Prevalence and associated factors of chlamydial infection among patients seeking clinic-based STI services in Shenzhen, China

Hong-Lin Wang

Shenzhen Center for Chronic Disease Control, Guangdong Province

Yu-Mao Cai (✉ 64165469@qq.com)

Shenzhen Center for Chronic Disease Control <https://orcid.org/0000-0002-8098-8244>

Xiang-Sheng Chen

Chinese Academy of Medical Sciences & Peking Union Medical College Hospital of Skin Diseases and Institute of Dermatology

Wei-Ye Yu

Baylor College of Medicine

Fu-Chang Hong

Shenzhen Center for Chronic Disease Control

Tie-Jian Feng

Shenzhen Center for Disease Control and Prevention

Jin-Hong Liu

Shenzhen Center for Chronic Disease Control

Chun-Lai Zhang

Shenzhen Center for Chronic Disease Control

Li-Zhang Wen

Shenzhen Center for Chronic Disease Control

Feng Wang

Shenzhen Center for Chronic Disease Control

Jian-Bin Ye

Shenzhen Center for Chronic Disease Control

Rong-Xing Weng

Shenzhen Center for Chronic Disease Control

Fen Tang

Shenzhen Center for Chronic Disease Control

Research article

Keywords: Chlamydia trachomatis, STI surveillance programming, intervention, resource allocation, China

Posted Date: January 20th, 2020

DOI: <https://doi.org/10.21203/rs.2.21284/v1>

License: This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Objectives

Prevalence assessment is one of the core components of WHO-recommended STI surveillance programming. This study aimed to provide prevalence and associated factors data for estimating the disease burden of CT, developing intervention programmes, and planning for resource allocations.

Methods

We carried out a cross-sectional survey among patients attending clinics for STI services. We collected background information from patients (aged 18-49) and determined positivity of CT by nucleic acid amplification test (NAAT) with self-collected urine specimens. Associated factors identified through logistic regression.

Results

Among the 8324 participants, 751 were detected to be positive for CT, giving an overall prevalence of 9.0% with 10.7% for male and 8.3% for female respectively. Aged older than 24 (OR=0.78, 95%CI=0.62-0.98), married (OR=0.61, 95%CI=0.50-0.75), college or higher education (OR=0.66, 95%CI=0.51-0.86), having no access to health insurance (OR=1.28, 95%CI=1.07-1.51), and positive for NG (OR=4.45, 95%CI=3.22-6.15) were factors found to be significantly associated with CT infection.

Conclusions

We found that CT infection is prevalent among patients seeking clinic-based STI services in Shenzhen, China. A comprehensive CT screening, surveillance, and treatment programme targeting this population are warranted. And the CT integrated prevention and control projects could be considered as routine public health services by the government.

Background

Chlamydia caused by *Chlamydia trachomatis* (CT) is a major sexually transmitted infection (STI)[1] which can cause significant morbidity, particularly in women. Because up to 70% of cases in women and 50% in men are asymptomatic[2], CT infection often remains undiagnosed and untreated. Untreated CT infection can lead to pelvic inflammatory disease (PID), chronic pelvic pain, ectopic pregnancy, and tubal factor infertility in women[3] and urethritis, epididymitis and other complications including infertility in men[4]. CT infection has become a major public health concern globally. Based on the estimation of the World Health Organization (WHO) in 2012, there were an estimated 131 million new cases and 127 million prevalent cases of CT infection per year[5]. Data from the surveillance programmes in the United States[6], the United Kingdom (UK) [7] and Canada[8] had indicated an increasing trend of the infection in recent years. Based on the national case-reporting system in China, the reported incidence of CT infection has increased from 35.8/100,000 in 2011 to 37.1/100,000 in 2015[9]. However, the true

burden of the infections in many parts of China including in Shenzhen is unknown because of significant under-reporting of the infections, particularly asymptomatic infections, in health facilities. In order to provide baseline data for estimating the disease burden, developing intervention programmes, and planning for resource allocations, we carried out a cross-sectional survey to estimate the prevalence of the infection and explored the factors associated with the infection among patients attending clinics for STI services in Shenzhen City, China.

Materials And Methods

Study setting and population

The survey was a cross-sectional study in Shenzhen, a "special economic zone" located in south coastal China and adjacent to Hong Kong. The city has witnessed an alarming increase in its economy, migration of population, and the spread of syphilis and other STIs[10]. The survey was conducted using a stratified sampling strategy to recruit potential participants. Of the 10 administrative districts in the city, 6 were purposively selected and 4 hospitals reporting a high number of STI cases in the previous year were included into the study in each of 5 districts and 2 hospitals were included in 1 district. In each day during the period of the survey (from April 15 to May 16, 2018), the first 15 patients attending clinics at departments of dermatology, gynecology, urology, and andrology for seeking STI services were invited to participate in the study according to the eligibility criteria. The criteria included being a patient aged 18–49 years old, seeking STI-related services, and having not any antibiotic use in the last 2 weeks. A written informed consent should be obtained before the survey can be conducted and each participant did provide written, informed consent.

Questionnaire interview and specimen collection

Interview with a structured questionnaire was conducted by the physician to collect demographic and behavioral data as well as clinical findings and the details of the questionnaire were kept anonymous. After completing the interview, participants were asked to provide a self-administered 15–30 mL first-catch urine specimen. A research nurse was assigned to check the integrity of questionnaire information and instruct participants on specimen collection. Urine specimens were collected using the Cobas1 urine specimen collection kit (Roche P/N 05170486190) according to the manufacturer's instructions. The specimens were temporarily stored at 4°C at the local laboratory for a maximum of 10 days before being transported to a central laboratory for testing.

Laboratory assays

At the central laboratory, DNA was extracted and purified from the urine specimens by an automated magnetism nucleic acid isolation method using the MagNA Pure 96 System (Roche, Switzerland) according to the manufacturer's instructions. The extracted DNA was further evaluated for CT and Neisseria Gonorrhoeae (NG) based on polymerase chain reaction (PCR) of the Cobas® 4800 System (Roche, Switzerland) using Cobas® 4800 CT/NG Amplification/Detection Kit. Diagnosis reagent and

supplies were preserved under requested condition. Laboratory performance was run according to standard operating procedures (SOPs). CT or NG infection was defined as having a positive PCR for CT or NG.

Statistical analyses

All data from questionnaires and laboratory tests were double entered into computer to establish a database using Epidata software (V.3.1, Denmark). The Epidata 3.1 dataset was subsequently transferred to the IBM SPSS Statistics for Windows Version 23.0 (IBM Corp., Armonk, NY) for statistical analyses. Univariate analysis was used to determine the association between variables and CT infection and odds ratio (OR) and 95% confidence interval (CI) were calculated. To adjust for potential confounders, all factors associated with the infection at $P < 0.2$ in univariate analysis were included in multivariable logistic regression analysis using a backward stepwise procedure. Variables significant at $P < 0.05$ were considered the factors independently associated with the infections.

Ethics consideration

The study was approved by the Ethical Review Committee of Shenzhen Centre for Chronic Disease Control (Approval No.20180301). Participation in this study was voluntary and the questionnaire was anonymous. Confidentiality of the study data was ensured to protect the privacies of the participants. Participants who tested positive for CT and/or NG were contacted privately by the research team members for further diagnosis, treatment, and other interventions at the STI clinic in Shenzhen Centre for Chronic Disease Control. Partner notification was conducted according to the routine process in the clinic.

Results

Participant characteristics

Out of the 8444 patients who provided urine specimens, 120 did not participate in a questionnaire interview. Therefore, a total of 8324 (98.6%) participants were included in the final analyses. The mean age was 32.1 years old (standard deviation [SD] 7.3 years) and 14.3% (1183/8281) of them were younger than 24 years old. About one-third of the participants were males (30.9%, 2567/8309). Most of the participants were married (75.1%, 6207/8269), heterosexuals (98.2%, 8039/8189), migrants (73.7%, 6022/8173), and living in Shenzhen for more than 2 years (77.3%, 6331/8189). 38.8% (3232/8324) of the participants had a monthly income above 5000 Yuan, most of whom were workers (25.4%, 2099/8264) and government employees (25.6%, 2119/8264). Less than one-fifth (17.7%, 1457/8223) finished an education of college or above. 36.2% (3096/8229) had no hold of health insurance and 36.2% (2973/8203) had casual sex in the last 3 months. 21.7% (1787/8231) had knowledge about CT. More details are shown in Table 1.

Prevalence and associated factors of CT infection

Among the 8324 participants, 751 were detected to be positive for CT, giving an overall prevalence of 9.0% with 10.7% for male and 8.3% for female respectively. The highest prevalence was detected among people aged younger than 24 (15.4%). CT infection of participants (positive and negative) was used as the dependent variable and the other factors were used as the independent variables in the logistic regression model. In the univariate analyses, female (OR = 0.75, 95%CI = 0.64–0.88), aged older than 24 (OR = 0.48, 95%CI = 0.40–0.57), married (OR = 0.48, 95%CI = 0.41–0.56), residing in Shenzhen for more than 2 years (OR = 0.69, 95%CI = 0.59–0.82), government employees (OR = 0.72, 95%CI = 0.58–0.90), household/unemployed (OR = 0.78, 95%CI = 0.60–1.00), college or higher education (OR = 0.63, 95%CI = 0.50–0.81), not having casual sex in the last 3 months (OR = 0.83, 95%CI = 0.71–0.96), having knowledge about CT (OR = 0.81, 95%CI = 0.67–0.99) were significantly associated with a decreased risk of CT infection ($P < 0.05$). Meanwhile, migrants (OR = 1.40, 95%CI = 1.16–1.68), entertainment service providers (OR = 1.68, 95%CI = 1.02–2.76), having no hold of health insurance (OR = 1.59, 95%CI = 1.37–1.85), and positive for NG (OR = 5.52, 95%CI = 4.06–7.49) were significantly associated with an increased risk of CT infection ($P < 0.05$). Sexual orientation and monthly income were not significantly associated with CT infection ($P > 0.05$).

In the univariate analyses, 11 variables were associated with CT infection at $P < 0.20$ (Table 2). In the multivariate analyses using these 11 variables as independent variables and potential interactions between these variables, the following factors were found to be significantly associated with CT infection: aged older than 24 (OR = 0.78, 95%CI = 0.62–0.98), married (OR = 0.61, 95%CI = 0.50–0.75), college or higher education (OR = 0.66, 95%CI = 0.51–0.86), having no hold of health insurance (OR = 1.28, 95%CI = 1.07–1.51), and positive for NG (OR = 4.45, 95%CI = 3.22–6.15). More details are shown in Table 2.

Table 1. Socio-demographic, and behavioral data of survey participants at baseline (n = 8324)			
Characteristic	Frequency*(%)	Characteristic	Frequency*(%)
Sex		Occupation	
Male	2567 (30.9)	Workers	2099 (25.4)
Female	5742 (69.1)	Entertainment services	129 (1.6)
Age in years		Businessman/Catering services	1606 (19.4)
≤ 24	1183 (14.3)	Government employees	2119 (25.6)
>24	7098 (85.7)	Household/Unemployed	1267 (15.3)
Marital status		Others	1044 (12.6)
Single and others	2062 (24.9)	Education level	
Married	6207 (75.1)	Junior high school or below	2636 (32.1)
Sexual orientation		Senior high school	2407 (29.3)
Heterosexuality	8039 (98.2)	Junior college	1723 (21.0)
Homo- or bi-sexuality	150 (1.8)	College or above	1457 (17.7)
Residence		Hold of health insurance	
Shenzhen	2151 (26.3)	Yes	5133 (62.4)
Other places	6022 (73.7)	No	3096 (37.6)
Duration in Shenzhen		Casual sex in the last 3 months	
<2 years	1858 (22.7)	Yes	2973 (36.2)
≥ 2 years	6331 (77.3)	No	5230 (63.8)
Monthly income		Knowledge about CT	
< 3000 Yuan	1672 (20.1)	Unknown	6444 (78.3)
3001–5000 Yuan	2775 (33.3)	Known	1787 (21.7)
5001–10000 Yuan	2666 (32.0)		
>10000 Yuan	566 (6.8)		
Not quite clear	645 (7.7)		
* The sum of participants in some items may be less than the total number of 8324 because some participants did not respond to these items.			

Table 2. Prevalence and associated factors of chlamydial infection among patients seeking clinic-based STI services in Shenzhen, China

Associated factors	Prevalence of CT (%)	Univariate		Multivariate	
		OR (95% CI)	P Value	OR (95% CI)	P Value
Sex					
Male	10.7	1.00			
Female	8.3	0.75 (0.64–0.88)	0.000*		
Age in years					
≤ 24	15.4	1.00		1.00	
>24	8.0	0.48 (0.40–0.57)	0.000*	0.78 (0.62–0.98)	0.034*
Marital status					
Single or others	14.3	1.00		1.00	
Married	7.3	0.48 (0.41–0.56)	0.000*	0.61 (0.50–0.75)	0.000*
Residence					
Shenzhen	7.2	1.00			
Other places	9.8	1.40 (1.16–1.68)	0.000*		
Duration in Shenzhen					
<2 years	11.2	1.00			
≥2 years	8.3	0.69 (0.59–0.82)	0.000*		
Occupation					
Workers	9.9	1.00			
Entertainment services	15.5	1.68 (1.02–2.76)	0.042*		

Table 2. Prevalence and associated factors of chlamydial infection among patients seeking clinic-based STI services in Shenzhen, China					
Businessman/Catering services	10.3	1.05 (0.84–1.30)	0.679		
Government employees	7.3	0.72 (0.58–0.90)	0.003*		
Household/Unemployed	7.8	0.78 (0.60–1.00)	0.046*		
Others	9.6	0.97 (0.75–1.25)	0.801		
Education level					
Junior high school or below	10.1	1.00		1.00	
Senior high school / technical secondary school	9.5	0.93 (0.77–1.12)	0.434	0.84 (0.69–1.02)	0.085
Junior college	8.7	0.85 (0.69–1.04)	0.119	0.84 (0.67–1.05)	0.122
College or above	6.7	0.63 (0.50–0.81)	0.000*	0.66 (0.51–0.86)	0.002*
Hold of health insurance					
Yes	7.5	1.00		1.00	
No	11.5	1.59 (1.37–1.85)	0.000*	1.28 (1.07–1.51)	0.006*
Casual sex in the last 3 months					
Yes	10.1	1.00			
No	8.5	0.83 (0.71–0.96)	0.015*		
Knowledge about CT					
Unknown	9.4	1.00			
Known	7.8	0.81 (0.67–0.99)	0.036*		

Table 2. Prevalence and associated factors of chlamydial infection among patients seeking clinic-based STI services in Shenzhen, China					
Neisseria gonorrhoeae detection					
Negative	8.4	1.00		1.00	
Positive	33.7	5.52 (4.06– 7.49)	0.000*	4.45 (3.22– 6.15)	0.000*
*P < 0.05					

Discussion

The findings from our study indicated a high prevalence of CT infection among either male or female patients attending clinics in departments of dermatology, gynecology, urology, and andrology in Shenzhen and highlight the risk factors associated with the infection in this population. STI surveillance plays an important role on measuring the magnitude of the STI burden in the general and target populations to assist in programme planning, monitoring trends over time and identify emerging infections and outbreaks, providing data to advocate for mobilization of resources, and assisting in evaluating the effectiveness of the response [11]. Prevalence assessment is one of the core components of WHO-recommended STI surveillance programming.

Our study was a cross-sectional study on genital CT infection with the largest sample size of patients seeking clinic-based STI services in China. Among 8324 patients, the total prevalence of CT infections was 9.0% with 10.7% for male and 8.3% for female respectively, which was higher than the national rates of 2.1% for male and 2.6% for female (1999–2000)[12]. This CT prevalence was also higher than that reported in many high-income countries[13], such as 1.7% in the US[14], 1.5% in the UK[15], and 1.7% in France[16]. Compare with high-risk populations, such as 8.5% among cross-border truck drivers in Hong Kong[17], 6.5% among MSM in Jiangsu Province[18], this CT prevalence still remained at a high level. The relatively high prevalence of CT infection further emphasized the importance of urgently implementing comprehensive interventions among patients seeking clinic-based STI services.

In our study, the highest prevalence (15.4%) was detected among patients seeking clinic-based STI services aged younger than 24. After controlling for confounding factors, aged younger than 24 was still significantly associated with an increased risk of CT infection ($P < 0.05$). This finding was similar to the findings of the US CDC, which reported that in 2013, the highest incidence of CT in the US was among people aged between 14 and 24 years[19]. These may indicate that patients of this age group had more exposure to new infection due to greater sexual activity and less knowledge about STI prevention. Opportunistic screening for CT among young sexually active adults had been recommended in many high-income countries including the USA, the UK, Australia, Sweden, Denmark and Norway[20–22]. The UK had run the nationwide programme-the National Chlamydia Screening Programme (NCSP)[23], which

targeted all sexually active men and women under 25 years of age for annual chlamydia screening through various clinical and nonclinical settings. As an economically developed region, Shenzhen has a good ability to undertake economic health. It is a feasible measure to develop a CT screening strategy for young people in reference to developed countries.

In addition, participants that were single/divorced/widowed were almost 50% more likely to have a CT infection than those that were married. This was consistent with the results of Wong WC et al.'s[24] and Walsh MS et al.'s[25] studies. It could be seen that maintaining loyal marital status was an effective protective factor for CT infection after excluding age, not having casual sex in the last 3 months and other confounding factors. Moreover, our results showed that positive for NG was significantly associated with an increased risk of CT infection. This was consistent with the findings of Guangdong Province[26]. Therefore, it would be better to suggest patients have a CT infections test when they need to have an NG detection.

Regarding educational level, we found that participants with lower educational level were at higher risk of incident CT infection, and this association remained after adjusted for age and occupation. Similar results were obtained in other studies[27–29]. Also, we found that a higher prevalence in patients who had no hold of health insurance. Poor healthcare-seeking behavior associated with higher infection rates, lower partner referral or inadequate care had been reported for people with lower socioeconomic status in many countries[30–32]. A German study showed that, because a quarterly fee had to be paid by persons, posing a possible barrier for people with a small income, the higher prevalence in groups with low or medium social status could be due to a lower healthcare use and subsequently a lower chance to be tested for CT[33–35]. It might be useful to reduce the CT infection of this population with strengthening the publicity and education of CT among the low-education population, and reducing the cost of CT screening and treatment.

Our study had limitations to be highlighted. First, the study was conducted in one city with a special economic background in China and convenient sampling might shift the results so that any generalization of the results from this study should be made with caution. Second, using a retrospective questionnaire may lead to recall bias. Although these limitations should be addressed in future studies, our findings could have significant implications for policy, practice, and research.

Conclusion

CT infection is prevalent among patients seeking clinic-based STI services, particularly aged younger than 24 in Shenzhen, China. Furthermore, patients that were single/divorced/widowed, positive for NG, low educational level and having no hold of health insurance were significantly associated with an increased risk of CT infection. It is strongly recommended that clinicians perform key screening and interventions for CT in these populations. As well, these findings suggest that the CT integrated prevention and control projects could be considered as routine public health services by the government. However, efforts are needed in the future studies on several areas such as the cost-effectiveness of

screening strategies, the burden of disease estimates, the capacity of CT screening in hospitals, the willingness of being screened of patients, and the knowledge of CT in patients.

Abbreviations

CT: Chlamydia trachomatis; STI: Sexually transmitted infection; PID: Pelvic inflammatory disease; WHO: World Health Organization; NAAT: Nucleic acid amplification test; UK: the United Kingdom; NG: Neisseria Gonorrhoeae; PCR: Polymerase chain reaction; SOPs: Standard operating procedures; OR: Odds ratio; CI: Confidence interval; SD: Standard deviation; NCSP: National Chlamydia Screening Programme

Declarations

Acknowledgments

We are indebted to all participants in this study for their cooperation. We thank the staff at all participated hospitals, Center for Chronic Diseases control and Center for Disease Control and Prevention.

Author contributions

HLW, YMC and XSC conceived and designed the study. WYY, FCH, TJF, JHL, CLZ, LZW, FW, JBY, RXW, and FT supervised the data and samples collection. HLW, YMC, XSC WYY, FCH, TJF, JHL, CLZ, LZW, FW, JBY, RXW, and FT performed the research. HLW, YMC and XSC analyzed and interpreted the results and were the major contributors in writing the manuscript. All authors read and approved the final manuscript.

Funding

This study was supported by Sanming Project of Medicine in Shenzhen (SZSM201611077). The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Availability of data and materials

The results section, figures and tables contain all data on which the conclusions of this paper rely. The raw data used for this study are available from the corresponding author upon request.

Ethics approval and consent to participate

The study was approved by the Ethical Review Committee of Shenzhen Centre for Chronic Disease Control (Approval No.20180206). We informed all study participants of the study details prior to their recruitment. Each study participant gave his written consent prior to enrollment.

Consent for publication

Not Applicable.

Competing interests

The authors declare that they have no competing interests.

Author details

¹Shenzhen Center for Chronic Disease Control, Shenzhen, Guangdong Province 518020, China. ²Peking Union Medical College Institute of Dermatology, Chinese Academy of Medical Science and Peking Union Medical College, Nanjing 210042, China. ³National Center for Sexually Transmitted Disease Control, Nanjing 210042, China. ⁴Shenzhen Center for Disease Control and Prevention, Shenzhen 518054, China.

References

1. World Health Organization. Global incidence and prevalence of selected curable sexually transmitted infections: 2008. *Reproductive Health Matters* 2012;20(40):207-209. doi: 10.1016/S0968-8080(12)40660-7.
2. [Morré SA](#), [Rozendaal L](#), [van Valkengoed IG](#), [Boeke AJ](#), [van Voorst Vader PC](#), [Schirm J](#), et al. Urogenital Chlamydia trachomatis Serovars in Men and Women with a Symptomatic or Asymptomatic Infection: an Association with Clinical Manifestations? *Journal of Clinical Microbiology* 2000;38(6):2292-2296. doi: <http://dx.doi.org/>.
3. Haggerty CL, Ness RB. Epidemiology, pathogenesis and treatment of pelvic inflammatory disease. *Expert Rev Anti Infect Ther* 2006;2(4):235-47. doi: 10.1586/14787210.4.2.235.
4. Wang QQ, Liu QZ, Xu JH. Treatment and prevention of sexually transmitted disease. Shanghai: Shanghai Scientific & Technical Publishers; 2014: 104-106.
5. Newman L, Rowley J, Vander HS, Wijesooriya NS, Unemo M, Low N, et al. 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. doi: 10.1371/journal.pone.0143304.
6. Centers For Disease Control and Prevention. Sexually Transmitted Disease Surveillance 2014. Atlanta: U.S. Department of Health and Human Services; 2015.
7. [European Centre for Disease Prevention and Control](#). Sexually Transmitted Infections Surveillance in Europe Annual Report No. 2; 2012. doi: 10.1258/jrsm.100.9.414.
8. Public Health Agency Of Canada. Report on Sexually Transmitted Infection in Canada:2012. In; 2012. <http://www.phac-aspc.gc.ca/sti-its-surv-epi/rep-rap-2012/rep-rap-1-eng.php>.
9. Chen XS. The Epidemic of Urogenital Infection with Chlamydia Trachomatis in China and the World. *China Medical Abstract of Dermatology* 2016(03):265-269+1.
10. Dai W, Luo Z, Xu R, Zhao G, Tu D, Yang L, 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 Infectious Diseases* 2017;17(1). doi: 10.1186/s12879-017-2187-1.
11. World Health Organization. Standard protocol to assess prevalence of gonorrhoea and chlamydia among pregnant women in antenatal care clinics; 2018.
 12. Parish WL, Laumann EO, Cohen MS, Suiming P, Heyi Z, Irving H, et al. Population-based study of chlamydial infection in China: a hidden epidemic. *Jama the Journal of the American Medical Association* 2003;289(10):1265-73. doi: 10.1001/jama.289.10.1265.
 13. Shelagh M R, Karin A, Sarah C W, Ingrid V F VDB, Jan VB, Helen W, et al. Genital chlamydia prevalence in Europe and non-European high income countries: systematic review and meta-analysis. *Plos One* 2015;10(1):e0115753. doi: 10.1371/journal.pone.0115753.
 14. Torrone E, Papp J, Weinstock H. Prevalence of Chlamydia trachomatis genital infection among persons aged 14-39 years—United States, 2007-2012. *Mmwr Morb Mortal Wkly Rep* 2014;63(38):834-838. doi: 10.1186/1471-2458-14-1004.
 15. Sonnenberg P, Clifton S, Beddows S, Field N, Soldan K, Tanton C, et al. Prevalence, risk factors, and uptake of interventions for sexually transmitted infections in Britain: findings from the National Surveys of Sexual Attitudes and Lifestyles (Natsal). *Lancet* 2013;382(9907):1795-1806.
 16. Goulet V, Barbeyrac BD, Raherison S, Prudhomme M, Semaille C, Warszawski J. Prevalence of Chlamydia trachomatis: results from the first national population-based survey in France. *Sexually Transmitted Infections* 2010;86(4):263-270. doi: 10.1136/sti.2009.038752.
 17. Leung PHM, Boost MV, Lau JTF, Wong ATY, Pang M, Ng TK, et al. Prevalence and risk factors for Chlamydia trachomatis infection among cross-border truck drivers in Hong Kong. *Sexually Transmitted Infections* 2009;85(1):27-29. doi: 10.1136/sti.2008.031880.
 18. Geng-Feng F, Ning J, Hai-Yang H, Tanmay M, Yue-Ping Y, Sanchita M, et al. The epidemic of HIV, syphilis, chlamydia and gonorrhea and the correlates of sexual transmitted infections among men who have sex with men in Jiangsu, China, 2009. *Plos One* 2015;10(3):e0118863. doi: 10.1371/journal.pone.0118863.
 19. Satterwhite CL, Torrone E, Meites E, Dunne EF, Mahajan R, Ocfemia MCB, et al. Sexually Transmitted Infections Among US Women and Men. *Sexually Transmitted Diseases* 2013;40(3):187-193. doi: 10.1097/OLQ.0b013e318286bb53.
 20. Lanjouw E, Ouburg S, de Vries HJ, Stary A, Radcliffe K, Unemo M. 2015 European guideline on the management of Chlamydia trachomatis infections. *International Journal of Std & Aids* 2015;37(5):721-729. doi: 10.1177/0956462415618837.
 21. Workowski KA, Berman SM. Centers for Disease Control and Prevention Sexually Transmitted Disease Treatment Guidelines. 2015;47(RR-1):1. doi: 10.1093/cid/cir694.
 22. Low N, Cassell JA, Spencer B, Bender N, Martin Hilber A, Van Bergen J, et al. Chlamydia control activities in Europe: cross-sectional survey. *European Journal of Public Health* 2012;22(4):556-561. doi: 10.1093/eurpub/ckr046.

23. Chandra NL, Soldan K, Dangerfield C, Sile B, Duffell S, Talebi A, et al. Filling in the gaps: estimating numbers of chlamydia tests and diagnoses by age group and sex before and during the implementation of the English National Screening Programme, 2000 to 2012. 2017(5). doi: 10.2807/1560-7917.ES.2017.22.5.30453.
24. Wong WC, Zhao Y, Wong NS, Parish WL, Miu HY, Yang LG, et al. Prevalence and risk factors of chlamydia infection in Hong Kong: A population-based geospatial household survey and testing. *Plos One* 2017;12(2):e0172561. doi: 10.1371/journal.pone.0172561.
25. Walsh MS, Hope E, Isaia L, Righarts A, Niupulusu T, Temese SV, et al. Prevalence of Chlamydia trachomatis infection in Samoan women aged 18 to 29 and assessment of possible risk factors: a community-based study. *Trans R Soc Trop Med Hyg* 2015;109(4):245-51. doi: 10.1093/trstmh/trv014.
26. Shen HC, Huang SJ, Qin XL, Zhao PZ, Lan YY, Zou HC, et al. Genital Chlamydia trachomatis infection and associated risk factors in male clients attending sexually transmitted disease clinics in 9 cities in Guangdong province. *Zhonghua liu xing bing xue za zhi* 2017;38(3):364. doi: 10.3760/cma.j.issn.0254-6450.2017.03.018.
27. Walker J, Tabrizi SN, Fairley CK, Chen MY, Bradshaw CS, Twin J, et al. Chlamydia trachomatis incidence and re-infection among young women—behavioural and microbiological characteristics. *PLoS One* 2012;7(5):e37778. doi: 10.1371/journal.pone.0037778.
28. Skjeldestad FE, Marsico MA, Sings HL, Nordbo SA, Størvold G. Incidence and risk factors for genital Chlamydia trachomatis infection: a 4-year prospective cohort study. *Sex Transm Dis* 2009;36(5):273-9. doi: 10.1097/olq.0b013e3181924386.
29. Deogan C, Cnattingius S, Mansdotter A. Risk of self-reported Chlamydia trachomatis infection by social and lifestyle factors: a study based on survey data from young adults in Stockholm, Sweden. *Eur J Contracept Reprod Health Care* 2012;17(6):458-67. doi: 10.3109/13625187.2012.729624.
30. Andrade MV, Noronha K, Singh A, Rodrigues CG, Padmadas SS. Antenatal care use in Brazil and India: Scale, outreach and socioeconomic inequality. *Health & Place* 2012;18(5):942-950. doi: 10.1016/j.healthplace.2012.06.014.
31. Watanabe R, Hashimoto H. Horizontal inequity in healthcare access under the universal coverage in Japan; 1986–2007. *Social Science & Medicine* 2012;75(8):1372-1378. doi: 10.1016/j.socscimed.2012.06.006.
32. Zhang Q, Lauderdale D, Mou S, Parish WI, Laumann EO, Schneider J. Socioeconomic disparity in healthcare-seeking behavior among Chinese Women with genitourinary symptoms. *Journal of Womens Health* 2009;18(11):1833. doi: 10.1089/jwh.2009.1394.
33. Simoes E, Kunz S, Schmahl F. Utilisation gradients in prenatal care prompt further development of the prevention concept. *Das Gesundheitswesen* 2009;71(7):385. doi: 10.1055/s-0029-1214401.
34. McGarrrity LA, Huebner DM. Behavioral intentions to HIV test and subsequent testing: the moderating role of sociodemographic characteristics. *Health Psychology Official Journal of the Division of Health Psychology American Psychological Association* 2014;33(4):396. doi: 10.1037/a0033072.

35. Lostao L, Regidor E, Geyer S, Aiach P. Patient cost sharing and social inequalities in access to health care in three western European countries. *Social Science & Medicine* 2007;65(2):367-376. doi: 10.1016/j.socscimed.2007.05.001.