang^{1,2*} , Xiao-Hui Zhang^{1,2}, Pei-Zhen Zhao^{1,2}, Zheng-Yu Chen^{1,2}, Wu-Jian Ke^{1,2}, Xu-Qi Ren^{1,2}, Liu-Yuan Wang^{1,2}, Wei-Ying Chen^{1,2} and Joseph D. Tucker^{1,2,3,4}

Abstract

Background: A high rectal and oropharyngeal sexually transmitted infection (STI) burden has been reported among men who have sex with men (MSM) in many regions, but little data exists on rectal and oropharyngeal STIs among MSM in China. The purpose of this study was to determine the prevalence of gonorrhoea and chlamydia at different anatomic sites among MSM in Guangzhou, China.

Methods: We recruited a cross-sectional sample of MSM in one Chinese city and collected detailed information about socio-demographic characteristics and sexual behaviors. Men had urine, rectal, and pharyngeal swab samples tested for gonorrhoea and chlamydia using nucleic acid amplification tests (NAAT). Univariate and multivariate logistic regressions were used to evaluate factors associated with gonorrhoea and chlamydia. Among men without any STI symptoms, we also examined the prevalence of gonorrhoea and chlamydia by anatomical site.

Results: We enrolled 463 men between January 2015 and March 2017. A total of 58/463 (12.5%) of men had gonorrhoea and 84/463 (18.1%) had chlamydia. MSM with gonorrhoea were more likely to have been recruited from the STI clinic (OR 3.41, 95% CI 1.94–5.99), living with HIV (OR 2.41, 95% CI 1.18–4.92), diagnosed had STI co-infection (OR 2.55, 95% CI 1.39–4.69). MSM with chlamydia were more likely to be students (OR 1.8, 95% CI 0.99–3.39). Most gonorrhoea (34/58, 59%) and chlamydia (64/84, 76%) infections were not associated with STI symptoms.

Conclusion: Asymptomatic gonorrhoea and chlamydia infection were common in this sample of Chinese MSM. Further research is necessary to determine optimal STI screening programs.

Keywords: MSM, Chlamydia, Gonorrhoea, Rectal, Pharyngeal

Background

Gonorrhoea and chlamydia infections are the most common curable sexually transmitted infections (STIs). In 2012 there were an estimated 78 million (53–110 million) new gonorrhoea infections and 131 million (100–166 million) chlamydia infections respectively, in 2012 [1]. Men who have sex with men (MSM) have particularly high rates of gonorrhoea and chlamydia [2–7].

Extragenital gonorrhoea and chlamydia are major public health problems among MSM. Compared with genital infections, rectal and pharyngeal gonorrhoea and chlamydia infections are more likely to be asymptomatic [5] and can easily be missed without screening. Several high-income countries recommend regular screening of extragenital sites (rectum and pharynx) among sexually active MSM [8–10]. World Health Organization MSM preventive guidelines also support gonorrhoea and chlamydia screening among MSM with a higher burden of asymptomatic disease [11]. This suggests the need for research to understand the burden of extragenital gonorrhoea and chlamydia among MSM in different settings.

* Correspondence: yanglg3@hotmail.com

¹Department of Sexually Transmitted Diseases, Dermatology Hospital, Southern Medical University, Guangzhou 510091, China

²Guangdong Provincial Dermatology Hospital, Guangzhou 510091, China
Full list of author information is available at the end of the article



Despite high HIV prevalence and frequent condomless sex among MSM in China, [12–18] there are limited data on MSM extragenital gonorrhoea and chlamydia. [19, 20] Better understanding the burden of rectal and pharyngeal gonorrhoea and chlamydia can provide useful information for research and screening pilots. We undertook this study in Guangzhou, China. Guangzhou is a provincial capital city in south China with a concentrated HIV infection in MSM [21] and a strong STI network. The purpose of this study was to determine the prevalence of gonorrhoea and chlamydia at different anatomic sites among MSM in Guangzhou, China.

Methods

Study population and procedure

We recruited a cross-sectional convenience sample of MSM between January 2015 and March 2017. Enrollment criteria included being male, currently living in Guangzhou, being at least 18 years of age, self-identifying as gay or bisexual, and receiving no antibiotics in the past month.

We recruited patients from two clinics at the Dermatology Hospital of Southern Medical University, a tertiary care center with experience serving MSM. The first was an STI clinic run by the hospital, through which any patient who had STI complaints or concerns could request to see a doctor. Patients meeting enrollment criteria who agreed to participate were asked to join the research study. The second was a weekend community clinic sponsored by the Zhitong Guangzhou LGBT (lesbian, gay, bisexual, and transgender) Center, an MSM community organization. This community clinic provides free HIV and syphilis testing services for MSM. During this study, Zhitong also advertised our project on their website and social media account.

Data collection

At enrollment, we collected baseline socio-demographic information, sexual behavior, and STI history. Information about symptoms was collected as a single item. If men had symptoms consistent with an STI, this was noted. There was no effort to attribute symptoms to a particular pathogen in cases of co-infection. All participants underwent physical examination, and any abnormal findings (i.e. warts) were recorded. Urine, rectal and pharyngeal swab samples were collected for gonorrhoea and chlamydia testing. Venous blood samples were collected for HIV and syphilis testing. Men with positive tests were treated according to Chinese STI clinical management guidelines.

Laboratory methods

Oropharyngeal, rectal, and urine specimens were tested for gonorrhoea and chlamydia using the Cobas 4800 system (Roche Molecular Systems, Inc. New Jersey, USA).

Blood samples were tested for syphilis using a toluidine red unheated serum test (TRUST, Rongsheng Bio-technology Limited Corporation, Shanghai, China) and *Treponema pallidum* particle agglutination test (TPPA, Fujirebio Inc., Japan). Blood samples were tested for HIV using two antibody tests - a rapid HIV antibody test (Wantai, Beijing, China) and a second antibody test (Abon Biopharm, Hangzhou, China). If both were positive, another blood sample was collected for Western blot confirmation (MP Biomedical, Singapore).

Men were considered infected with gonorrhoea and chlamydia if respective tests were positive. Men with positive TRUST and TPPA tests were considered to have syphilis infection, unless a documented history of previously treated syphilis was available. Men with positive HIV screening and confirmatory tests were considered to have HIV infection. Anogenital warts and anogenital herpes were diagnosed according to the diagnostic criteria for China's notifiable diseases reporting system (Version 2008). These diagnoses are mainly based on exposure history and consistent clinical findings.

Data analysis

We described socio-demographic characteristics, sexual risk behaviors, and STI (by anatomic site) among men. We compared men presenting to the STI clinic and men presenting to the MSM community clinic. Chi-square tests were used to compare gonorrhoea/chlamydia prevalence between the STI clinic and MSM community groups. Univariate and multivariate logistic regressions were used to evaluate factors associated gonorrhoea and chlamydia, respectively. We also calculated the frequency of men with gonorrhoea and chlamydia who were asymptomatic. All data were analyzed using SAS 9.2 (SAS, Cary, USA).

Ethics, consent and permissions

Ethical approval for this study was obtained from the Science Research Ethical Committee of the Dermatology Hospital of Southern Medical University (GDDHLS-201502). Written informed consent was waived because the risk associated with participating in this study was deemed minimal and involved no procedures requiring consent outside of the context of participating in the study. This was approved by the Chinese IRB. It is also in accordance with DHHS (45 CFR 46.117). Verbal consent was obtained before participants were enrolled.

Results

We recruited 463 MSM to join the study. One-hundred and fifty-three men were from the STI clinic and 310 men were from the MSM community clinic. Most men were young, Han ethnicity, unmarried, non-students,

and had a higher education level. Socio-demographic characteristics are shown in Table 1.

Among 463 men, a total of 58 (12.5%) men had gonorrhea infection. The gonorrhea prevalence at urethral, rectal, and pharyngeal sites was 5.2% (24/463), 6.1% (28/463), and 3.9% (18/463), respectively (Table 2). Among all men with gonorrhea, most men (34/58, 59%) did not have STI symptoms. MSM with asymptomatic extragenital gonorrhea were common (Fig. 1). MSM with gonorrhea were more likely to have been recruited from the STI clinic (OR 3.41, 95% CI 1.94–5.99), living with HIV (OR 2.41, 95% CI 1.18–4.92), and diagnosed with STI co-infection (OR 2.55, 95% CI 1.39–4.69) (Table 3).

A total of 84 men (18.1%) had chlamydia infection at any site. The chlamydia prevalence at the urethral, rectal and oropharyngeal sites was 6.7% (31/463), 11.2% (52/463), and

1.3% (6/463), respectively. Among all men with chlamydia, most men (64/84, 76%) did not have STI symptoms. 61.3% of urethral infections, 83.3% of rectal infections and 83.3% of pharyngeal infections were asymptomatic (Fig. 1). There was a trend towards MSM with chlamydia being more likely to be students (OR 1.8, 95% CI 0.99–3.39).

The chlamydia and gonorrhea coinfection rate was 5.6% ($n = 26$). Sixty men (13.0%) were living with HIV infection. Eighty-four men (18.1%) had other STIs, including syphilis, anogenital warts, or herpes.

Discussion

Our study evaluated the prevalence of urethral, anal, and pharyngeal gonorrhea and chlamydia among MSM in Guangzhou, China. This study expands the limited literature on MSM extragenital gonorrhea and chlamydia

Table 1 Demographic and behavioral characteristics of participants from the hospital STI clinic and the community-based MSM clinic ($n = 463$), 2015–2017

	STI Clinic n (frequency)	Community clinic n (frequency)	P-value
Age(years)			0.159
< 25	50/153 (32.7%)	128/310 (41.3%)	
25–35	68/153 (44.4%)	113/310 (36.4%)	
> 35	35/153 (22.9%)	69/310 (22.3%)	
Ethnicity			0.088
Han	146/153 (95.4%)	282/310 (91.0%)	
Others	7/153 (4.6%)	28/310 (9.0%)	
Marital status			< 0.0001
Unmarried	101/153 (66.0%)	265/310 (86.6%)	
Married	50/153 (32.7%)	35/310 (11.4%)	
Other	2/153 (1.3%)	6/310 (2.0%)	
Student			0.049
Yes	14/153 (9.2%)	49/310 (15.8%)	
No	139/153 (90.8%)	261/310 (84.2%)	
Local residence time			0.854
0–6 months	22/153 (14.4%)	44/310 (14.5%)	
6–12 months	9/153 (5.9%)	22/310 (7.3%)	
Over 1 year	122/153 (79.7%)	237/310 (78.2%)	
Education level			0.065
Junior middle school and below	22/153 (14.4%)	24/310 (7.8%)	
Senior middle school	22/153 (14.4%)	41/310 (13.2%)	
Senior middle school above	109/153 (71.2%)	245 (79.0%)	
Any STI related symptoms			< 0.001
Yes	49/153 (32.0%)	31/310 (10.0%)	
No	104/153 (68.0%)	279/310 (90.0%)	
Condom use in the last 6 months			< 0.001
Any condom less sex	141/153 (92.8)	305/310 (99.3%)	
Consistent condom use	11/153 (7.2%)	2/310 (0.7%)	

Table 2 Gonorrhoea and chlamydia infection by anatomic sites among 463 MSM in an STI clinic and a community-based clinic in Guangzhou China, 2015–2017

Variables	STI clinic n (frequency)	Community clinic n (frequency)	Total n (frequency)	P*
Gonorrhoea	34/153(22.2%)	24/310 (7.7%)	58/463 (12.5%)	< 0.001
Urethral	22/153 (14.4%)	2/310 (0.7%)	24/463 (5.2%)	< 0.001
Rectal	11/153 (7.2%)	17/310 (5.5%)	28/463 (6.1%)	0.469
Pharyngeal	6/153 (3.9%)	12/310 (3.9%)	18/463 (3.9%)	0.979
Chlamydia	29/153 (19.0%)	55/310(17.7%)	84/463 (18.1%)	0.750
Urethral	18/153 (11.8%)	13/310 (4.2%)	31/463 (6.7%)	0.002
Rectal	10/153 (6.5%)	42/310 (13.6%)	52/463 (11.2%)	0.025
Pharyngeal	1/153 (0.7%)	5/310 (1.6%)	6/463 (1.3%)	0.391
HIV	20/153 (13.1%)	40/310 (12.9%)	60/463 (13.0%)	0.959
^a Other STIs	49/153 (32.0%)	35/310 (11.3%)	84/463 (18.1%)	< 0.001

*Chi-squared test

^aOther STIs refers to syphilis, ano-genital warts and herpes

26 participants were co-infected with gonorrhoea and chlamydia

prevalence in an low and middle income country context. This study also compares two different populations of MSM within the same city, providing insight about risk in these groups.

The overall chlamydia prevalence was 18.1%, and the gonorrhoea prevalence was 12.5%. The burden of chlamydia and gonorrhoea are similar to findings from other Chinese studies in Shenzhen [19] and Kunming [20]. Over half of all STIs were asymptomatic, consistent with other studies. Given that World Health Organization Guidelines recommend MSM screening for asymptomatic urethral and rectal gonorrhoea/chlamydia if prevalence is greater than 1–2% [11], our data suggest that screening would be indicated in this population.

We found that the majority of MSM STI infections were asymptomatic. This is consistent with a previous study from the United States [5]. This trend is more pronounced for rectal and pharyngeal infections [22]. The high burden of extra-genital STIs among MSM may help

researchers and policy makers making decisions about routine screening guidelines.

Our data suggest that more MSM with symptoms seek care at the STI clinic compared to the MSM community clinic. This is consistent with the STI literature on MSM seeking care at STI clinics compared to community clinics [5]. Asymptomatic infections were especially common in the MSM community clinic. This suggests that asymptomatic screening programs may be more appropriate for MSM community clinics and related settings.

Our study has implications for STI research priorities among MSM. Better understanding the burden of asymptomatic extragenital STIs may be helpful in designing prospective screening studies or modelling research. Despite the fact that many guidelines recommend periodic STI screening among MSM, there are also barriers to screening (cost. Feasibility, logistics). The US Preventive Service Task Force found insufficient evidence to recommend gonorrhoea and chlamydia testing among men when it last reviewed

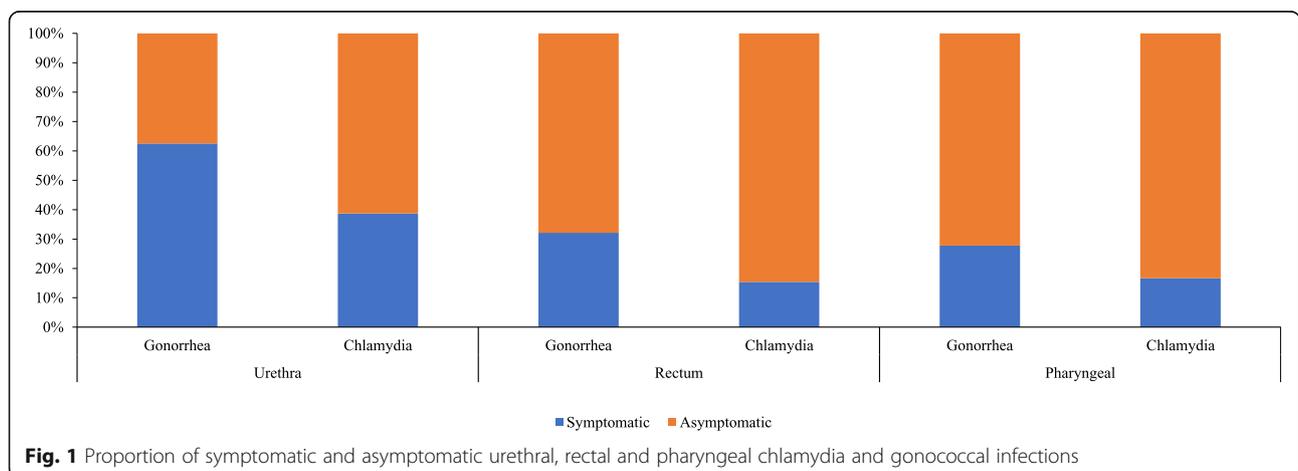


Fig. 1 Proportion of symptomatic and asymptomatic urethral, rectal and pharyngeal chlamydia and gonococcal infections

Table 3 Factors associated with gonorrhoea and chlamydia infections among 463 MSM in Guangzhou China, 2015–2017

	gonorrhoea(%)	OR (95%CI)	P	AOR	chlamydia(%)	OR(95%CI)	P	AOR
Age(years)								
< 25	26/178 (14.6%)	1.81 (0.81,4.02)	0.148	–	37/178 (20.8%)	1.34 (0.71,2.53)	0.362	
25~35	23/181 (12.7%)	1.54 (0.68,3.46)	0.299	–	30/181 (16.6%)	1.02 (0.53,1.95)	0.960	
> 35	9/104 (8.7%)	1.00		–	17/104 (16.4%)	1.00		
Ethnicity								
Han	52/428 (12.2%)	0.67(0.27,1.69)	0.394	–	76/428 (17.8%)	0.73(0.32,1.67)	0.453	
Others	6/35 (17.1%)	1.00		–	8/35 (22.9%)	1.00		
Marital status								
Unmarried	45/366 (12.3%)	0.98(0.12,8.16)	0.986	–	63/366 (17.2%)	0.62(0.12,3.16)	0.568	
Married	12/85 (14.1%)	1.15(0.13,10.20)	0.899	–	17/85 (20.0%)	0.75(0.14,4.05)	0.737	
Other	1/8 (12.5%)	1.00		–	2/8 (25.0%)	1.00		
Student								
Yes	11/63 (17.5%)	1.59(0.78,3.26)	0.206	–	17/63 (27.0%)	1.84(0.99,3.39)	0.053	
No	47/400 (11.8%)	1.00		–	67/400 (16.8%)	1.00		
Local residence time								
0–6 months	12/66 (18.2%)	1.59(0.79,3.21)	0.194	–	12/66 (18.2%)	0.99(0.50,1.95)	0.969	
6–12 months	2/31(6.5%)	0.49(0.11,2.14)	0.346	–	4/31 (12.9%)	0.66(0.22,1.94)	0.449	
Over 1 year	44/359 (12.3%)	1.00		–	66/359 (18.4%)	1.00		
Education level								
Junior middle school and below	6/46 (13.0%)	1.03(0.41,2.57)	0.949	–	7/46 (15.2%)	0.74(0.32,1.73)	0.488	
Senior middle school	7/63 (11.1%)	0.86(0.39,2.00)	0.723		8/63 (12.7%)	0.60(0.27,1.32)	0.204	
Senior middle school above	45/354 (12.7%)	1.00			69/354 (19.5%)	1.00		
Recruited from								
STI clinic	34/153 (22.2%)	3.41(1.94,5.99)	< 0.01	2.71(1.49,4.96)	29/153 (19.0%)	1.08(0.66,1.79)	0.750	–
Community clinic	24/310 (7.7%)	1.00		1.00	55/310 (17.7%)	1.00		–
Any STI related symptoms								
Yes	24/80 (30.0%)	4.40(2.43,7.97)	< 0.01	2.89(1.53,5.47)	20/80 (25.0%)	1.66(0.94,2.95)	0.082	–
No	34/383 (8.9%)	1.00		1.00	64/383 (16.7%)	1.00		–
Condom use in the last 6 months								
Any condom less sex	56/446 (12.6%)	0.79(0.17,3.66)	0.763	–	82/446 (18.4%)	1.23(0.27,5.70)		–
Consistent condom use	2/13 (15.4%)	1.00		–	2/13 (15.4%)	1.00		–
No. of sex partners in last 6 months	–	1.04(0.94,1.15)	0.424	–	–	1.09(1.01,1.18)	0.0495	1.09(1.01,1.18)
HIV positive								
Yes	15/60 (25.0%)	2.79(1.44,5.42)	0.0025	2.41(1.18,4.92)	15/60 (25.0%)	1.61(0.85,3.06)	0.1424	–
No	43/403 (10.7%)	1.00		1.00	69/403 (17.1%)	1.00		–
Other STIs [#]								
Yes	19/84 (22.6%)	2.55(1.39,4.69)	0.0026	–	18/84 (21.4%)	1.29(0.72,2.32)	0.3885	–
No	39/379 (10.3%)	1.00		–	66/379 (17.4%)	1.00		–

[#]: other STIs refers to syphilis, ano-genital warts and ano-genital herpes

the evidence [23]. Accurate assessment of asymptomatic extragenital MSM STIs will also be helpful for the development of local policies and practice guidelines.

Our study has several limitations. First, our study was limited to two clinics taking place in the same hospital in Guangzhou. This study is not representative of MSM

in China and caution should be used in making generalizations to other settings. Second, the study was cross-sectional in nature, so we cannot draw conclusions regarding causality. Third, although we asked patients about their symptoms, the main purpose of the survey instrument was not to better understand co-existing

symptoms. In addition, symptoms may not have been related to an STI. Pharyngeal symptoms have a wide differential diagnosis, so our estimate of asymptomatic cases of pharyngeal chlamydia and gonorrhea are likely underestimates.

Conclusions

Our findings show that chlamydia and gonorrhea prevalence are high among Chinese MSM. Enhanced screening and treatment of rectal chlamydia and gonorrhea among MSM is necessary to improve sexual health.

Abbreviations

DHHS: Department of Health and Human Services; LGBT: Lesbian, gay, bisexual, and transgender; MSM: Men who have sex with men; NAAT: Nucleic acid amplification tests; STI: Sexually transmitted infection; STIs: Sexually transmitted infections; TPPA: *Treponema pallidum* particle agglutination test; TRUST: Tolidine red unheated serum test

Acknowledgements

The authors gratefully acknowledge the support of the Guangzhou LGBT Center and thank the many study participants who made this work possible.

Funding

This work was supported by Medical Science and Technology Foundation of Guangdong Province (C2013010) and Research Fund of the Bureau of Science and Information Technology of Guangzhou Municipality (201704020219). This funding resources had no role in the design of the study and collection, analysis, interpretation of data, and in writing the manuscript.

Availability of data and materials

The original data is available on request to the corresponding author.

Authors' contributions

YLG, ZXH, ZPZ and JDT designed the study and wrote the initial manuscript. YLG, ZXH, ZPZ, CZY, KWJ, RXQ, WLY and CWY did the data collection and analysis. YLG, ZXH, ZPZ, CZY, KWJ, RXQ, WLY, CWY and JDT edited the manuscript and completed the final revisions. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Ethical approval for this study was obtained from the Science Research Ethical Committee of the Dermatology Hospital of Southern Medical University (GDDHLS-201502). Written informed consent was waived because the risk associated with participating in this study was deemed minimal and involved no procedures requiring consent outside of the context of participating in the study. This was approved by the Chinese IRB. It is also in accordance with DHHS (45 CFR 46.117). Verbal consent was obtained before participants were enrolled.

Consent for publication

Not Applicable.

Competing interests

The authors declare that they have no competing interests.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Author details

¹Department of Sexually Transmitted Diseases, Dermatology Hospital, Southern Medical University, Guangzhou 510091, China. ²Guangdong Provincial Dermatology Hospital, Guangzhou 510091, China. ³Institute for Global Health and Infectious Diseases, University of North Carolina at Chapel

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

Received: 16 August 2017 Accepted: 3 December 2018

Published online: 18 December 2018

References

- Newman L, Rowley J, Vander Hoorn S, Wijesooriya NS, Unemo M, Low N, Stevens G, Gottlieb S, Kiarie J, Temmerman M. Global estimates of the prevalence and incidence of four curable sexually transmitted infections in 2012 based on systematic review and global reporting. *PLoS One*. 2015; 10(12):e0143304.
- Leon SR, Segura ER, Konda KA, Flores JA, Silva-Santisteban A, Galea JT, Coates TJ, Klausner JD, Caceres CF. High prevalence of chlamydia trachomatis and *Neisseria gonorrhoeae* infections in anal and pharyngeal sites among a community-based sample of men who have sex with men and transgender women in Lima, Peru. *BMJ Open*. 2016;6(1):e008245.
- Tongtoyai J, Todd CS, Chonwattana W, Pattanasin S, Chaikummao S, Varangrat A, Lokpichart S, Holtz TH, van Griensven F, Curlin ME. Prevalence and correlates of chlamydia trachomatis and *Neisseria gonorrhoeae* by anatomic site among urban Thai men who have sex with men. *Sex Transm Dis*. 2015;42(8):440–9.
- Vodstrcil LA, Fairley CK, Fehler G, Leslie D, Walker J, Bradshaw CS, Hocking JS. Trends in chlamydia and gonorrhea positivity among heterosexual men and men who have sex with men attending a large urban sexual health service in Australia, 2002–2009. *BMC Infect Dis*. 2011;11:158.
- Kent CK, Chaw JK, Wong W, Liska S, Gibson S, Hubbard G, Klausner JD. Prevalence of rectal, urethral, and pharyngeal chlamydia and gonorrhea detected in 2 clinical settings among men who have sex with men: San Francisco, California, 2003. *Clin Infect Dis*. 2005;41(1):67–74.
- Rebe K, Lewis D, Myer L, de Swardt G, Struthers H, Kamkuemah M, McIntyre J. A Cross Sectional Analysis of gonococcal and chlamydial infections among men-who-have-sex-with-men in Cape Town, South Africa. *PLoS One*. 2015;10(9):e0138315.
- Dudareva-Vizule S, Haar K, Sailer A, Wisplinghoff H, Wisplinghoff F, Marcus U. Group Ps: prevalence of pharyngeal and rectal chlamydia trachomatis and *Neisseria gonorrhoeae* infections among men who have sex with men in Germany. *Sex Transm Infect*. 2014;90(1):46–51.
- Workowski KA, Bolan GA, centers for disease C. prevention: sexually transmitted diseases treatment guidelines, 2015. *MMWR Recomm Rep*. 2015; 64(RR-03):1–137.
- Bourne C, Edwards B, Shaw M, Gowers A, Rodgers C, Ferson M. Sexually transmissible infection testing guidelines for men who have sex with men. *Sex Health*. 2008;5(2):189–91.
- Patel RR, Patel S, Clarke E, Khan AW, Doshi B, Radcliffe KW. European collaborative clinical G: guidance and practice on frequency of HIV and sexually transmitted infection testing in men who have sex with men - what is the European situation? *Int J STD AIDS*. 2014;25(3):213–8.
- Gerbase A. Prevention and treatment of HIV and other sexually transmitted infections among men who have sex with men and transgender People: Recommendations for a public health approach. Geneva: WHO, Programme HIV/AIDS; 2011. Report No.: ISBN 978 92 4 150175 0.
- Dai W, Luo Z, Xu R, Zhao G, Tu D, Yang L, Wang F, Cai Y, Lan L, Hong F, et al. Prevalence of HIV and syphilis co-infection and associated factors among non-commercial men who have sex with men attending a sexually transmitted disease clinic in Shenzhen, China. *BMC Infect Dis*. 2017;17(1):86.
- Zhao J, Chen L, Chaillon A, Zheng C, Cai W, Yang Z, Li G, Gan Y, Wang X, Hu Y, 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.
- Zeng X, Zhong X, Peng B, Zhang Y, Kong C, Liu X, Huang A. Prevalence and associated risk characteristics of HIV infection based on anal sexual role among men who have sex with men: a multi-city cross-sectional study in Western China. *Int J Infect Dis*. 2016;49:111–8.
- Yang Z, Huang Z, Dong Z, Li J, Zhang S, Wu N, Jin M. 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 Retrovir*. 2016;32(12): 1163–8.
- Li R, Wang H, Pan X, Ma Q, Chen L, Zhou X, Jiang T, He L, Chen J, Zhang X, et al. Prevalence of condomless anal intercourse and recent HIV testing and

- their associated factors among men who have sex with men in Hangzhou, China: a respondent-driven sampling survey. *PLoS One*. 2017;12(3):e0167730.
17. Qin Q, Tang W, Ge L, Li D, Mahapatra T, Wang L, Guo W, Cui Y, Sun J. Changing trend of HIV, syphilis and hepatitis C among men who have sex with men in China. *Sci Rep*. 2016;6:31081.
 18. Qin Q, Guo W, Tang W, Mahapatra T, Wang L, Zhang N, Ding Z, Cai C, Cui Y, Sun J. Spatial analysis of the human immunodeficiency virus epidemic among men who have sex with men in China, 2006-2015. *Clin Infect Dis*. 2017;64(7):956-63.
 19. Li JH, Cai YM, Yin YP, Hong FC, Shi MQ, Feng TJ, Peng RR, Wang BX, Chen XS. Prevalence of anorectal chlamydia trachomatis infection and its genotype distribution among men who have sex with men in Shenzhen, China. *Jpn J Infect Dis*. 2011;64(2):143-6.
 20. Zhang X, Jia M, Chen M, Luo H, Chen H, Luo W, Zhang W, Ma Y, Yang C, Yang Y, et al. Prevalence and the associated risk factors of HIV, STIs and HBV among men who have sex with men in Kunming, China. *Int J STD AIDS*. 2017;28(11):1115-23.
 21. Zhong F, Liang B, Xu H, Cheng W, Fan L, Han Z, Liang C, Gao K, Mai H, Qin F, et al. Increasing HIV and decreasing syphilis prevalence in a context of persistently high unprotected anal intercourse, six consecutive annual surveys among men who have sex with men in Guangzhou, China, 2008 to 2013. *PLoS One*. 2014;9(7):e103136.
 22. Chan PA, Robinette A, Montgomery M, Almonte A, Cu-Uvin S, Lonks JR, Chapin KC, Kojic EM, Hardy EJ. Extragenital infections caused by chlamydia trachomatis and *Neisseria gonorrhoeae*: a review of the literature. *Infect Dis Obstet Gynecol*. 2016;2016:5758387.
 23. LeFevre ML, Force USPST. Screening for chlamydia and gonorrhea: U.S. preventive services task Force recommendation statement. *Ann Intern Med*. 2014;161(12):902-10.

Ready to submit your research? Choose BMC and benefit from:

- fast, convenient online submission
- thorough peer review by experienced researchers in your field
- rapid publication on acceptance
- support for research data, including large and complex data types
- gold Open Access which fosters wider collaboration and increased citations
- maximum visibility for your research: over 100M website views per year

At BMC, research is always in progress.

Learn more biomedcentral.com/submissions

