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1 **Title: Low chlamydia and gonorrhea testing rates among men who have sex with men in**
2 **Guangdong and Shandong Provinces, China**

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44 **Background**

45 Although periodic chlamydia and gonorrhea testing is recommended for men who have sex
46 with men (MSM), little is known about testing rates in China. This study examines chlamydia
47 and gonorrhea testing rates and testing correlates among Chinese MSM.

48

49 **Methods**

50 An online survey of MSM was conducted in August 2017. Men aged 16 years or above who
51 had ever had sex with a man were enrolled through a gay social networking mobile
52 application. We asked men about their sexual behaviors, community engagement in sexual
53 health, and previous testing for chlamydia, gonorrhea and HIV. Multivariable logistic
54 regressions were used to examine the association of testing with community engagement and
55 recent HIV testing.

56

57 **Results**

58 Of 1031 men, 819 (79.5%) were under 30 years of age, and 263 (25.5%) reported condomless
59 sex in past three months. In total, 294 (28.5%) men tested for chlamydia, 315 (30.6%) men
60 tested for gonorrhea, and 817(79.2%) men tested for HIV. One hundred and twenty-five
61 (42.5%) men who received chlamydia testing and 134 (42.5%) men who received
62 gonorrhea testing had substantial community engagement. Compared to men with
63 no/minimal community engagement, men with substantial community engagement had
64 greater odds of chlamydia testing (adjusted odds ratio [AOR] =2.8, 95%CI: 1.9-4.3) and
65 gonorrhea testing (AOR=2.9, 95%CI: 2.0-4.4). Men with recent HIV testing were more likely

66 to have received chlamydia testing (AOR=1.5, 95%CI: 1.1-2.0) and gonorrhea testing
67 (AOR=1.6, 95%CI: 1.2-2.1).

68

69 **Conclusions**

70 Chlamydia and gonorrhea testing levels are low among Chinese MSM. Integrating chlamydia
71 and gonorrhea test promotion strategies into HIV prevention programs that engage MSM
72 communities may help bridge the gap.

73

74 **Summary**

75 We found low chlamydia and gonorrhea lifetime testing rates among MSM in China and
76 integrated STI/HIV testing programs that engage MSM may improve lifetime chlamydia and
77 gonorrhea test uptake.

78

79 **Keywords:** chlamydia test; gonorrhea test; men who have sex with men; China

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87 **INTRODUCTION**

88 Chlamydia and gonorrhea are the most common bacterial sexually transmitted diseases
89 (STDs) worldwide.[1] Men who have sex with men (MSM) are at particularly high risk for
90 infection. In China, prevalence estimates among MSM range from 8.0-24.0% for chlamydia,
91 and 1.5-2.7% for gonorrhea.[2] Chlamydia and gonorrhea infection increase the risk of both
92 transmitting and acquiring HIV,[3-5] and the rate of coinfection with HIV is high.[6] In
93 addition to the risk of transmitting chlamydia and gonorrhea to male sex partners, MSM may
94 also be a bridge for transmitting the two infections to their female sex partners. A previous
95 study showed that up to 26.3% of Chinese MSM had recent sexual intercourse with women
96 and only 25.6% consistently used condoms with female sex partners in the last six months.[7]
97 Further, antimicrobial resistance (AMR) is becoming a global concern, and treatment options
98 for drug-resistant gonorrhea strains are increasingly limited.[8] Early diagnosis and
99 prevention of further transmission are crucial for controlling the spread and impact of drug-
100 resistant gonorrhea.[9]
101 WHO guidelines suggest that if the prevalence of asymptomatic urethral and rectal chlamydia
102 and gonorrhea infections is over 1-2%, the benefits of periodic testing for these two
103 infections among MSM outweigh the harms and costs.[10] However, current STI control
104 efforts are focused on controlling HIV and syphilis in most resourced limited low- and
105 middle-income countries, including China. China has no guidelines for chlamydia and
106 gonorrhea testing among MSM, and chlamydia is not a reportable STI. The expense of
107 nucleic acid amplification tests for gonorrhea and chlamydia may also discourage testing.[10]

108 Given that China's universal healthcare system has many competing priorities with limited
109 health resources, optimal gonorrhea and chlamydia testing frequency for Chinese MSM
110 remains unknown. Periodic chlamydia and gonorrhea testing recommended by the WHO may
111 be a challenging strategy for the country. However, it is also unwise to neglect the two
112 infections among Chinese MSM due to the high prevalence in this group. Other less
113 complicated and costly alternative screening strategies in MSM may be worth consideration,
114 such as testing chlamydia and gonorrhea at least once in sexually active young MSM.

115

116 We conducted a cross-sectional survey among MSM recruited online from Guangdong and
117 Shandong Provinces in China. The purpose of this study is to examine self-reported
118 chlamydia/gonorrhea testing rates and factors associated with testing among a Chinese MSM
119 population.

120

121 **MATERIALS AND METHODS**

122 **Sampling**

123 We conducted an online survey of 1,031 MSM in August 2017. We recruited men through a
124 gay social networking dating app, Blued, by sending a survey invitation to registered users in
125 eight Chinese cities (Guangzhou, Shenzhen, Zhuhai, and Jiangmen in Guangdong Province;
126 Jinan, Qingdao, Yantai and Jining in Shandong Province). In both provinces, HIV and
127 syphilis testing services are promoted in MSM but chlamydia and gonorrhea testing are only
128 recommended among symptomatic men. Eligibility criteria for our study included the

129 following: 1) biologically male at birth, 2) 16 years old or above, 3) reported ever having anal
130 sex with men, and 4) HIV negative or unknown HIV status. All survey data were anonymous
131 and confidential, and online consent was obtained before the commencement of the survey.
132 An incentive of 7.5 USD (50 Chinese Yuan) mobile phone top-up was provided to all
133 participants.

134 **Measures**

135 We collected information about participants' sociodemographic characteristics including age,
136 residence, marital status, highest education obtained, and annual income. We also collected
137 sexual history, including sexual orientation (gay, bisexual/unsure), sexual orientation
138 disclosure to healthcare providers (yes/no), and whether they had condomless sex with either
139 men or women in past three months (yes/no). We obtained information about ever testing for
140 HIV, syphilis, chlamydia or gonorrhoea (yes/no), and their HIV testing in the past three months
141 (yes/no). Community engagement was measured using a six-item construct validated in
142 Chinese MSM. [11] These questions assessed whether men had (1) discussed HIV/STI
143 testing or sexual health online, (2) awareness of ongoing sexual health community events, (3)
144 encouraged someone to get tested for HIV/STDs, (4) accompanied someone to get tested for
145 HIV/STDs, (5) volunteered to help provide sexual health services, or (6) helped organize a
146 sexual health campaign. Participants who answered "yes" to items (1) and/or (2) were
147 considered to have "minimal engagement"; (3) and/or (4) to have "moderate engagement",
148 and (5) and/or (6) to have "substantial engagement".[11] Participants who answered yes to
149 multiple items were categorized into the level of engagement corresponding with the highest
150 item number. Participants did not answer "yes" to any items were considered to have no

151 engagement.

152 We also measured anticipated HIV stigma[12] and HIV testing self-efficacy.[13] The 7-item
153 anticipated HIV stigma scale asked participants about their own feelings about themselves if
154 they had HIV as well as perceived discriminating attitudes from other people. For example,
155 men were asked to rate level of agreement with “If I had HIV, I’d worry about people
156 discriminating against me”. HIV testing self-efficacy was measured using a six-item scale,
157 measuring men’s confidence about HIV testing. For example, we asked them about the level
158 of agreement with “You have confidence that you will undergo HIV testing regularly”. We
159 used a four-point Likert format: strongly disagree (1), disagree (2), agree (3), strongly agree
160 (4) for responses to above scales. Scores for anticipated HIV stigma and self-efficacy ranged
161 from 1 to 4. A higher score indicated a higher level of anticipated stigma or better self-
162 efficacy.

163 **Statistical analysis**

164 Descriptive analysis was used to describe sample characteristics, including sociodemographic
165 backgrounds, sexual behaviors, HIV, syphilis, chlamydia and gonorrhea testing, anticipated
166 HIV-related stigma, HIV testing self-efficacy, and community engagement. Chi-squared tests
167 or independent samples t-tests were conducted to examine differences in characteristics
168 between testers and never testers for chlamydia and gonorrhea.

169 We carried out multivariable logistic regression analyses to examine factors associated with
170 chlamydia and gonorrhea testing behaviors, controlling for age, marital status, education,
171 annual income and province. No engagement and minimal engagement were grouped as one
172 category for regression analysis due to small cell numbers. We reported odds ratios, 95%

173 confidence intervals (CIs) and p values. A p-value of <0.05 was considered statistically
174 significant. Data were analyzed using SPSS, version 25.

175 **Ethical statement**

176 Ethical approval was obtained from the institutional review committees at the Dermatology
177 Hospital of Southern Medical University (14-1865) and the University of North Carolina at
178 Chapel Hill (1R01AI114310) prior to the launch of the survey.

179 **RESULTS**

180 A total of 1031 men completed the survey. Figure 1 shows self-reported lifetime testing
181 history of HIV, syphilis, gonorrhea and chlamydia. In total, 294 (28.5%) men ever tested for
182 chlamydia, 315 (30.6%) men ever tested for gonorrhea, 473 (45.9%) men tested for syphilis,
183 and 817 (79.2%) men tested for HIV. The socio-demographic and behavioral characteristics
184 of the total sample, respondents who ever tested for chlamydia and gonorrhea, are shown in
185 Table 1. The majority were aged under 30 years (819, 79.4%), never married (907, 88.0%),
186 had an annual personal income of 8500 USD or below (779, 75.6%), and obtained up to a
187 college education (649, 62.9%). About a quarter reported condomless sex with either men or
188 women in past three months.

189 Over half of chlamydia (175, 59.5%) and gonorrhea (185, 58.7%) testers were living in
190 Guangdong Province. The majority of chlamydia and gonorrhea testers were not students,
191 had no children, self-identified as gay, and did not report condomless sex in past three
192 months. Among chlamydia testers, 138 (46.9%) had any HIV testing, 92(31.3%) had facility-
193 based HIV testing, and 97(33.0%) had HIV self-testing in the past three months. Among

194 gonorrhea testers, 152(48.3%) had any HIV testing, 101(32.1%) had facility-based HIV
195 testing, and 106(33.7%) had HIV self-testing in past three months. Up to 125 (42.5%) of
196 chlamydia testers and 134 (42.5%) of gonorrhea testers had substantial community
197 engagement.

198 Compared to those who had never tested for gonorrhea or chlamydia, mean scores of HIV
199 testing self-efficacy were significantly higher among those who had tested for chlamydia
200 (3.26 vs 3.10, $p<0.001$) and gonorrhea (3.24 vs 3.10, $p<0.001$); anticipated HIV stigma mean
201 scores were significantly lower among chlamydia (2.80 vs 2.91, $p=0.02$) and gonorrhea
202 testers (2.81 vs 2.91, $p=0.04$) (Table 2). Multivariable logistic regression analyses showed
203 that men living in Guangdong had higher odds of testing for chlamydia (adjusted odds ratio
204 [AOR]= 1.6, 95%CI: 1.2-2.2) and gonorrhea (AOR=1.5, 95%CI: 1.1-2.0) compared to those
205 who lived in Shandong (Table 3). The odds of testing for gonorrhea in men with high
206 school/below education were 60% higher (AOR=1.6, 95%CI: 1.1-2.3) than those with
207 university education or above.

208 After controlling for demographic variables, those who had substantial community
209 engagement were significantly more likely to report ever testing for chlamydia (AOR =2.8,
210 95%CI: 1.9-4.3) and gonorrhea (AOR=2.9, 95%CI: 2.0-4.4), compared to men with no or
211 minimal community engagement. Men with recent HIV testing were more likely to have
212 received chlamydia testing (AOR=1.5, 95%CI: 1.1-2.0) and gonorrhea testing (AOR=1.6,
213 95%CI: 1.2-2.1). Further, each point increase in the HIV testing self-efficacy mean score was
214 associated with higher odds of chlamydia (AOR=1.9, 95%CI: 1.4-2.6) and gonorrhea testing
215 (AOR=1.8, 95%CI: 1.3-2.4) respectively (Table 3).

216 **DISCUSSION**

217 Chlamydia and gonorrhea are common STDs in China, but test uptake rates are low. We
218 surveyed 1031 MSM in Guangdong and Shandong Provinces to analyze their
219 chlamydia/gonorrhea testing history. This study extends the literature by examining
220 chlamydia and gonorrhea testing uptake in a middle-income country. We found that less than
221 one-third of men reported ever receiving a chlamydia or gonorrhea testing.

222 Chlamydia/gonorrhea testing was associated with recent HIV testing and higher levels of
223 community engagement.

224

225 We found low levels of lifetime testing for chlamydia and gonorrhea in MSM in China. We
226 examined chlamydia and gonorrhea testing at a single time point in two provinces only. The
227 study findings may not be generalizable to the entire MSM population in the country.

228 Additionally, a self-administered online survey may be subject to social desirability bias and
229 men might not be familiar with chlamydia and gonorrhea. But our study provides a snapshot
230 of testing behaviors for these often neglected STDs in an important Chinese subpopulation.

231 Our test uptake rates were similar to previous reports from China,[14] and lower than test
232 uptake rates from high-income country MSM.[15 16] Many more men received HIV and
233 syphilis testing, compared to the number of men who received chlamydia/gonorrhea testing.

234 This may be due to China's focused efforts on HIV/syphilis prevention, without integration of
235 chlamydia and gonorrhea testing services.[17] However, previous studies have shown that a
236 substantial proportion of new HIV infections can be attributed to coinfection with chlamydia

237 or gonorrhea,[18 19] and screening for chlamydia/gonorrhea may be beneficial to the subset
238 of MSM who are at higher risk of HIV acquisition.[20] To comprehensively address the HIV
239 epidemic among MSM, there is a need for more attention to chlamydia/gonorrhea testing
240 promotion in China.

241
242 We also found that chlamydia/gonorrhea testing was significantly associated with substantial
243 community engagement in sexual health. It is worth noting, however, that men with more
244 community engagement and who have been tested are more likely to take the survey than
245 their counterparts. Our test uptake rates are likely over-estimates. This trend is consistent with
246 previous literature showing improved HIV and syphilis testing uptake among individuals
247 with higher community engagement.[11] A recent quasi-experimental study in China also
248 found that engaging MSM in STI testing programs significantly improved men's dual
249 chlamydia/gonorrhea test uptake.[21] There is currently a trend toward key population-led
250 HIV prevention campaigns and strategies.[22-24] Integrating chlamydia and gonorrhea test
251 promotion strategies into HIV prevention programs that engage MSM communities may help
252 increase testing rates.

253
254 Chlamydia/gonorrhea testing was significantly associated with recent HIV testing, including
255 both facility-based and self-testing. This may be partly attributable to the extensive HIV
256 testing system in China, which may serve as a gateway for MSM to improve awareness of
257 STIs such as chlamydia and gonorrhea. Previous literature has explored the potential for
258 integrated syphilis/HIV testing.[25-27] Given that there is already a relationship between

259 chlamydia/gonorrhea testing and HIV testing, incorporating chlamydia/gonorrhea testing
260 with existing HIV testing services may be a promising strategy to increase test uptake.
261 Nonetheless, our cross-sectional survey approach evaluated lifetime chlamydia and gonorrhea
262 testing, and the analyses do not imply a causal relationship between HIV testing and
263 chlamydia/gonorrhea testing. Further research is needed to examine potential effects of HIV
264 testing behaviors on chlamydia and gonorrhea test uptake in China.

265 **CONCLUSION**

266 Compared to HIV and syphilis testing levels, chlamydia and gonorrhea testing rates in
267 Chinese MSM are suboptimal. Few STI services are integrated into HIV prevention programs
268 in China. We found that chlamydia and gonorrhea testing behaviors had a significant
269 association with men's community engagement in sexual health and their recent HIV testing.
270 This suggests that integrating chlamydia and gonorrhea test promotion strategies into HIV
271 prevention programs that engage MSM may be useful.

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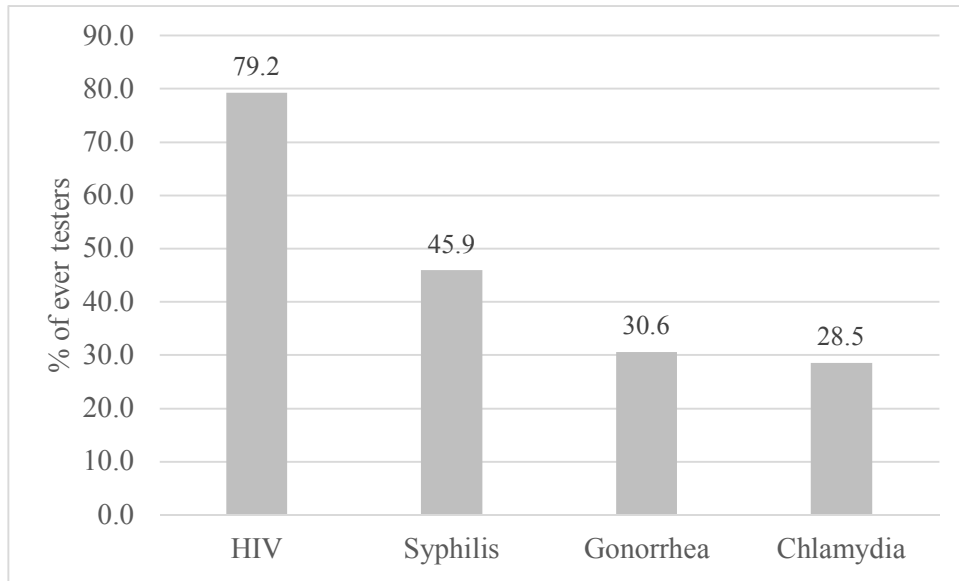
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370 Figure 1: Percentage of MSM who reported to have ever tested for HIV, syphilis, gonorrhea,
371 and chlamydia in 2017 in China (N=1031).

372