ORIGINAL RESEARCH ARTICLE

Prevalence and associated risk factors of chlamydia and *gonorrhoea* infections among men who have sex with men in Durban, South Africa

DOI: 10.29063/ajrh2024/v28i4.10

Kehinde C. Mofolorunsho[1], Nonkululeko Mabaso[1], Nikita Nundlall[1], Apiwe Nightingale[2], Makandwe Nyirenda[3,4] and Nathlee Abbai[1]*

School of Clinical Medicine Laboratory, College of Health Sciences, University of KwaZulu-Natal, South Africa[1]; Aurum Institute, Durban, South Africa[2]; School of Nursing and Public Health, College of Health Sciences, University of KwaZulu-Natal, South Africa[3]; Burden of Disease Unit, South African Medical Research Council, Cape Town, South Africa[4]

***For Correspondence:** Email: *abbain@ukzn.ac.za*

Abstract

Despite significant research on the prevalence of STIs in South African men who have sex with men (MSM), recent data on the prevalence and risk factors for curable STI infections among this key populations are limited. This study determined the prevalence of and risk factors associated with *Neisseria gonorrhoeae* and *Chlamydia trachomatis* infections among MSM. The sample consisted of 200 MSM resident in Durban. Data were collected using a self-administered questionnaire, and urine samples were collected and tested for *N. gonorrhoeae* and *C. trachomatis*. The prevalence of *N. gonorrhoeae* and *C. trachomatis* were 3.0% and 6.0%, respectively. Younger age was significantly associated with testing positive for *C. trachomatis* (p=0.037). Being between the ages of 30-39 years old reduced the risk of acquiring *C. trachomatis* infection (OR: 0.10, 95% CI: 0.0120-0.7564, p=0.026). In addition, being circumcised reduced the risk of contracting *C. trachomatis* (adjusted OR: 0.01, 95% CI: 0.0005-0.3516, p=0.01). However, having between 2-4 sex partners increased the risk of testing positive for *C. trachomatis* (adjusted OR: 107.45, 95% CI: 1.3467-8573.3130, p=0.036). The following factors were significantly associated (p<0.05) with testing positive for *N. gonorrhoeae* infection: cohabiting with sex partner, engaging in group sex, and drug use. Fear and stigma were the main barriers to accessing health care in the studied population. This study provided evidence of high rates of *C. trachomatis* infection among MSM resident in Durban. Based on the results, South African MSM, especially the young MSM population, should be given priority when delivering intervention programs to prevent STIs. *(Afr J Reprod Health 2024; 28 [4]: 90-110)*

Keywords: MSM, Prevalence, *Neisseria gonorrhoeae*, *Chlamydia trachomatis*, South Africa

Résumé

Malgré des recherches importantes sur la prévalence des IST chez les hommes sud-africains ayant des rapports sexuels avec des hommes (HSH), les données récentes sur la prévalence et les facteurs de risque d'infections IST curables parmi ces populations clés sont limitées. Cette étude a déterminé la prévalence et les facteurs de risque associés aux infections à Neisseria gonorrhoeae et à Chlamydia trachomatis chez les HARSAH. L'échantillon était composé de 200 HSH résidant à Durban. Les données ont été collectées à l'aide d'un questionnaire auto-administré et des échantillons d'urine ont été collectés et testés pour N. gonorrhoeae et C. trachomatis. La prévalence de N. gonorrhoeae et de C. trachomatis était respectivement de 3,0 % et 6,0 %. Un âge plus jeune était significativement associé à un test positif pour C. trachomatis (p = 0,037). Le fait d'être âgé de 30 à 39 ans réduisait le risque de contracter une infection à C. trachomatis (OR : 0,10, IC à 95 % : 0,0120-0,7564, p = 0,026). De plus, être circoncis réduisait le risque de contracter C. trachomatis (OR ajusté : 0,01, IC à 95 % : 0,0005-0,3516, p=0,01). Cependant, avoir entre 2 et 4 partenaires sexuels augmentait le risque d'être testé positif pour C. trachomatis (OR ajusté : 107,45, IC à 95 % : 1,3467-8573,3130, p=0,036). Les facteurs suivants étaient significativement associés (p < 0,05) au test positif pour l'infection à N. gonorrhoeae : cohabitation avec un partenaire sexuel, participation à des relations sexuelles en groupe et consommation de drogues. La peur et la stigmatisation étaient les principaux obstacles à l'accès aux soins de santé dans la population étudiée. Cette étude a mis en évidence des taux élevés d'infection à C. trachomatis parmi les HSH résidant à Durban. Sur la base des résultats, les HSH sud-africains, en particulier la jeune population HSH, devraient être prioritaires lors de la mise en œuvre de programmes d'intervention visant à prévenir les IST. *(Afr J Reprod Health 2024; 28 [4]: 90-110).*

Mots-clés: HSH, Prévalence, Neisseria gonorrhoeae, Chlamydia trachomatis, Afrique du Sud

Introduction

Sexually transmitted infections (STIs) are a major public health problem affecting the health and lives of people globally[1,2]. Gonorrhoea and chlamydia are amongst the most common infectious diseases worldwide[2] and are acquired by more than one million individuals daily[3], constituting an epidemic of tremendous magnitude[4]. They are capable of causing diseases like urethritis, vaginitis, cervicitis, and genital ulceration. Their etiological agents (*Neisseria gonorrhoeae* and *Chlamydia trachomatis*) can sometimes infect the rectum and pharynx causing serious complications, including pelvic inflammatory disease in women and orchitis in men[2]. The incidence and prevalence of these infections are widespread, particularly in resource-poor countries[5-7] where the rates of STIs remain high as the result of ineffective diagnostic methods and the lack of access to health care facilities[8].

The World Health Organization (WHO) in 2020, reported there were about 373.1 million infections from four of the most common curable STIs (128 million chlamydia cases, 82 million gonorrhoea cases, 156 million trichomoniasis cases, and 7.1 million syphilis cases)[9]. Other reports also indicated that 273 million prevalent cases of STIs occurred annually among adults between 15 and 49 years of age[5,6]. In the African region, gonorrhoea and chlamydia account for 11.4 and 12 million new cases per year, respectively[10,11]. These STIs are curable but can increase the risk of infection with the Human immunodeficiency virus (HIV), especially in men who have sex with men (MSM)[12-14].

Men who have sex with Men (MSM) are at greater risk of acquiring STIs compared to heterosexual populations[15-17]. This is usually due to their sexual network or behaviours (homosexual or bisexual behaviours)[18,19], resulting in rectal and urethral infections (mucosal inflammation and anogenital ulcers) mostly through insertive and receptive anal intercourses as well as possible transmission through oral-anal contact[20,21]. In recent years, MSM have become the group at highest risk for STI infections worldwide, higher than female sex workers and much higher than the general population[2]. MSM face significant social stigma and internalized homophobia that may poses as barriers to seeking healthcare services including screening for HIV and other STIs[19] which contribute to poor health outcomes. Data from Europe, the United States of America and China have also shown that MSM are affected by a high STI burden[22]. In England, 77, 371 new STI cases were reported in MSM and the most common of the STIs were gonorrhoea (n = 33,853; 44%) and chlamydia (n = 23,187; 30%)[23].

Gonorrhoea is caused by the bacterium, *Neisseria gonorrhoeae* (*N. gonorrhoeae*) and transmission can occur by direct inoculation of infected mucosal secretions[24]. Chlamydia, a similarly behaving and equally concerning infection[25], is a sexually transmitted infectious disease caused by the bacterium *Chlamydia trachomatis* (*C. trachomatis*)[26]. Gonorrhoea and chlamydia are associated with an increased risk for HIV in men[27]. Although curable with antibiotics, these bacterial STIs are generally asymptomatic and as a result readily progress to symptoms affecting the urethra or spread within the body[28]. In addition to the associated symptoms, these STIs may promote reoccurrence of other STIs[29,30] including HIV[31,32] through mucosal inflammation and ulceration of local tissues[27,33]. Studies have demonstrated that among MSM, the prevalence of rectal gonorrhoea and chlamydia ranges from 0.2% to 24% and 2.1 to 23%, respectively, while the prevalence of pharyngeal gonorrhoea and chlamydia ranges from 0.5% to 16.5% and 0% to 3.6%, respectively[34].

South Africa accounts for one of the highest HIV prevalence rates in the world; and other STIs continue to be endemic[35,36]. KwaZulu-Natal (KZN), one of the most densely populated provinces in South Africa, has been reported to be greatly affected by both the HIV and STI epidemic[37] particularly among MSM. In 2013, 42.7% of MSM in Durban were reported to have had symptoms of a STI in the last 12 months while an estimated 48.2% were living with HIV. This reported HIV prevalence is 2.58 times higher than that among non-MSM aged 15 years and older in KZN[38-40].

Despite significant research on the prevalence of STIs in South African MSM[39,40-43], recent data on the prevalence and risk factors for curable STI infections among MSM populations in KZN are limited. This study investigated the prevalence of gonorrhoea and chlamydia among MSM in KZN. We also assessed risk factors associated with these STIs.

Methods

Ethical approval

Ethical clearance for this study was granted by the Biomedical Research Ethics Committee (BREC) of the University of KwaZulu-Natal (BREC/00002798/2021). All study participants provided written informed consent.

Study design and population

This cross-sectional study including all laboratory assays were conducted at the School of Clinical Medicine Research Laboratory of the Nelson R. Mandela School of Medicine, University of KwaZulu-Natal. Participants were MSM recruited from the King Edward VIII hospital and the Aurum Institute both located in Durban, South Africa. The study participants were enrolled from October 2021 to July 2022 and included sexually active MSM, 18 years and older. Participants were voluntarily asked to provide a urine sample.

Sample processing

The urine samples were processed within 24 hours of collection. Samples were refrigerated between 2-8°C until processed. A total of 10 ml of urine was centrifuged at 14 000 rpm for 45 minutes and the supernatant discarded. The recovered pellets were then subjected to further molecular analyses.

DNA extraction

Deoxyribonucliec acid (DNA) was extracted from the sample pellets using the commercially available kit, PureLink Microbiome Kit (ThermoFisher Scientific, United States), according to the manufacturer's protocol for the isolation of genomic DNA from bacteria. Sample pellets were suspended in 800 μL of S1 lysis buffer by pipetting up and down. The sample was then transferred to the bead tube and 100 μL of S2 lysis enhancer was added to the bead tube, capped and homogenized with a vortex mixer. The tubes were incubated at 95°C for 10 minutes, followed by vortexing at a maximum speed for 7 minutes. The samples were then centrifuged at 14 000x g for 1 minute and 500 μL of the supernatant was transferred to a clean micro-centrifuge tube. To bind DNA to the column, 900 μL of binding buffer was added and vortexed briefly. Thereafter, 700 μL of the sample mixture was loaded onto a spin column-tube and centrifuged at 14 000x g for 1 minute. The flow through was discarded and the spin column was centrifuged at 14 000x g for 1 minute. Following this, the spin column was placed in a clean tube and 50 μL of S6 elution buffer was added. The tube was then incubated at room temperature for 1 minute. After incubation, the tube was centrifuged at 14 000x g for 1 minute, and the extracted DNA concentration was measured using a Nanodrop Spectrophotometer (ThermoFisher Scientific, United States). Extracted DNA from samples were stored at –20°C until subsequent analysis.

Detection of C. trachomatis and *N. gonorrhoeae*

PCR amplification was performed on the Quant Studio 5 real-time PCR detection system (ThermoFisher Scientific, Waltham, Massachusetts, United States of America), in a 96-well microtiter reaction plate. *C. trachomatis* and *N. gonorrhoeae* were detected using the Applied Biosystems™ TaqMan® Assays. The following commercial primers and probes (Ba04646249_S1) and (Ba04646252_S1) ThermoFisher Scientific, Waltham, Massachusetts, United States of America) were used for each organism respectively. The (Ba04646249_S1) targets the translocated actin-recruiting phosphoprotein gene of *C. trachomatis*, and (Ba04646252_S1) targets the hypothetical protein gene of *N. gonorrhoeae*. Each PCR reaction was performed in a final volume of 20 µL comprising: 1 µL FAM-labeled probe/primer mix, 5 µL Fast Start 4x probe master mix, (ThermoFisher, Part No. 4444434), 2 µL template DNA and 12 µL nuclease-free water. Non-template and positive controls (TaqMan™ Vaginal Microbiota Extraction Control; cat no. A32039) were also included. Amplification was performed at 95ºC for 30 seconds followed by 40 cycles comprising of denaturation at 95ºC for 30 seconds and annealing at 60ºC for 30 seconds. Detection of amplified fluorescent products was carried out at the end of the annealing phase. The raw fluorescent data that included the CT mean values were automatically generated by the Quant Studio 5 Real-time PCR system software.

Data collection tool and analysis

Participants' data were collected using structured interviewer-administered questionnaires. The questionnaires contained questions on socio-demographic characteristics, sexual behaviour, risk factors and substance use, and were administered at enrolment. The primary objective of the study analysis was to determine the prevalence of *C. trachomatis* and *N. gonorrhoeae* in a sample of MSM individuals. The analysis further explored the associated risk factors for each of the STIs as well as the barriers or facilitators to care.

Participant's age was measured in single ages at time of interview from last birthday. Categorisation of the data into broad age groups (18-29, 30-39, 40+) was also explored. Participant's education level completed was in the following categories: none, primary, high school, university or higher. The categories none and primary were later combined due to the very small numbers in those groups. Other explanatory variables included in the analysis were: employed (yes/no); having a regular partner (yes/no); cohabiting with partner (yes/no); number of life time partners (1, 2-4, >4); knowledge of partner having other partners (yes, no, don't know); condom use at last sex (always, frequent, sometimes, never); frequency of group sex (none, once, few times, weekly, monthly); receiving money for sex (no, once, few times, weekly, monthly); HIV status (negative, positive, don't know); substance use at last sex; knowledge and attitudes of access to sexual health clinics including preference to consult own doctor rather than use public health facilities for sexual health needs; experienced stigma due to sexual orientation (yes, no, no data); and being conformable to disclose sexual orientation (yes, no , no data).

Univariable and adjusted multivariable logistic regression models were run for *C. trachomatis* and *N. gonorrhoeae* to test for associations with the explanatory variables. Model fit was checked using standard statistical tests for logistic regression models with detected influential variables dropped and models refitted. We used 5% and 10% significance level with 95% confidence intervals to determine statistical significance. All analyses were conducted using STATA 17.1 software.

Results

Factors significantly associated with testing positive for C. trachomatis

Table 1 describes the characteristics of the study population according to *C. trachomatis* infection status. The prevalence of *C. trachomatis* in the study population was 6% (12/200). The majority of the men (67%) who tested positive for *C. trachomatis* were between the ages of 25-30 years old when compared to 25% who were between 18-24 years old and this was significant, p=0.037. A higher percentage (58.3%) of men who were positive for *C. trachomatis* had attended University when compared to 33.3% who had attended high school, p=0.006.

Three thirds (75.0%) of the men who had tested positive, reported that they did not know if their partners had other partners when compared to 25.0% who reported that their partners did not have other partners, p=0.032. A higher percentage (58.3%) of the men reported engaging in anal sex only in the past 30 days, 25.0% had engaged in anal and oral sex and this had a borderline significance, p=0.054. An estimated, 41.7% of the men reported that they had frequently used condoms when compared to 33.3% who reported sometimes using condoms and 25.0% who always used condoms, p=0.069. There was an equal proportion of men (50.0%) who were circumcised and uncircumcised in the *C. trachomatis* positive group, p=0.043 (Table 1).

Significant risk factors for C. trachomatis infection

Table 2 describes the factors which are significantly associated with the risk for *C. trachomatis* infection. According to the univariate analysis, being between the ages of 30-39 years old reduced the risk of acquiring *C. trachomatis* infection (Odds Ratio [OR]: 0.10, 95% Confidence Interval [CI]: 0.0120-0.7564, p=0.026). With respect to condom use, men who frequently used condoms were at increased risk of acquiring *C. trachomatis* infection (OR: 6.67, 95% CI: 1.4791-30.0478, p=0.014). Being circumcised reduced the risk of being infected, (OR: 0.25, 95% CI: 0.0747-0.8033, p=0.02).

Table 1: Characteristics of the study population according to *C. trachomatis* infection status

	***C.* trachomatis Negative**	***C. trachomatis* Positive**	**Total**	**p-value**
	188 (94)	12 (6)	200	
Age group (years old)				0.037
18-24	21 (11.17)	3 (25)	24 (12)	
25-30	75 (39.89)	8 (66.67)	83 (41.5)	
31-44	78 (41.49)	1 (8.33)	79 (39.5)	
45+	14 (7.45)	0 (0)	14 (7)	
Level of education				0.006
Primary School	10 (5.32)	1 (8.33)	11 (5.5)	
High School	133 (70.74)	4 (33.33)	137 (68.5)	
University	31 (16.49)	7 (58.33)	38 (19)	
Refused to answer	14 (7.45)	0 (0)	14 (7)	
Employed				0.141
No	149 (79.26)	7 (58.33)	156 (78)	
Yes	39 (20.74)	5 (41.67)	44 (22)	
Has a regular sex partner				0.872
No	51 (27.13)	3 (25)	54 (27)	
Yes	137 (72.87)	9 (75)	146 (73)	
Cohabiting with partner				0.664
No	112 (59.57)	9 (75)	121 (60.5)	
Yes	71 (37.77)	3 (25)	74 (37)	
Refused to answer	5 (2.66)	0 (0)	5 (2.5)	
Number of sex partners in last 30 days				0.293
1	92 (48.94)	5 (41.67)	97 (48.5)	
2-4	66 (35.11)	3 (25)	69 (34.5)	
>4	7 (3.72)	1 (8.33)	8 (4)	
None	23 (12.23)	3 (25)	26 (13)	
Partner has other partners				0.032
No	53 (28.19)	3 (25)	56 (28)	
Yes	55 (29.26)	0 (0)	55 (27.5)	
Don't know	80 (42.55)	9 (75)	89 (44.5)	
Sex practices in the past 30 days				0.054
Anal sex only	62 (32.98)	7 (58.33)	69 (34.5)	
Oral sex only	40 (21.28)	0 (0)	40 (20)	
Oral and anal sex	73 (38.83)	3 (25)	76 (38)	
None	13 (6.91)	2 (16.67)	15 (7.5)	
Condom use				0.069
Always	78 (41.49)	3 (25)	81 (40.5)	
Frequent	22 (11.7)	5 (41.67)	27 (13.5)	
Sometimes	76 (40.43)	4 (33.33)	80 (40)	
Never	12 (6.38)	0 (0)	12 (6)	
Frequency of group sex				0.573
Sometimes	39 (20.74)	1 (8.33)	40 (20)	
Frequently	10 (5.32)	1 (8.33)	11 (5.5)	
One time	55 (29.26)	3 (25)	58 (29)	
Never	84 (44.68)	7 (58.33)	91 (45.5)	
Trades sex for cash				0.896
Sometimes	49 (26.06)	3 (25)	52 (26)	
Frequently	19 (10.11)	0 (0)	19 (9.5)	
One time	53 (28.19)	4 (33.33)	57 (28.5)	

Never	67 (35.64)	5 (41.67)	72 (36)	
Has symptoms of STIs				0.738
No	92 (48.94)	5 (41.67)	97 (48.5)	
Yes	88 (46.81)	7 (58.33)	95 (47.5)	
Refused to answer	8 (4.26)	0 (0)	8 (4)	
Circumcised				0.043
No	34 (18.09)	6 (50)	40 (20)	
Yes	144 (76.6)	6 (50)	150 (75)	
Refused to answer	10 (5.32)	0 (0)	10 (5)	
HIV status				0.969
Negative	121 (64.36)	8 (66.67)	129 (64.5)	
Positive	53 (28.19)	3 (25)	56 (28)	
Did not know status	14 (7.45)	1 (8.33)	15 (7.5)	
Previously screened for STIs				0.622
Never	27 (14.36)	2 (16.67)	29 (14.5)	
Past 3 months	34 (18.09)	1 (8.33)	35 (17.5)	
More than 3 months ago	66 (35.11)	3 (25)	69 (34.5)	
Last month	61 (32.45)	6 (50)	67 (33.5)	
Previous STIs				0.681
None	11 (5.85)	1 (8.33)	12 (6)	
Chlamydia/Gonorrhoea	30 (15.96)	1 (8.33)	31 (15.5)	
Hepatitis B/C	13 (6.91)	0 (0)	13 (6.5)	
Herpes	7 (3.72)	1 (8.33)	8 (4)	
Syphilis	12 (6.38)	0 (0)	12 (6)	
Refused to answer	115 (61.17)	9 (75)	124 (62)	
Drug use				0.307
No	59 (31.55)	6 (50)	65 (32.66)	
Yes	126 (67.38)	6 (50)	132 (66.33)	
Refused to answer	2 (1.07)	0 (0)	2 (1.01)	

Table 2: Risk factors for *C. trachomatis* infection

Univariable			
	Odds ratio	**95% Confidence Interval**	**P>z**
Age (years old)			
18-29	1.00		
30-39	0.10	0.0120-0.7564	0.026
40+	1.00	0.0000-0.0000	0
Condom use			
Always	1.00		
Frequently	6.67	1.4791-30.0478	0.014
Sometimes	1.54	0.3349-7.1162	0.578
Never	1.00	0.0000-0.0000	0
Is circumcised (yes)	0.25	0.0747-0.8033	0.02
Multivariable			
	Odds ratio	**95% Confidence Interval**	**P>z**
Age	0.62	0.4224-0.8967	0.011
Is circumcised (yes)	0.01	0.0005-0.3516	0.01
Number of sex partners in the past 30 days			
1			
2-4	107.45	1.3467-8573.3130	0.036
None	0.69	0.0191-24.9668	0.84

Table 3: Characteristics of the study population according to *N. gonorrhoeae* infection status

	***N. gonorrhoeae* Negative**	***N. gonorrhoeae* Positive**	**Total**	**p-value**
	194 (97)	6 (3)	200	
Age group (years old)				0.829
18-24	23 (11.86)	1 (16.67)	24 (12)	
25-30	81 (41.75)	2 (33.33)	83 (41.5)	
31-44	76 (39.18)	3 (50)	79 (39.5)	
45+	14 (7.22)	0 (0)	14 (7)	
Level of education				0.047
Primary School	11 (5.67)	0 (0)	11 (5.5)	
High School	135 (69.59)	2 (33.33)	137 (68.5)	
University	36 (18.56)	2 (33.33)	38 (19)	
Refused to answer	12 (6.19)	2 (33.33)	14 (7)	
Employed				0.615
No	152 (78.35)	4 (66.67)	156 (78)	
Yes	42 (21.65)	2 (33.33)	44 (22)	
Has a regular sex partner				0.662
No	52 (26.8)	2 (33.33)		
Yes	142 (73.2)	4 (66.67)		
Cohabiting with partner				0.055
No	120 (61.86)	1 (16.67)	121 (60.5)	
Yes	69 (35.57)	5 (83.33)	74 (37)	
Refused to answer	5 (2.58)	0 (0)	5 (2.5)	
Number of sex partners in last 30 days				0.4
1	94 (48.45)	3 (50)	97 (48.5)	
2-4	68 (35.05)	1 (16.67)	69 (34.5)	
>4	8 (4.12)	0 (0)	8 (4)	
None	24 (12.37)	2 (33.33)	26 (13)	
Partner has other partners				0.496
No	55 (28.35)	1 (16.67)	56 (28)	
Yes	52 (26.8)	3 (50)	55 (27.5)	
Don't know	87 (44.85)	2 (33.33)	89 (44.5)	
Sex practices in the past 30 days				0.034
Anal sex only	69 (35.57)	0 (0)	69 (34.5)	
Oral sex only	36 (18.56)	4 (66.67)	40 (20)	
Oral and anal sex	74 (38.14)	2 (33.33)	76 (38)	
None	15 (7.73)	0 (0)	15 (7.5)	
Condom use				0.133
Always	80 (41.24)	1 (16.67)	81 (40.5)	
Frequent	24 (12.37)	3 (50)	27 (13.5)	
Sometimes	78 (40.21)	2 (33.33)	80 (40)	
Never	12 (6.19)	0 (0)	12 (6)	
Frequency of group sex				0.001
Sometimes	39 (20.1)	1 (16.67)	40 (20)	
Frequently	8 (4.12)	3 (50)	11 (5.5)	
One time	56 (28.87)	2 (33.33)	58 (29)	
Never	91 (46.91)	0 (0)	91 (45.5)	
Trades sex for cash				0.032
Sometimes	51 (26.29)	1 (16.67)	52 (26)	
Frequently	17 (8.76)	2 (33.33)	19 (9.5)	
One time	54 (27.84)	3 (50)	57 (28.5)	
Never	72 (37.11)	0 (0)	72 (36)	

Has symptoms of STIs				0.178
No	95 (48.97)	2 (33.33)	97 (48.5)	
Yes	92 (47.42)	3 (50)	95 (47.5)	
Refused to answer	7 (3.61)	1 (16.67)	8 (4)	
Circumcised				0.033
No	39 (20.1)	1 (16.67)	40 (20)	
Yes	147 (75.77)	3 (50)	150 (75)	
Refused to answer	8 (4.12)	2 (33.33)	10 (5)	
HIV status				0.082
Negative	126 (64.95)	3 (50)	129 (64.5)	
Positive	55 (28.35)	1 (16.67)	56 (28)	
Did not know status	13 (6.7)	2 (33.33)	15 (7.5)	
Previously screened for STIs				0.141
Never	27 (13.92)	2 (33.33)	29 (14.5)	
Past 3 months	34 (17.53)	1 (16.67)	35 (17.5)	
More than 3 months ago	69 (35.57)	0 (0)	69 (34.5)	
Last month	64 (32.99)	3 (50)	67 (33.5)	
Previous STIs				0.182
None	12 (6.19)	0 (0)	12 (6)	
Chlamydia/Gonorrhoea	28 (14.43)	3 (50)	31 (15.5)	
Hepatitis B/C	12 (6.19)	1 (16.67)	13 (6.5)	
Herpes	8 (4.12)	0 (0)	8 (4)	
Syphilis	12 (6.19)	0 (0)	12 (6)	
Refused to answer	122 (62.89)	2 (33.33)	124 (62)	
Drug use				0.055
No	63 (32.64)	2 (33.33)	65 (32.66)	
Yes	129 (66.84)	3 (50)	132 (66.33)	
Refused to answer	1 (0.52)	1 (16.67)	2 (1.01)	

After performing further adjustments, in the multivariable model, being between the ages of 30-39 years old still reduced the risk of acquiring *C. trachomatis* infection (OR: 0.62, 95% CI: 0.4224-0.8967, p=0.011). Similarly, being circumcised reduced the risk of infection (OR: 0.01, 95% CI: 0.0005-0.3516, p=0.01). Having between 2-4 sex partners in the past 30 days increased the risk of testing positive for infection (OR: 107.45, 95% CI: 1.3467-8573.3130, p=0.036) (Table 2).

Factors significantly associated with testing N. gonorrhoeae positive

The prevalence of *N. gonorrhoeae* in the study population was 3% (6/200). According to the analysis, an equal proportion of men who tested positive for *N. gonorrhoeae* (33.3%) had attended High school and University and this was significant, p=0.047. A high proportion of men (83.3%) were cohabiting with their sex partners, cohabitation status was significantly associated with testing positive for infection, p=0.05. A high proportion of men (66.7%) had engaged in oral sex and 33.3% had engaged in anal sex and this was significant, p=0.034. In addition, a high proportion of men were engaging in group sex frequently, p=0.001. A high proportion of men (50%) were also engaging in sex for cash frequently, p=0.032. A high proportion of men (50%) who tested positive for infection were circumcised, p=0.033. A high proportion of men (50%) who tested positive for infection were also drug users, p=0.055 (Table 3).

Factors significantly associated with access to care according to C. trachomatis and N. gonorrhoeae status

According to the analysis, the majority of the men who tested positive for *C. trachomatis* (66.7%) were not aware of the sexual health services offered by the clinics in the city and this was significant, p=0.002. Of the men who tested positive for *N. gonorrhoeae*, 50% reported that they would prefer to access care from a General Practitioner based in a surgery, p=0.042. In addition, 33.3% of the men believed that

Table 4: Factors associated with access to care according to *C. trachomatis* and *N. gonorrhoeae* status

	***C. trachomatis* Negative** n (%)	***C. trachomatis* Positive** n (%)	**Total** n (%)	**p-value**
Aware of sexual health clinics in the city				0.83
No	35 (18.62)	2 (16.67)	37 (18.5)	
Yes	148 (78.72)	10 (83.33)	158 (79)	
Refused to answer	5 (2.66)	0 (0)	5 (2.5)	
Aware of sexual health services offered by clinics				0.002
No	36 (19.15)	8 (66.67)	44 (22)	
Yes	139 (73.94)	4 (33.33)	143 (71.5)	
Refused to answer	13 (6.91)	0 (0)	13 (6.5)	
Prefer to seek care from General Practitioner at surgery				0.756
No	46 (24.47)	4 (33.33)	50 (25)	
Yes	117 (62.23)	7 (58.33)	124 (62)	
Don't know	25 (13.3)	1 (8.33)	26 (13)	
Comfortable disclosing sexual orientation to health care worker				0.158
No	34 (18.09)	5 (41.67)	39 (19.5)	
Yes	146 (77.66)	7 (58.33)	153 (76.5)	
Refused to answer	8 (4.26)	0 (0)	8 (4)	
Experienced stigma				0.171
No	85 (45.21)	9 (75)	94 (47)	
Yes	96 (51.06)	3 (25)	99 (49.5)	
Refused to answer	7 (3.72)	0 (0)	7 (3.5)	
Fear stopped you from accessing health care				0.546
No	91 (48.4)	6 (50)	97 (48.5)	
Yes	90 (47.87)	5 (41.67)	95 (47.5)	
Refused to answer	7 (3.72)	1 (8.33)	8 (4)	
Having a trusted and flexible sexual health clinic will encourage access to care				0.996
Do not know	17 (9.04)	1 (8.33)	18 (9)	
No	139 (73.94)	9 (75)	148 (74)	
Yes	32 (17.02)	2 (16.67)	34 (17)	
	***N. gonorrhoeae* Negative**	***N. gonorrhoeae* Positive**	**Total**	**p-value**
	194 (97)	6 (3)	200	
Aware of sexual health clinics in the city				0.416
No	35 (18.04)	2 (33.33)	37 (18.5)	
Yes	154 (79.38)	4 (66.67)	158 (79)	
Refused to answer	5 (2.58)	0 (0)	5 (2.5)	
Aware of sexual health services offered by clinics				0.431
No	43 (22.16)	1 (16.67)	44 (22)	
Yes	139 (71.65)	4 (66.67)	143 (71.5)	
Refused to answer	12 (6.19)	1 (16.67)	13 (6.5)	
Prefer to seek care from General Practitioner at surgery				0.042
No	50 (25.77)	0 (0)	50 (25)	
Yes	121 (62.37)	3 (50)	124 (62)	
Don't know	23 (11.86)	3 (50)	26 (13)	
Comfortable disclosing sexual orientation to health care worker				0.493
No	39 (20.1)	0 (0)	39 (19.5)	

Yes	147 (75.77)	6 (100)	153 (76.5)	
Refused to answer	8 (4.12)	0 (0)	8 (4)	
Experienced stigma				0.075
No	90 (46.39)	4 (66.67)	94(47)	
Yes	98 (50.52)	1 (16.67)	99 (49.5)	
Refused to answer	6 (3.09)	1 (16.67)	7 (3.5)	
Fear stopped you from accessing health care				0.242
No	94 (48.45)	3 (50)	97 (48.5)	
Yes	93 (47.94)	2 (33.33)	95 (47.5)	
Refused to answer	7 (3.61)	1 (16.67)	8 (4)	
Having a trusted and flexible sexual health clinic will encourage access to care				0.02
No	18 (9.28)	0 (0)	18 (9)	
Yes	146 (75.26)	2 (33.33)	148 (74)	
Don't know	30 (15.46)	4 (66.67)	34 (17)	

Table 5: Factors related to accessing to health care services by the study population

Factors related to access to care	Overall (N=200)
Aware of sexual health clinics in the city	
No	37 (18.5%)
Yes	158 (79%)
Refused to answer	5 (2.5%)
Aware of sexual health services offered by clinics	
No	44 (22%)
Yes	143 (71.5%)
Refused to answer	13 (6.5%)
Comfortable disclosing sexual orientation to health care worker	
No	39 (19.5%)
Yes	153 (76.5%)
Refused to answer	8 (4%)
Prefer to seek care from General Practitioner at surgery	
No	50 (25%)
Yes	124 (62%)
Don't know	26 (13%)
Experienced stigma	
No	94 (47%)
Yes	99 (49.5%)
Refused to answer	7 (3.5%)
Fear stopped you from accessing health care	
No	97 (48.5%)
Yes	95 (47.5%)
Refused to answer	8 (4%)
Having a trusted and flexible sexual health clinic will encourage access to care	
Do not know	34 (17%)
No	18 (9%)
Yes	148 (74%)

having a trusted and flexible sexual health clinic will encourage access to care and this was significant, p=0.02 (Table 4).

Barriers and facilitators to accessing care

The majority of the MSM were aware of sexual health clinics in the city (79%). In addition, the majority of the MSM (71.5%) were aware of the services that these clinics could provide to them. However, the majority of the MSM (62%) reported that they would prefer to seek care from a General Practitioner at a surgery. A high proportion, 76.5% reported that they would be comfortable disclosing their sexual behaviour to health care workers and 58.3% believed that their confidentiality would be protected. Almost half of the MSM, 49.5% had experienced stigma based on their sexual behaviour and 47.5% reported being afraid to go to health care centres due to stigma. The majority, 74% reported that having a trusted health care facility for MSM would encourage them to access care (Table 5).

Discussion

This study aimed to estimate the prevalence of *N. gonorrhoeae* and *C. trachomatis* among MSM living in Durban, South Africa. In this study, the prevalence of the individual STIs investigated among MSM were as follows: *N. gonorrhoeae* 3.0% and *C. trachomatis* 6.0%. The prevalence of *C. trachomatis* and *N. gonorrhoeae* observed in this study are consistent with those reported in a study among MSM in Marrakech which reported a prevalence of 6.3% for *C. trachomatis* and 2.4% for *N. gonorrhoeae*[44]. Prevalence estimates from our study are also similar to those found in another study

conducted among MSM in Tanga where prevalence rates of 7.5% and 2.5% were reported for chlamydia and gonorrhoea respectively[45]. Similarly, a study conducted among MSM in Hong Kong, reported a prevalence of 4.7% for *C. trachomatis* and 0.2% for *N. gonorrhoeae*[46]. In other reported studies, *C. trachomatis* prevalence rates ranged from 2.2% to 26.0%[41,47-51] while prevalence estimates for *N. gonorrhoeae* ranged from 1.0% to 16.0%[25,47,52-54].

Results from our study show that *C. trachomatis* is the most prevalent bacterial STI among MSM in South Africa. This is in line with previous studies conducted in South Africa[41,42]. Evidence from a systematic review by Dewart et al. has shown that although chlamydia and gonorrhoea are the most prevalent STIs among MSM, chlamydia is more prevalent when compared with gonorrhoea[55]. In South Africa, a study carried out in adult men and women found that amongst 15-49 year olds, men had more cases of *C. trachomatis* than women while the number of new cases of gonorrhoea was similar in both groups[56]. Another study conducted in Nairobi, Kenya among tertiary student MSM, reported a higher prevalence of chlamydia[54]. Studies among community-recruited MSM have also shown that infection with gonorrhoea are far less common than chlamydia infection[57,58]. Contrasting trends, however, have been reported in other areas. For instance, in England, MSM were most likely to contract *N. gonorrhoeae* than any other STI[23]. A study conducted by Ribeiro et al. in a population of MSM reported a prevalence rate of 10.75% for gonorrhoea and 7.59% for chlamydia[25]. Another study among MSM conducted in the city of Agadir in 2020 reported an overall prevalence of 11.3% and 13.3% for *C. trachomatis* and *N. gonorrhoeae* respectively[59]. The predominant asymptomatic presentation of *C. trachomatis* which allows for longer duration of infection and subsequent transmission, may be responsible for the high prevalence of the infection worldwide[60,61].

The current standard for the management of STIs (chlamydia, gonorrhoea, syphilis and trichomoniasis) in South Africa and other developing countries is the syndromic approach, which depends on patients presenting with signs and symptoms for presumptive diagnosis and treatment of STIs without the use of laboratory tests[3]. This is especially concerning in low- and middle-income nations, which frequently have high-risk sexually active populations[62]. In this study, a considerable number of MSM who tested positive with *N. gonorrhoeae* and *C. trachomatis* infections were asymptomatic. These findings suggest that syndrome-based STI management is an inadequate approach for reducing the burden of STIs in MSM, as this screening approach can create a false sense of security in asymptomatic patients, favouring the progression of silent STIs towards irreversible complications[11].

Of the MSM who reported previous history of STIs, 32% (64/200) reported that they had been diagnosed with at least one STI in the past. A study conducted by Budkaew et al. reported that a participant's previous history of diagnosed STIs was significantly associated with urethral gonorrhoeal infection[63]. Similarly, findings from other studies indicated that asymptomatic gonorrhoea or chlamydia infection was associated with a past exposure with at least one STI infection[47,49,64]. Bacterial STIs have been identified as a potential driver of HIV infection in MSM[65,66]. Several studies have established among MSM the association between STIs and increased risk of HIV infection[67-69]. A retrospective study conducted in San Francisco demonstrated that two or more prior rectal gonorrhoea or chlamydia infections among MSM were associated with 8 times increased risk of HIV seroconversion[27]. Furthermore, a study by Harney et al. found that a cumulated history of rectal gonorrhoea infection increased the risk of subsequent HIV infection among MSM[70].

Several risk factors such as unprotected sex[71], younger age[21,72,73], multiple sex partners[21,71,74,75], transactional sex and substance use[25,43,76] have been found to be associated with chlamydia and gonorrhoea infections. Knowledge of these associated risk factors are important as they play a crucial role in designing effective control measures[77]. In this present study, a range of factors were found to be associated with *C. trachomatis* and/or *N. gonorrhoeae* infections. We found that sex for cash and drug use were associated with testing positive for gonorrhoea. We hypothesize that this observed association is due to drug effects which impairs judgement and contribute to risky sexual behaviours thereby increasing the likelihood of STIs. A similar study reported that inhaled drug use was significantly associated with higher rates of

gonorrhoea and chlamydia infections[25]. Other studies have found that MSM having sexual contact with individuals who exchanged sex for money or drugs was significantly associated with high prevalence of gonorrhoea[43,76]. Persons who transact sex are not likely to be able to negotiate safe sex due to fear of losing out on transactional benefits[78]. This places them at risk of an infection.

Previous studies have indicated that low level of education is associated with acquiring STIs[33,79,80]. This may be attributed to risk taking behaviour among the people with low education[81]. In our study however, 58.3% of MSM who tested positive for *C. trachomatis* had a university education (p=0.006), and of the men who tested positive for *N. gonorrhoeae*, an equal proportion (33.3%) attended high school and university (p=0.047). This finding, may be as a result of the unwillingness of MSM in seeking care due to stigma and discriminatory attitudes of healthcare workers which limits the uptake of health services[82] irrespective of educational status.

Engaging in anal/oral sex was also found to be significantly associated with testing gonorrhoea positive in this study. Engaging in anal/oral sex also showed a borderline significance with testing positive for *C. trachomatis* in our study. Previous studies in MSM have shown that anal sex is associated with anorectal gonorrhoea[83,84]. Other studies however have shown that anal sex is not associated with anorectal chlamydia in MSM[84,85]. In contrast, other STIs, including chlamydia, have been shown to be frequently transmitted through oral-genital or oral-rectal pathways[86].

Our study found that a high proportion of MSM engaged in group sex. Previous studies from Australia, the United Kingdom and the United States have documented that group sex was common among MSM[87-90]. Other studies have shown that between 25% and 55% of MSM who participate in group sex engaged in condomless anal sex[89-93], and were susceptible to contracting and transmitting STIs[94,95]. The relationship between group sex participation and STIs have also been discussed in previous studies[96-98]. In this study, group sex was significantly associated with testing positive for *N. gonorrhoeae*. A study by Rice *et al*. reported that participation in group sex was associated with more than twofold increased prevalence of *N. gonorrhoea* infection, but not with chlamydia[96]. According to van den Boom *et al*., group sex may be a higher-risk setting for the acquisition of STIs such as gonorrhoea[97].

A high proportion of MSM in our study were cohabiting with their sex partners. Furthermore, we found that cohabitation status was significantly associated with testing positive for *N. gonorrhoeae*. It has been reported that cohabiting and/or married MSM were less likely to use condom than not cohabiting/unmarried MSM[99]. More so, MSM who have sex in a married or cohabiting relationship are more likely to be monogamous or believe their partner is, which may cause them to believe they are less likely to contract HIV and STIs[100,101]. Previous research have indicated that MSM in committed relationships may see condoms as limiting sexual intimacy and indicating mistrust of a partner[100].

With respect to condom use, MSM who reported frequent use of condoms in this study were at increased risk of acquiring *C. trachomatis* infection (OR: 6.67, 95% CI: 1.4791-30.0478, p=0.014). A similar study among MSM in Lisbon demonstrated that despite the consistent use of condom during anal sex, gonorrhoea and chlamydia transmission still occurred[25]. Our finding was however not consistent with reports from other studies where condom use significantly decreased the prevalence of chlamydia and gonorrhoea[63,102]. Although an invaluable tool in combating HIV, condom effectiveness in preventing other STIs has increasingly been questioned[25] since it does not adequately prevent infection caused by Hepatitis A virus[103].

With regards to circumcision, half of the MSM population who tested positive for *N. gonorrhoeae* infection were circumcised (p=0.033). For *C. trachomatis*, in the adjusted analysis, being circumcised was shown to reduce the risk of infection (OR: 0.01, 95% CI: 0.0005-0.3516, p=0.01). There are inconsistent reports on the effect of circumcision on the incidence of STIs[104]. However, there is convincing evidence to show that male circumcision reduces the risk of HIV and STI infection[105-107]. A systematic review and meta-analysis conducted by Yuan et al., reported the association between male circumcision and HIV and other STIs among MSM in low- and middle-income countries. The authors found that circumcision was associated with 23% reduced odds of HIV

infection[108]. Similarly, a meta-analyses conducted by Sharma and colleagues found that voluntary medical male circumcision (VMMC) may well reduce the risk of HIV infection by 20% among MSM[109]. Uncircumcised men can be at increased risk of STIs by reason of entry of pathogens through the inner surface of the foreskin[104]. A study conducted in Rustenburg, South Africa among circumcised and uncircumcised adult males reported that the prevalence of STIs was lower in the circumcised participants compared with those who were uncircumcised[110]. Furthermore, in a cohort study by Diseker et al., uncircumcised men were significantly more likely to have gonorrhoea than circumcised men[111]. As an approach to preventing HIV and other STIs, the World Health Organization now recommends VMMC as one of the key prevention strategies[112].

In this study, our analysis found that younger age was significantly associated with testing positive for *C. trachomatis*. Most cases of chlamydia infection were found in MSM aged 25-30 years. This finding is in agreement with several previous studies which demonstrated that younger age was associated with having chlamydia and/or gonorrhoea infections[21,25,73,113,114]. This observed trend might be due to younger populations engaging in sexual practices with greater number of sexual contacts, as well as a higher probability of infection among those contacts[115]. Age was also associated with the risk of acquiring *C. trachomatis* in this study. In the univariate analysis conducted in our study, results show that being between the ages of 30-39 years old reduced the risk of acquiring chlamydia infection (OR: 0.10, 95% CI: 0.0120-0.7564, p=0.026). After further adjustments, being within the age range 30 - 39 years old still reduced the risk for infection with *C. trachomatis* in the multivariate analysis (OR: 0.62, 95% CI: 0.4224-0.8967, p=0.011). A study conducted by Cunha et al. in a population of MSM in Brazil showed that for every additional 10 years of age, the prevalence of having at least one STI decreased by 22%[116]. On the other hand, Several other studies have shown that younger age is associated with an increased risk for STI diagnosis[74,117].

Having multiple sex partners increases the likelihood of encountering an infected partner[118]. Having multiple sexual contacts has also been shown to predispose MSM to multiple concurrent STIs[75,119]. In the adjusted analysis conducted in our study, we found that MSM having between 2 to 4 sex partners in the past 30 days increased the risk of testing positive for *C. trachomatis* infection (OR: 107.45, 95% CI: 1.3467-8573.3130, p=0.036). Findings from a similar study by Ribeiro et al., reported a significant association between infection and having a higher number of concurrent sex partners[25]. Similarly, a study conducted in the United States found that MSM who reported multiple sexual partners had an increased risk of incident bacterial STIs[120]. Other studies on MSM have indicated that having multiple sex partners is associated with having anorectal chlamydia and gonorrhoea infections[21,74,114].

Majority of MSM in this study were generally well-informed about sexual health clinics in Durban and the services they provide. However, a high proportion (62%) of these participants would rather seek care from a general practitioner (GP) at a surgery. Half of the MSM who tested positive for *N. gonorrhoeae* preferred to access care from a GP based in a surgery (p=0.042). A study by Lea et al., reported that some gay men preferred accessing sexual health care via their GP due to ease of access and concerns about anonymity[121].

Research has indicated that MSM oftentimes experience discrimination from public sector healthcare workers[122,123], which negatively affects health-seeking behaviours[124]. In this study, almost half of the MSM reported being stigmatized based on their sexual behaviour while 47.5% reported being afraid to visit a health care clinic due to stigma. On the contrary, 58.3% believed that their confidentiality would be protected. A study in Vietnam reported that sexual stigma contributed to MSM's reluctance to actively access healthcare services[125]. Studies conducted in Africa have also highlighted on a number of challenges that MSM experience in accessing adequate medical care including negative patient-provider relationships[126-128]. A survey on stigma, health care access, and HIV knowledge among MSM conducted in Malawi, Namibia, and Botswana observed strong associations between MSM health-seeking behaviour and stigma/discrimination from healthcare workers[129]. Similarly, a study conducted in South Africa among MSM utilizing health services in South African cities found that stigma, discrimination, and negative health worker attitudes

were major barriers to accessing health services[122]. Another study conducted in the South African cities of Bloemfontein and Mafikeng stated lack of confidentiality and concern around negative treatment from healthcare workers as reasons for MSM's reluctance to seek public sector healthcare and fear of disclosing their behaviours[82].

The strength of this study is that it fills a gap in the literature on the prevalence and risk factors associated with *C. trachomatis* and *N. gonorrhoeae* infection among MSM in South Africa as well as identified barriers to accessing healthcare services. A major limitation of this study is that it did not test for anorectal *C. trachomatis* and *N. gonorrhoeae*. Prevalence may have been substantially higher had the test been included. Data on demographic and behavioural characteristics as well as symptoms were self-reported, and as such might be subject to both recall and/or social desirability biases. Finally, although certain risk factors were identified to be associated with *C. trachomatis* and *N. gonorrhoeae* prevalence, the cross-sectional nature of the study limited inferences about the direction of causality.

Conclusion

Our study provides evidence of STI prevalence rates, particularly the high rates of *C. trachomatis* infection among MSM resident in Durban. It also confirms previous research that *C. trachomatis* is the most common STI among MSM in South Africa. A few MSM who tested positive for *N. gonorrhoeae* and *C. trachomatis* infections were asymptomatic. This poses a treatment challenge since South Africa employs the syndromic management approach. The majority of MSM positive for *C. trachomatis* were between 25-30 years of age. A high proportion frequently engaged in group sex and tested positive for *N. gonorrhoeae*. A few factors were significantly associated with both *C. trachomatis* and *N. gonorrhoeae* infections. Fear and stigma were the main barriers to seeking medical care in this study. The results of this study not only contribute to the body of information showing the high burden of STIs in MSM populations worldwide[11], but also calls for more attention to be paid to younger MSM and healthcare workers' unfavourable attitudes towards this key population. Also, MSM in South Africa should be given priority in the delivery of interventions for the treatment and prevention of STIs.

Acknowledgements

Authors would like to thank the management and staff of King Edward VIII hospital and Aurum Institute for the support given to this research.

Competing interest

The authors declare no conflict of interest.

Funding

This research was supported by Professor Abbai' research funds awarded by the University of KwaZulu-Natal.

References

1. Jones KG, Johnson AM, Wellings K, Sonnenberg P, Field N, Tanton C, Erens B, Clifton S, Datta J, Mitchell KR, Prah P and Mercer CH. The prevalence of, and factors associated with, paying for sex among men resident in Britain: Findings from the third National Survey of Sexual Attitudes and Lifestyles (Natsal-3). Sex Transm Infect 2015; 91: 116–123. https://doi.org/10.1136/sextrans-2014-051683.
2. Hu H, Chen Y, Shi L, Liu X, Xu Z, Sun L, Zhao X, Zhou Y, Lu J, Zhang Z, Liu X and Fu G. Prevalence of Syphilis and *Chlamydia trachomatis* infection among men who have sex with men in Jiangsu province, China: A cross-sectional survey. Front Public Health 2022; 10: 1006254. https://doi.org/10.3389/fpubh.2022.1006254.
3. World Health Organization. Sexually transmitted infections (STIs): Key facts [Internet]. 2019, https://www.who.int/news-room/fact-sheets/detail/sexually-transmitted-infections-(stis) (2019, accessed 17 April 2023).
4. Workowski KA and Bachmann LH. Centers for Disease Control and Prevention's sexually transmitted diseases infection guidelines. **Clinical Infectious Diseases** 2022; 74(2): S89–S94, https://doi.org/10.1093/cid/ciab1055.
5. Newman L, Rowley J, Hoorn SV, Wijesooriya NS, Unemo M, Low N, Stevens G, Gottlieb S, Kiarie J and Temmerman M. Global estimates of the prevalence and incidence of four curable sexually transmitted infections in 2012 based on systemic review and global reporting. PLoS ONE 2015; 10: e0143304. https://doi.org/10.1371/journal.pone.0143304.
6. Centers for Disease Control and Prevention. Sexually transmitted disease surveillance [Internet]. 2019, https://www.cdc.gov/std/statistics/2019/std-surveillance-2019.pdf. (2019, accessed 20 April 2023).
7. Workowski KA and Bolan GA. Centers for Disease Control and Prevention. Sexually transmitted diseases

treatment guidelines, 2015. MMWR Recomm Rep 2015; 64: 1–137.
8. Aboud S, Buhalata SN, Onduru OG, Chiduo MG, Kwesigabo GP, Mshana SE, Manjurano AM, Temu MM, Kishamawe C and Changalucha JM. High prevalence of sexually transmitted and reproductive tract infections (STI/RTIS) among patients attending STI/outpatient department clinics in Tanzania. Trop Med Infect Dis 2023; 8: 62. https://doi.org/10.3390/tropicalmed8010062.
9. World Health Organization. Global Progress Report on HIV, Viral Hepatitis and Sexually Transmitted Infections, 2021 [Internet]. 2021, Available online at: http://apps.who.int/iris/bitstream/handle/10665/342808/9789240030985-eng.pdf (2021, accessed 17 April 2023).
10. World Health Organization. Global health sector strategy on sexually transmitted infections 2016-2021: toward ending STIs, in In Global health sector strategy on sexually transmit- ted infections 2016-2021: toward ending STIs, WHO. 2016, Available online at: https://www.who.int/publications/i/item/WHO-RHR-16.09 (2016, accessed 17 April 2023).
11. Unemo M, Bradshaw CS, Hocking JS, de Vries HJC, Francis SC, Mabey D, Marrazzo JM, Sonder GJB, Schwebke JR, Hoornenborg E, Peeling RW, Philip SS, Low N and Fairley CK. Sexually transmitted infections: challenges ahead. The Lancet Infectious Diseases 2017; 17(8): e235–e279. https://doi.org/10.1016/S1473-3099(17)30310-9.
12. Cohen MS. Sexually transmitted diseases enhance HIV transmission: no longer a hypothesis. Lancet 1998; 351: 5–7. https://doi.org/10.1016/S0140-6736(98)90002-2.
13. Vodstrcil LA, Fairley CK, Fehler G, Leslie D, Walker J, Bradshaw CS, and Hocking JS. Trends in chlamydia and gonorrhoea 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. https://doi.org/10.1186/1471-2334-11-158.
14. Fu GF, Jiang N, Hu HY, Mahapatra T, Yin YP, Mahapatra S, Wang XL, Chen XS, Babu GR, Xu XQ, Ding P, Qiu T, Liu XY, Guo H, Huan XP and Tang W. The epidemic of HIV, syphilis, chlamydia and gonorrhoea and the correlates of sexual transmitted infections among men who have sex with men in Jiangsu, China, 2009. PLoS ONE 2015; 10: e0118863. https://doi.org/10.1371/journal.pone.0118863.
15. Rob F, Juzlová K, KruŽicová Z, Vanousová D, Lásiková Š, Sýkorová B, Machala L, Rozsypal H, Vesely D, Zákouckà H and Hercogová J. Prevalence of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* co-infections among patients with newly diagnosed syphilis: a single-centre, cross-sectional study. Cent Eur J Public Health 2019; 27: 285–91. https://doi.org/10.21101/cejph.a5142.
16. Peeling RW, Mabey D, Kamb ML, Chen XS, Radolf JD and Benzaken AS. Syphilis. Nat Rev Dis Primers 2017; 3: 17073. http://doi.org/10.1038/nrdp.2017.73.
17. Remis RS, Liu J, Loutfy MR, Tharao W, Rebbapragada A, Huibner S, Kesler M, Halpenny R, Grennan T, Brunetta J, Smith G, Reko T and Kaul R. Prevalence of sexually transmitted viral and bacterial infections in HIV- positive and HIV-negative men who have sex with men in Toronto. PLoS One 2016; 11: e0158090. http://dx.plos.org/10.1371/journal.pone.
18. Spicknall IH, Gift TL, Bernstein KT and Aral SO. Sexual networks and infection transmission networks among men who have sex with men as causes of disparity and targets of prevention. Sex Transm Infect 2017; 93: 307– 8. https://doi.org/10.1136/sextrans-2016-052676.
19. Paz-Bailey G, Mendoza MC, Finlayson T, Wejnert C, Le B, Rose C, Raymond HF and Prejean J. Trends in condom use among MSM in the United States: the role of antiretroviral therapy and sero-adaptive strategies. AIDS 2016; 30: 1985–90. https://doi.org/10.1097/QAD.0000000000001139.
20. Zhou Y, Cai YM, Li SL, Cao NX, Zhu XF, Wang F, Han Y, Yin YP and Chen XS. Anatomical site prevalence and genotypes of *Chlamydia trachomatis* infections among men who have sex with men: a multi-site study in China. BMC Infect Dis 2019; 19: 1041. https://doi.org/10.1186/s12879-019-4664-1.
21. Peters RP, Verweij SP, Nijsten N, Ouburg S, Mutsaers J, Jansen CL, van Leeuwen AP and Morré SA. Evaluation of sexual history-based screening of anatomic sites for *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infection in men having sex with men in routine practice. BMC Infect Dis 2011; 11: 203. https://doi.org/10.1186%2F1471-2334-11-203.
22. Blondeel K, Say L, Chou D, Toskin I, Khosla R, Scolaro E and Temmerman M. Evidence and knowledge gaps on the disease burden in sexual and gender minorities: a review of systematic reviews. Int J Equity Health 2016; 15: 16. https://doi.org/10.1186/s12939-016-0304-1.
23. Mitchell H, Allen H, Sonubi T, Kuyumdzhieva G, Harb A, Shah A, Glancy M, Checchi M, Milbourn H, Folkard K, Mohammed H and contributors. Sexually transmitted infections and screening for Chlamydia in England, 2019. Public Health England [Internet]. 2019, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/914249/STI_ NCSP_report_2019.pdf (2019, accessed 20 April 2023).
24. Bignell C and Unemo M. 2012 European guideline on the diagnosis and treatment of gonorrhoea in adults. Int J STD AIDS 2013; 24: 85–92. https://doi.org/10.1177/0956462412472837.
25. Ribeiro S, de Sousa D, Medina D, Castro R, Lopes Â and Rocha M. Prevalence of gonorrhoea and chlamydia in a community clinic for men who have sex with men in Lisbon, Portugal. Int J STD AIDS 2019; 30(10): 951-959. https://doi.org/10.1177/0956462419855484.
26. Mohseni M, Sung S, and Takov V. Chlamydia. (Updated 2023). In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023, https://www.ncbi.nlm.nih.gov/books/NBK537286/ (2023, accessed 19 April 2023).

27. Bernstein KT, Marcus JL, Nieri G, Philip SS and Klausner JD. Rectal gonorrhoea and chlamydia reinfection is associated with increased risk of HIV seroconversion. J Acquir Immune Defic Syndr 2010; 53: 537–43. https://doi.org/10.1097/QAI.0b013e3181c3ef29.
28. Stöppler MC. 9 Common Sexually Transmitted Diseases in Men. MedicineNet [Internet]. 2023, https://www.medicinenet.com/stds_in_men_overview/article.htm (2023, accessed 19 April 2023).
29. Kaul R, Nagelkerke NJ, Kimani J, Ngugi E, Bwayo JJ, Macdonald KS, Rebbaprgada A, Fonck K, Temmerman M, Ronald AR, Moses S and Kibera HIV Study Group. Prevalent herpes simplex virus type 2 infection is associated with altered vaginal flora and an increased susceptibility to multiple sexually transmitted infections. J Infect Dis 2007; 196: 1692–7. https://doi.org/10.1086/522006.
30. Götz HM, van Doornum G, Niesters HG, den Hollander JG, Thio HB and de Zwart O. Cluster of acute hepatitis C virus infection among men who have sex with men–results from contact tracing and public health implications. AIDS 2005; 19: 969–74. https://doi.org/10.1097/01.aids.0000171412.61360.f8.
31. Dreyer G. Clinical implications of the interaction between HPV and HIV infections. Best Pract Res Clin Obstet Gynaecol 2018; 47: 95–106. https://doi.org.10.1016/j.bpobgyn.2017.08.011.
32. Ward H, Martin I, Macdonald N, Alexander S, Simms I, Fenton K, French P, Dean G and Ison C. Lymphogranuloma venereum in the United kingdom. Clin Infect Dis 2007; 44: 26–32. https://doi.org/10.1086/509922.
33. Ye Z-H, Chen S, Liu F, Cui S-T, Liu Z-Z, Jiang Y-J and Hu Q-H. Patterns of sexually transmitted co-infections and associated factors among men who have sex with men: a cross-sectional study in Shenyang, China. Front Public Health 2022; 10: 842644. https://doi.org.10.3389/fpubh.2022.842644.
34. Chan PA, Robinette A, Montgomery M, Almonte A, Cu-Uvin S, Lonks JR Chapin KC, Kojic EM and Hardy EJ. Extragenital infections caused by *Chlamydia trachomatis* and *Neisseria gonorrhoeae*: A review of the literature. Infect Dis Obstet Gynecol 2016; 2016: 5758387. https://doi.org/10.1155/2016/5758387.
35. Kharsany B, Cawood C, Lewis L, Yende-Zuma N, Khanyile D, Puren A, Madurai S, Baxter C, George G, Govender K, Beckett S, Samsunder N, Toledo C, Ayalew KA, Diallo K, Glenshaw M, Herman-Roloff A, Wilkinson E, de Oliveira T, Abdool Karim SS and Abdool Karim Q. Trends in HIV prevention, treatment, and incidence in a hyperendemic area of KwaZulu-Natal, South Africa. JAMA Network Open 2019; 2(11): e1914378–e1914378. https://doi.org/10.1001/jamanetworkopen.2019.14378.
36. Naidoo S, Wand H, Abbai NS, and Ramjee G. High prevalence and incidence of sexually transmitted infections among women living in Kwazulu-Natal, South Africa. AIDS Research and Therapy 2014; 11(1): 31–31. https://doi.org/10.1186%2F1742-6405-11-31.
37. Nel A, Mabude Z, Smit J, Kotze P, Arbuckle D, Wu J, van Niekerk N, and van de Wijgert J. HIV incidence remains high in KwaZulu-Natal, South Africa: evidence from three districts. Plos One 2012; 7(4): e35278. https://doi.org.10.1371/journal.pone.0035278.
38. University of California, San Francisco. Report of the South Africa men-who-have-sex with-men Data Triangulation Project. San Francisco: UCSF. Global Health Sciences. 2015, https://globalhealthsciences.ucsf.edu/sites/globalhealthsciences.ucsf.edu/files/pub/msm-triangulation-south-africa.pdf (2015, accessed 19 April 2023).
39. Cloete A, Simbayi LC, Rehle T, Jooste S, Mabaso M, Townsend L, Ntsepe Y, LouwJ, Naidoo D, Duda T, Naidoo P and the Marang Men's Project Team. The South African Marang Men's Project: HIV bio-behavioural surveys using respondent-driven sampling conducted among men who have sex with men in Cape Town, Durban and Johannesburg. Cape Town: HSRC Press [Internet]. 2014, https://www.researchgate.net/publication/268729646_The_South_African_Marang_Men%27s_Project_HIV_biobehavioural_surveys_conducted_among_men_who_have_sex_with_men_in_Cape_Town_Durban_and_Johannesburg_using_respondent-driven_sampling (2014, accessed 19 April 2023).
40. Rispel LC, Metcalf CA, Cloete A, Reddy V, and Lombard C. HIV prevalence and risk practices among men who have sex with men in two South African cities. J Acquir Immune Defic Syndr 2011; 57(1): 69-76. https://doi.org.10.1097/QAI.0b013e318211b40a.
41. Mashingaidze R, Moodie Z, Allen M, Bekker L-G, Grove D, Grunenberg N, Huang Y, Janes HE, Lazarus EM, Malahleha M, Nchabeleng M and Laher F. Sexually transmitted infections amongst men who have sex with men (MSM) in South Africa. PLOS Glob Public Health 2023; 3(4): e0001782. https://doi.org/10.1371/journal.pgph.0001782.
42. Jones J, Sanchez TH, Dominguez K, Bekker L-G, Phaswana-Mafuya N, Baral SD, McNaghten AD, Kgatitswe L, Valencia R, Yah CS, Zahn R, Siegler AJ and Sullivan PS. Sexually transmitted infection screening, prevalence and incidence among South African men and transgender women who have sex with men enrolled in a combination HIV prevention cohort study: the Sibanye Methods for Prevention Packages Programme (MP3) project. J Int AIDS Soc 2020; 23(S6): e25594. https://doi.org/10.1002/jia2.25594.
43. Rebe K, Lewis D, Myer L, de Swardt G, Struthers H, Kamkuemah M and 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. https://doi:10.1371/journal.pone.0138315.
44. Hançali A, Bellaji B, Jennane S, Soraa N, Bennani A, Ghargui L, Rhilani H, Alami K and Rhajaoui M. P539 Prevalence of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* among MSM in Morocco. Sex Transm Infect 2019; 95: A244. https://doi.org/10.1136/sextrans-2019-sti.614.

45. Ross MW, Nyoni J, Ahaneku HO, Mbwambo J, McClelland RS, and McCurdy SA. High HIV seroprevalence, rectal STIs and risky sexual behaviour in men who have sex with men in Dar es Salaam and Tanga, Tanzania. BMJ Open 2014; 4(8): e006175. https://doi.org/10.1136/bmjopen-2014-006175.
46. Wong HTH, Wong KH, Lee SS, Leung RWM, and Lee KCK. Community-based surveys for determining the prevalence of HIV, Chlamydia, and Gonorrhoea in men having sex with men in Hong Kong. J Sex Transm Dis 2013; 958967: 1-8. https://doi.org/10.1155/2013/958967.
47. Mimiaga MJ, Helms DJ, Reisner SL, Grasso C, Bertrand T, Mosure DJ, Weinstock H, McLean C and Mayer KH. Gonococcal, chlamydia, and syphilis infection positivity among MSM attending a large primary care clinic, Boston, 2003 to 2004. Sex Transm Dis 2009; 36(8): 507–511. https://doi.org/10.1097/olq.0b013e3181a2ad98.
48. Sanders EJ, Thiong'o AN, Okuku HS, Mwambi J, Priddy F, Shafi J, de Vries H, McClelland RS and Graham SM. High prevalence of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infections among HIV-1 negative men who have sex with men in coastal Kenya. Sex Transm Infect 2010; 86: 440–1. https://doi.org/10.1136/sti.2010.043224.
49. Tongtoyai J, Todd CS, Chonwattana W, Pattanasin S, Chaikummao S, Varangrat A, Lokpichart S, Holtz TH, van Griensven F, and 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. https://doi.org/10.1097/olq.0000000000000311.
50. Yang LG, Zhang XH, Zhao PZ, Chen ZY, Ke WJ, Ren XQ Wang LY, Chen WY and Tucker JD. Gonorrhea and chlamydia prevalence in different anatomical sites among men who have sex with men: a cross-sectional study in Guangzhou, China. BMC Infect Dis 2018; 18: 675. https://doi.org/10.1186/s12879-018-3579-6.
51. Adamson PC, Bhatia R, Tran KDC, Bui HTM, Vu D, Shiraishi RW and Giang LM. Prevalence, anatomic distribution, and correlates of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infections among a cohort of men who have sex with men in Hanoi, Vietnam. Sex Transm Dis 2022; 49: 504–10. https://doi.org/10.1097/OLQ.0000000000001626.
52. Benn PD, Rooney G and Carderetal, C. *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infection and the sexual behaviour of men who have sex with men. Sex Transm Infect 2007; 83(2): 106–112. https://doi.org/10.1136%2Fsti.2006.021329.
53. Jansen K, Steffen G, Potthoff A, Schuppe AK, Beer D, Jessen H, Scholten S, Spornraft-Ragaller P, Bremer V, Tiemann C and MSM Screening Study group. STI in times of PrEP: high prevalence of chlamydia, gonorrhoea, and mycoplasma at different anatomic sites in men who have sex with men in Germany. BMC Infect Dis 2020; 20: 110. https://doi.org/10.1186/s12879-020-4831-4.
54. Mwaniki SW, Kaberia PM, Mugo PM and Palanee-Phillips T. Prevalence of five curable sexually transmitted infections and associated risk factors among tertiary student men who have sex with men in Nairobi, Kenya: a respondent-driven sampling survey. Sex Health 2023; 20(2): 105-117. https://doi.org/10.1071/sh22114.
55. Dewart CM, Bernstein KT, DeGroote NP, Romaguera R and Turner AN. Prevalence of rectal chlamydial and gonococcal infections: a systematic review. Sex Transm Dis 2018; 45(5): 287–93. https://doi.org/10.1097/OLQ.0000000000000754.
56. Kularatne RS, Niit R, Rowley J, Kufa-Chakezha T, Peters RPH, Taylor MM, Johnson LF, and Korenromp EL. Adult gonorrhea, chlamydia and syphilis prevalence, incidence, treatment and syndromic case reporting in South Africa: Estimates using the Spectrum-STI model, 1990–2017. PLoS ONE 2018; 13(10): e0205863. https://doi.org/10.1371/journal.pone.0205863.
57. Debattista J, Clementson C, Mason D, Dwyer J, Argent S, Woodward C, Dean J, Buks L, Copley M, Hinwood G, Benfield C and Walton P. Screening for *Neisseria gonorrhoeae* and *Chlamydia trachomatis* at entertainment venues among men who have sex with men. Sex Transm Dis 2002; 29(4): 216–221. https://doi.org/10.1097/00007435-200204000-00006.
58. Lister NA, Smith A, Tabrizi S, Hayes P, Medland NA, Garland S and Fairley CK. Screening for *Neisseria gonorrhoeae* and *Chlamydia trachomatis* in men who have sex with men at male-only saunas. Sex Transm Dis 2003; 30(12): 886–889. https://doi.org/10.1097/01.olq.0000099160.26205.22.
59. Aitlhaj-Mhand R, Bellaji B, Jennane S, Remz C, Charof R, Khoudri I, Kettani A, El Rhilani H, Alami K, Ghargui L, Youbi M, Abdelmoumen H, Hançali A and Oumzil H. Assessment of *Chlamydia trachomatis, Neisseria gonorrhoeae* and *Trichomonas vaginalis* prevalence using a molecular Point of Care: Findings from a respondent driven sampling study among MSM. Infez Med 2023; 31(2): 234-242. https://doi.org/10.53854/liim-3102-12.
60. Chow EPF, Jing J, Feng Y, Min D, Zhang J, Wilson DP, Zhang X and Zhang L. Pattern of HIV testing and multiple sexual partnerships among men who have sex with men in China. BMC Infect Dis 2013; 13: 549. https://doi.org/10.1186/1471-2334-13-549.
61. Chow EPF, Camilleri S, Ward C, Huffam S, Chen MY, Bradshaw CS and Fairley CK. Duration of gonorrhoea and chlamydia infection at the pharynx and rectum among men who have sex with men: a systematic review. Sex Health 2016; 13(3): 199–204. https://doi.org/10.1071/SH15175.
62. Calas A, Zemali N, Camuset G, Jaubert J, Manaquin R, Saint-Pastou C, Koumar Y, Poubeau P, Gerardin P and Bertolotti A. Prevalence of urogenital, anal, and pharyngeal infections with *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, and *Mycoplasma genitalium*: a cross-sectional study in Reunion island. BMC Infect Dis. 2021; 21: 95. https://doi.org/10.1186/s12879-021-05801-9.
63. Budkaew J, Chumworathayi B, Pientong C and Ekalaksananan T. Prevalence and factors associated with gonorrhoea infection with respect to anatomic

distributions among men who have sex with men. PLoS ONE 2019; 14(4): e0211682. https://doi.org/10.1371/journal.pone.0211682.
64. Shafer MA, Boyer CB, Shaffer RA, Schachter J, Ito SI and Brodine SK. Correlates of sexually transmitted diseases in a young male deployed military population. Mil Med 2002; 167: 496–500. https://doi.org/10.1093/milmed/167.6.496.
65. Galvin SR and Cohen MS. The role of sexually transmitted diseases in HIV transmission. Nat Rev Microbiol 2004; 2: 33-42. https://doi.org/10.1038/nrmicro794.
66. Berman SM and Cohen MS. STD treatment: how can it improve HIV prevention in the South? Sex Transm Dis 2006; 33: S50-7. https://doi.org/10.1097/01.olq.0000175395.95911.85.
67. Cheung KT, Fairley CK, Read TR, Denham I, Fehler G, Bradshaw CS, Chen MY and Chow EP. HIV incidence and predictors of incident HIV among men who have sex with men attending a sexual health clinic in Melbourne, Australia. PLoS One 2016; 11: e0156160. https://doi.org/10.1371/journal.pone.0156160.
68. Pathela P, Braunstein SL, Blank S, Shepard C and Schillinger JA. The high risk of an HIV diagnosis following a diagnosis of syphilis: a population-level analysis of New York City men. Clin Infect Dis 2015; 61: 281–7. https://doi.org/10.1093/cid/civ289.
69. Katz DA, Dombrowski JC, Bell TR, Kerani RP and Golden MR. HIV incidence among men who have sex with men after diagnosis with sexually transmitted infections. Sex Transm Dis 2016; 43:249–54. https://doi.org/10.1097/olq.0000000000000423.
70. Harney BL, Agius PA, El-Hayek C, Fairley CK, Chow EPF, Roth N, Tee BK, Leslie D, Tachedjian G, Hellard M and Stoové M. Risk of subsequent HIV infection following sexually transmissible infections among men who have sex with men. Open Forum Infect Dis 2019; 6(10): ofz376. https://doi.org/10.1093/ofid/ofz376.
71. Ghebremichael M and Paintsil E. High risk behaviours and sexually transmitted infections among men in Tanzania. AIDS Behav 2011; 15(5): 1026–32. https://doi.org/10.1007/s10461-009-9594-2.
72. Savage EJ, Marsh K, Duffell S, Ison CA, Zaman A and Hughes G. Rapid increase in gonorrhoea and syphilis diagnoses in England in 2011. Euro Surveill 2012; 17(29) :pii=20224. https://doi.org/10.2807/ese.17.29.20224-en.
73. Castillo R, Konda KA, Leon SR, Silva-Santisteban A, Salazar X, Klausner JD, Coates TJ, and Cáceres CF. HIV and sexually transmitted infection incidence and associated risk factors among high-risk MSM and male-to-female transgender women in Lima, Peru. J Acquir Immune Defic Syndr 2015; 69: 567–575. https://doi.org/10.1097/qai.0000000000000667.
74. Dudareva-Vizule S, Haar K, Sailer A, Wisplinghoff H, Wisplinghoff F and Marcus U. 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: 46–51. https://doi.org/10.1136/sextrans-2012-050929.
75. Jones MLJ, Chapin-Bardales J, Bizune D, Papp JR, Phillips C, Kirkcaldy RD, Wejnert C, Bernstein KT, and National HIV behavioural surveillance sexually transmitted infection study group. Extragenital chlamydia and gonorrhoea among community venue–attending men who have sex with men, five cities, united states, 2017. MMWR Morb Mortal Wkly Rep 2019; 68(14): 321–325. https://doi.org/10.15585/mmwr.mm6814a1.
76. Dutt K, Chow Eric PF, Haffam S, Klassen K, Fairley CK, Bradshaw CS, Denham I and Chen MY. High prevalence of rectal gonorrhoea among men reporting contact with men with gonorrhoea: Implications for epidemiological treatment. BMC Public Health 2015; 15: 658. https://doi.org/10.1186/s12889-015-1971-3.
77. Dallabetta G, Wi TEC, and Nielsen G. Prevention and control of STD and HIV infection in developing countries. In: Holmes KK, Sparling PF, Stamm WE, Piot P, Wasserheit JN, Corey L, Cohen M, and Watts H (eds.). Sexually transmitted diseases 4th edn. New York, NY: McGraw-Hill; 2008.
78. Esser S, Krotzek J, Dirks H, Scherbaum N and Schadendorf D. Sexual risk behaviour, sexually transmitted infections, and HIV transmission risks in HIV-positive men who have sex with men (MSM)—approaches for medical prevention. J Dtsch Dermatol Ges 2017; 15(4): 421–428. https://doi.org/10.1111/ddg.13217.
79. Corsenac P, Noël M, Rouchon B, Hoy D and Roth A. Prevalence and sociodemographic risk factors of chlamydia, gonorrhoea and syphilis: a national multicentre STI survey in New Caledonia, 2012. BMJ Open 2015; 5: e007691. https://doi.org/10.1136/bmjopen-2015-007691.
80. Slurink IA, Götz HM, van Aar F and van Benthem BH. Educational level and risk of sexually transmitted infections among clients of Dutch sexual health centres. Int J STD AIDS 2021; 32(11): 1004-1013. https://doi.org/10.1177/09564624211013670.
81. Centers for Disease Control and Prevention (CDC). Gonorrhea–CDC Fact Sheet [Internet]. 2023, https://www.cdc.gov/std/gonorrhea/stdfact-gonorrhea.htm (2023, accessed 29 August 2023).
82. Duby Z, Nkosi B, Scheibe A, Brown B and Bekker L-G. Scared of going to the clinic: contextualising healthcare access for men who have sex with men, female sex workers and people who use drugs in two South African cities. S Afr J HIV Med 2018; 19(1): a701. https://doi.org/10.4102/sajhivmed.v19i1.701.
83. van Liere GA, Hoebe CJ and Dukers-Muijrers NH. Evaluation of the anatomical site distribution of chlamydia and gonorrhoea in men who have sex with men and in high-risk women by routine testing: cross-sectional study revealing missed opportunities for treatment strategies. Sex Transm Infect 2013; 90: 58–60. https://doi.org/10.1136/sextrans-2013-051248.
84. van Liere GA, Hoebe CJ, Niekamp AM, Koedijk FD and Dukers-Muijrers NH. Standard symptom- and sexual history-based testing misses anorectal *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infections in swingers and men who have sex with men. Sex

Transm Dis 2013; 40: 285–289. https://doi.org.10.1097/OLQ.0b013e31828098f8.
85. van Liere GA, Hoebe CJ, Wolffs PF and Dukers-Muijrers NH. High co-occurrence of anorectal chlamydia with urogenital chlamydia in women visiting an STI clinic revealed by routine universal testing in an observational study; a recommendation towards a better anorectal chlamydia control in women. BMC Infect Dis 2014; 14: 274. https://doi.org/10.1186/1471-2334-14-274.
86. Edwards S and Carne C. Oral sex and transmission of non-viral STIs. Sex Transm Infect 1998; 74: 95–100. https://doi.org/10.1136/sti.74.2.95.
87. Prestage G, Down I, Grulich A and Zablotska I. Sex partying among gay men in Sydney, Melbourne and Brisbane, Australia. AIDS Behav 2011; 15(2): 298–304. https://doi.org/10.1007/s10461-010-9824-7.
88. Goedel WC and Duncan DT. Correlates of engagement in group sex events among men who have sex with men in London who use geosocial- networking smartphone applications. Int J STD AIDS 2018; 29(3): 244–50. https://doi.org/10.1177/0956462417722478.
89. Phillips G, Magnus M, Kuo I, Rawls A, Peterson J, West-Ojo T, Jia Y, Opoku J and Greenberg AE. Correlates of group sex among a community-based sample of men who have sex with men (MSM) in Washington, DC. AIDS Behav 2014; 18: 1413–9. https://doi.org/10.1007/s10461-013-0527-8.
90. Mimiaga MJ, Reisner SL, Bland SE, Driscoll MA, Cranston K, Isenberg D, Van Derwarker R and Mayer KH. Sex parties among urban MSM: an emerging culture and HIV risk environment. AIDS Behav 2011; 15(2): 305–18. https://doi.org/10.1007/s10461-010-9809-6.
91. Prestage GP, Hudson J, Jin F, Corrigan N, Martin P, Grulich AE and McInnes D. Testing for HIV and sexually transmissible infections within a mainly online sample of gay men who engage in group sex. Sex Transm Infect 2009; 85: 70–74. https://doi.org/10.1136/sti.2008.031120.
92. Mimiaga MJ, Reisner SL, Bland S, Cranston K, Isenberg D, Driscoll MA, VanDerwarker R and Mayer KH. It's a quick way to get what you want: a formative exploration of HIV risk among urban Massachusetts men who have sex with men who attend sex parties. AIDS Patient Care *STDS* 2010; 24: 659–674. https://doi.org/10.1089/apc.2010.0071.
93. Rosenberger JG, Reece M, Schick V, Herbenick D, Novak DS, Van Der Pol B and Fortenberry JD. Sexual behaviours and situational characteristics of most recent male-partnered sexual event among gay and bisexually identified men in the United States. J Sex Med 2011; 8: 3040–3050. https://doi.org/10.1111/j.1743-6109.2011.02438.x.
94. Grov C, Rendina HJ, Ventuneac A and Parsons JT. HIV risk in group sexual encounters: an event-level analysis from a national online survey of MSM in the U.S. J Sex Med 2013; 10(9): 2285–94. https://doi.org/10.1111/jsm.12227.
95. Friedman SR, Bolyard M, Khan M, Maslow C, Sandoval M, Mateu-Gelabert P, Krauss B and Aral SO. Group sex events and HIV/STI risk in an urban network. J Acquir Immune Defic Syndr 2008; 49(4): 440–6. https://doi.org/10.1097/QAI.0b013e3181893f31.
96. Rice CE, Lynch CD, Norris AH, Davis JA, Fields KS, Ervin M and Turner AN. Group sex and prevalent sexually transmitted infections among men who have sex with men. Arch Sex Behav 2016; 45(6): 1411–9. https://doi.org/10.1007/s10508-015-0554-9.
97. van den Boom W, Davidovich U, Heuker J, Lambers F, Prins M, Sandfort T and Stolte IG. Is group sex a higher-risk setting for HIV and other sexually transmitted infections compared with dyadic sex among men who have sex with men? Sex Transm Dis 2016; 43(2): 99–104. https://doi.org/10.1097/OLQ.0000000000000389.
98. Scheidell JD, Friedman SR, Golin C, Wohl DA and Khan MR. Group sex event participation: a link to STI risk among African-American heterosexual men incarcerated in North Carolina. Sex Transm Infect 2017; 93(2): 144. https://doi.org/10.1136/sextrans-2016-052980.
99. Abara WE, Oraka E, Jeffries WL, Chavez P, Nasrullah M, and DiNenno E. Prevalence and correlates of condom use among sexually active men who have sex with men in the United States: findings from the National Survey of Family Growth, 2002, 2006–10 and 2011–13. Sex Health 2017; 14: 363-371. https://doi.org/10.1071/sh16034.
100. Adam BD, Husbands W, Murray J and Maxwell J. AIDS optimism, condom fatigue, or self-esteem? Explaining unsafe sex among gay and bisexual men. J Sex Res 2005; 42: 238–48. https://doi.org/10.1080/00224490509552278.
101. Mansergh G, Naorat S, Jommaroeng R, Jenkins RA, Stall R, Jeeyapant S, Phanuphak P, Tappero JW and van Griensven F. Inconsistent condom use with steady and casual partners and associated factors among sexually-active men who have sex with men in Bangkok, Thailand. AIDS Behav 2006; 10: 743–51. https://doi.org/10.1007/s10461-006-9108-4.
102. Lee W, Daniel RN, Harland DA, Mary LK, John MD, Malotte CK, Jonathan MZ, Judy R, Gail B, Martin F, David GK, Maurizio M and Thomas AP. Condom effectiveness for reducing transmission of gonorrhoea and chlamydia: the importance of assessing partner infection status. Am J Epidemiol 2004; 159: 242–25. https://doi.org/10.1093/aje/kwh044.
103. Werber D, Michaelis K, Hausner M, Sissolak D, Wenzel J, Bitzegeio J, Belting A, Sagebiel D and Faber M. Ongoing out-breaks of hepatitis A among men who have sex with men (MSM), Berlin, November 2016 to January 2017—linked to other German cities and European countries. Euro Surveill 2017; 22(5): 30457. https://doi.org/10.2807/1560-7917.es.2017.22.5.30457.
104. Mehta KS, Marfatia YS, Jain AP, Shah DJ and Baxi DS. Male circumcision and Sexually transmitted infections – An update. Indian J Sex Transm Dis AIDS 2021; 42(1) :1-6. https://doi.org/10.4103/ijstd.ijstd_20_21.
105. Bailey RC, Moses S, Parker CB, Agot K, Maclean I, Krieger JN, Williams CF, Campbell RT, and Ndinya-

Achola JO. Male circumcision for HIV prevention in young men in Kisumu, Kenya: a randomised controlled trial. Lancet 2007; 369(9562): 643-56. https://doi.org/10.1016/s0140-6736(07)60312-2.

106. Gray RH, Kigozi G, Serwadda D, Makumbi F, Watya S, Nalugoda F, Kiwanuka N, Moulton LH, Chaudhary MA, Chen MZ and Sewankambo NK. Male circumcision for HIV prevention in men in Rakai, Uganda: a randomised trial. Lancet 2007; 369(9562): 657-66. https://doi.org/10.1016/s0140-6736(07)60313-4.
107. Sobngwi-Tambekou J, Taljaard D, Nieuwoudt M, Lissouba P, Puren A and Auvert B. Male circumcision and *Neisseria gonorrhoeae*, *Chlamydia trachomatis* and *Trichomonas vaginalis*: observations after a randomised controlled trial for HIV prevention. Sex Transm Infect 2009; 85(2): 116-20. https://doi.org/10.1136/sti.2008.032334.
108. Yuan T, Fitzpatrick T, Ko N-Y, Cai Y, Chen Y, Zhao J, Li L, Xu J, Gu J, Li J, Hao C, Yang Z, Cai W, Cheng CY, Luo Z, Zhang K, Wu G, Meng X, Grulich, AE, Hao Y and Zou H. Circumcision to prevent HIV and other sexually transmitted infections in men who have sex with men: a systematic review and meta-analysis of global data. Lancet Glob Health 2019; 7(4): e436-e447. https://doi.org/10.1016/s2214-109x(18)30567-9.
109. Sharma SC, Raison N, Khan S, Shabbir M, Dasgupta P and Ahmed K. Male circumcision for the prevention of human immunodeficiency virus (HIV) acquisition: a meta-analysis. BJU Int 2018; 121(4): 515-526. https://doi.org/10.1111/bju.14102.
110. Iyemosolo, BM, Chivese T and Esterhuizen, TM. A comparison of the prevalence of sexually transmitted infections among circumcised and uncircumcised adult males in Rustenburg, South Africa: a cross-sectional study. BMC Public Health 2021; 21: 656. https://doi.org/10.1186/s12889-021-10509-1.
111. Diseker RA 3rd, Peterman TA, Kamb ML, Kent C, Zenilman JM, Douglas JM Jr, Rhodes F and Iatesta M. Circumcision and STD in the United States: cross sectional and cohort analyses. Sex Transm Infect 2000; 76: 474-9. https://doi.org/10.1136/sti.76.6.474.
112. WHO/UNAIDS Technical consultation on male circumcision and HIV prevention: Research implications for policy and programming Montreux, 6-8 March 2007 [Internet]. 2007, https://apps.who.int/iris/handle/10665/43751 (2007, accessed 17 August 2023).
113. Jin F, Prestage GP, Mao L, Kippax SC, Pell CM, Donovan B, Cunningham PH, Templeton DJ, Kaldor JM and Grulich AE. Incidence and risk factors for urethral and anal gonorrhoea and chlamydia in a cohort of HIV-negative homosexual men: the health in men study. Sex Transm Infect 2007; 83: 113–119. https://doi.org/10.1136/sti.2006.021915.
114. van Liere GAFS, van Rooijen MS, Hoebe CJPA, Heijman T, de Vries HJC and Dukers-Muijrers NHTM. Prevalence of and factors associated with rectal-only chlamydia and gonorrhoea in women and in men who have sex with men. PLoS ONE 2015; 10(10): e0140297. https://doi.org/10.1371/journal.pone.0140297.
115. Allan-Blitz LT, Leon SR, Bristow CC, Konda KA, Vargas SK, Flores JA, Brown BJ, Caceres CF and Klausner JD. High prevalence of extra-genital chlamydial or gonococcal infections among men who have sex with men and transgender women in Lima, Peru. Int J STD AIDS 2017; 28(2): 138-144. https://doi.org/10.1177/0956462416630909.
116. Cunha CB, Friedman RK, de Boni RB, Gaydos C, Guimarães MR, Siqueira BH, Cardoso SW, Chicayban L, Coutinho JR, Yanavich C, Veloso VG and Grinsztejn B. *Chlamydia trachomatis*, *Neisseria gonorrhoeae* and syphilis among men who have sex with men in Brazil. BMC Public Health 2015; 15: 686. https://doi.org/10.1186/s12889-015-2002-0.
117. Ananworanich J, Chitwarakorn A, Wimonsate W, Varangrat A, Chaikummao S, Sriporn A, Tongtoyai J, Mock P, Sukwicha W, Chonwattana W, Luechai P, Curlin M, McNicholl J, Holtz T and van Griensven F. HIV and syphilis infection among men who have sex with men - Bangkok, Thailand, 2005–2011. MMWR Morb Mortal Wkly Rep 2013; 62: 518–20. PMCID: PMC4604950.
118. Ruchika K, Walter PK, Timona O, William S and Gunturu R. Prevalence of genital chlamydia infection in urban women of reproductive age, Nairobi, Kenya. BMC Res Notes 2013; 6: 44. https://doi.org/10.1186/1756-0500-6-44.
119. Machouf N, Thomas R, O'Brien R, Vezina S, Longpre D, Legault D, Milne M, Fafard J and Trottier B. P1-S2.52 Risk factors for STIs among MSM attending a sexually transmitted disease clinic in Montreal, Canada. Sex Trans Infect 2011; 87: A144. http://dx.doi.org/10.1136/sextrans-2011-050108.109.
120. Gravett RM, Westfall AO, Overton ET, Kudroff K, Muzny CA and Eaton EF. Sexually transmitted infections and sexual behaviours of men who have sex with men in an American Deep South PrEP clinic. Int J STD AIDS 2020; 31(2): 127–135. https://doi.org/10.1177/0956462419886228.
121. Lea T, Anning M, Wagner S, Owen L, Howes F and Holt M. Barriers to accessing HIV and sexual health services among gay men in Tasmania, Australia, J Gay Lesbian Soc Serv 2019; 31: 153-165. https://doi.org/10.1080/10538720.2019.1567427.
122. Rispel LC, Metcalf CA, Cloete A, Moorman J and Reddy V. You become afraid to tell them that you are gay: health service utilization by men who have sex with men in South African cities. J Public Health Policy 2011; 32(Suppl 1): S137–S151. https://doi.org/10.1057/jphp.2011.29.
123. Lane T, Mogale T, Struthers H, McIntyre J and Kegeles SM. They see you as a different thing: the experiences of men who have sex with men with healthcare workers in South African township communities. Sex Transm Infect 2008; 84(6): 430–433. https://doi.org/10.1136/sti.2008.031567.
124. Ayala G. HIV treatment cascades that leak: correlates of drop-off from the HIV care continuum among men who have with men worldwide. J AIDS Clin Res

2014; 5: 2. https://doi.org/10.4172/2155-6113.1000331.

125. Trang K, Ly AT, Lam LX, Brown CA, To MQ, Sullivan PS, Worthman CM, Giang LM and Jovanovic T. Mental health in HIV prevention and care: a qualitative study of challenges and facilitators to integration in Vietnam. Soc Sci Med 2021; 279: 113978. https://doi.org/10.1016/j.socscimed.2021.113978.
126. Batist E, Brown B, Scheibe A, Baral SD and Bekker LG. Outcomes of a community-based HIV-prevention pilot programme for township men who have sex with men in Cape Town, South Africa. J Int AIDS Soc 2013; 16(Suppl 3): 18754. https://doi.org/10.7448/ias.16.4.18754.
127. Delany-Moretlwe S, Cowan FM, Busza J, Bolton-Moore C, Kelley K and Fairlie L. Providing comprehensive health services for young key populations: needs, barriers and gaps. J Int AIDS Soc 2015; 18(2 Suppl 1): 19833. https://doi.org/10.7448/IAS.18.2.19833.
128. Wanyenze RK, Musinguzi G, Matovu JK, Kiguli J, Nuwaha F, Mujisha G, Musinguzi J, Arinaitwe J and Wagner GJ. "If you tell people that you had sex with a fellow man, it is hard to be helped and treated": barriers and opportunities for increasing access to HIV services among men who have sex with men in Uganda. PLoS One 2016; 11(1): e0147714. https://doi.org/10.1371/journal.pone.0147714.

Fay H, Baral SD, Trapence G, Motimedi F, Umar E, Iipinge S, Dausab F, Wirtz A and Beyrer C. Stigma, health care access, and HIV knowledge among men who have sex with men in Malawi, Namibia, and Botswana. AIDS Behav 2011; 15(6): 1088-97. https://doi.org/10.1007/s10461-010-9861-2.