MSM

Chlamydia trachomatis and *Neisseria gonorrhoeae* infection and the sexual behaviour of men who have sex with men

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Background : Rates of bacterial sexually transmitted infections (STIs) continue to rise among men who have sex with men (MSM) in the UK.

Objective: To evaluate factors associated with *Chlamydia trachomatis* and *Neisseria gonorrhoeae* among MSM attending a genitourinary medicine clinic in inner London.

Study design : 599 MSM undergoing testing for STIs were recruited. Specimens for ligase chain reaction (LCR), strand displacement amplification (SDA) assay and culture were collected from the pharynx, urethra and rectum for the detection of *C trachomatis* and *N gonorrhoeae*. Details regarding demographics, symptoms, signs and sexual behaviour were recorded. Associations of these factors with each infection were tested, adjusting for other risk factors.

Results: The prevalence of *C trachomatis* and *N gonorrhoeae* was 11.0% and 16.0%, respectively. LCR and SDA performed well for the detection of *C trachomatis* and *N gonorrhoeae* from urethra and rectum. Using either method, compared with our current testing policy, over 18% of those with *C trachomatis* and *N gonorrhoeae* would not have had their infection diagnosed or treated. Age, sexual behaviour, urethral and rectal symptoms and signs were strongly associated with both infections. A total of 33.7% of men reported at least one episode of unprotected anal intercourse in the previous month. Men reporting multiple episodes were markedly more likely to be HIV positive.

Conclusion: The prevalence of infection, rates of partner acquisition and unprotected anal intercourse reported among these MSM are alarming. Improved detection of *C trachomatis* and *N gonorrhoeae* using nucleic acid amplification tests has major public health implications for STI and possibly HIV transmission in this population.

Recent studies suggest that there has been an increase in risky sex behaviours associated with the transmission of sexually transmitted infections (STIs) among the general population.¹ In men having sex with men (MSM) in the UK, there have been reports of increased high-risk sexual behaviour^{2–3} and a rise in the incidence of *Neisseria gonorrhoeae* and *Chlamydia trachomatis*.⁴ Furthermore, there have been marked increases in reported cases of infectious syphilis^{5–6} and lymphogranuloma venereum.⁷

Previous studies on MSM have shown prevalence rates of 1–4% and 4–7% for pharyngeal and rectal *C trachomatis*, respectively, using culture or direct immunofluorescence.^{8–14} Studies using nucleic acid amplification tests (NAATs) have shown improved detection of *C trachomatis* and *N gonorrhoeae* from pharyngeal and rectal specimens.^{15–19}

Little data are available regarding the association between sexual behaviours of MSM and the presence of either pharyngeal or rectal *C trachomatis* and *N gonorrhoeae*. Demonstration of factors associated with an increased prevalence of infections in pharyngeal, urethral and rectal sites may assist the development of testing recommendations in MSM. By improving the detection of these organisms and treating the infected people, the transmission of infections will be reduced, and consequently, the transmission of HIV.

AIMS

This study aimed to determine the association between the presence or absence of symptoms and signs, and to establish behavioural factors associated with an increased prevalence of *C trachomatis* and *N gonorrhoeae* at pharyngeal, urethral and rectal sites using NAATs in MSM.

METHODS

Study population characteristics

MSM aged ≥18 years attending for routine STI testing were eligible; exclusion criteria were declining to participate or receipt of any antibiotics in the previous 4 weeks. Patients completed a questionnaire on history of STIs, the number of male sexual partners in the preceding month, year and lifetime, and the number of protected and unprotected specific sexual practices undertaken with men in the previous month. Clinicians recorded presenting symptoms and signs (additional information is available at the website at <http://sti.bmj.com/supplemental>)

Microbiology

Samples from the pharynx, urethra and rectum (obtained at proctoscopy) were collected. Randomisation of specimens for each test was ensured by using pre-prepared sealed envelopes.

Urethral samples were subjected to LCR for *C trachomatis* and *N gonorrhoeae*, and microscopy and culture for *N gonorrhoeae*.

Pharyngeal and rectal samples

Culture specimens for *C trachomatis*, were stored in transport medium (2-sucrose phosphate) and inoculated into tissue culture using cycloheximide treated McCoy cells (in the first 270 patients only).

Microscopy (rectal only) and culture for *N gonorrhoeae* were carried out using Thayer Martin selective medium (Oxoid,

Abbreviations: LCR, ligase chain reaction; MSM, men who have sex with men; NAAT, nucleic acid amplification test; SDA, strand displacement amplification; STI, sexually transmitted infection

Basingstoke, Hampshire, UK) in 10% CO₂, incubated at 37°C for 48 h should be part of tests for pharynx and rectum.

LCR for *C trachomatis* and *N gonorrhoeae*

Discrepant results were further analysed by direct immunofluorescence (Syva MicroTrak, Behring, Cupertino, California, USA) performed on the sample for culture for *C trachomatis* (available in the first 270 patients only).

After an interim analysis showing poor performance of culture for *C trachomatis*, the protocol was amended after the first 270 patients were recruited. SDA was performed on pharyngeal and rectal samples for *C trachomatis* and *N gonorrhoeae*, retrospectively on the specimens for culture of *C trachomatis* in the first 270 patients and prospectively thereafter.

LCR and SDA tests were carried out according to the respective manufacturer's package insert instructions.

Interpretation of microbiological results

A result was considered to be positive if

- LCR was positive for *C trachomatis* or *N gonorrhoeae*ⁱ from urethral samples
 - Positive culture for either *C trachomatis* or *N gonorrhoeae* was obtained from any site
- or
- Two or more tests were positive for the same organism from the same site by different testing methods.

Sample size

Assuming a 2.5% prevalence of urethral *C trachomatis* infection, a sample size of 600 allows a 95% confidence interval (CI) of mean (standard deviation (SD)) width 2.5% (1.25%). Assuming that the prevalence of pharyngeal and rectal *C trachomatis* and the prevalence of *N gonorrhoeae* are similar, this study estimates the prevalence of both infections at these sites with similar accuracy. CIs were calculated using STATA V.7.0.

Statistical methods

Unadjusted odds ratios (ORs) and 95% CIs were used to examine the association between factors and a current diagnosis of either infection. Age and the behavioural factors are ordinal, relating to numbers of sexual episodes or partners, and the associations between these factors and infection were tested using the Mann–Whitney U test. Logistic regression was used to examine and test for the simultaneous associations of multiple risk factors with infection. For these ordinal factors, the primary test for association with infection is a test for a trend, obtained by fitting a linear term in the regression model. Although the p values quoted relate to these tests for trend, ORs for categories of these factors are presented for ease of interpretation. When obtaining a test for trend for the highly skewed behavioural factors, the log of the factor was used as the linear term in the model. All analyses were performed using STATA V.7.

RESULTS

In all, 613 MSM were recruited in a 25-month period between August 1999 and September 2001. Of these, 14 were excluded from the analysis because samples were unavailable from every site.

ⁱLCR for urethral *C trachomatis* or *N gonorrhoeae* has previously been validated,^{20 21} and for the purposes of this study the specificity and positive predictive value (PPV) are considered to be 100%.

Chlamydia trachomatis

We found an overall prevalence (resolved positive) of 11% (66/599) for *C trachomatis* (95% CI 8.6% to 13.8%), including 1% (6/599) of men having more than one site infected.

The prevalence at each site was

- pharyngeal: 1.2% (95% CI 0.5% to 2.4%);
- urethral: 4.3% (95% CI 2.9% to 6.3%); and
- rectal: 6.5% (95% CI 4.7% to 8.8%).

Neisseria gonorrhoeae

We found an overall prevalence (resolved positive) of 16% (96/599) for *N gonorrhoeae* (95% CI 13.2% to 19.2%), with 4.8% (29/599) of men having more than one site infected.

The prevalence at each site was

- pharyngeal: 7.3% (95% CI 5.4% to 9.7%);
- urethral: 7.2% (95% CI 5.0% to 9.2%); and
- rectal: 7.3% (95% CI 5.4% to 9.7%).

In all, 21 men were coinfectd: 21.9% of all those with *N gonorrhoeae* and 31.8% of all those with *C trachomatis* (table 1; supplementary material available online at <http://sti.bmj.com/supplemental>).

Performance testing methodologies

The sensitivity and specificity of LCR for the detection of *C trachomatis* and *N gonorrhoeae* from the pharynx and rectum exceeded 95.5%. The sensitivity and specificity of SDA for the detection of *C trachomatis* and *N gonorrhoeae* from the pharynx and rectum exceeded 86.6%. The predictive value of a positive LCR from the pharynx for *C trachomatis* and *N gonorrhoeae* was 58.3% and 78.6%, respectively. The predictive value of a positive LCR from the rectum for *C trachomatis* and *N gonorrhoeae* was 83% and 89.4%, respectively. The predictive value of a positive SDA result from the pharynx for *C trachomatis* and *N gonorrhoeae* was 100% and 60.9%, respectively. The predictive value of a positive SDA result from the rectum for *C trachomatis* and *N gonorrhoeae* was 92.3% and 89.6%, respectively. We found no significant differences in the sensitivity of SDA to detect pharyngeal and rectal *C trachomatis* and *N gonorrhoeae* for samples tested prospectively compared with those tested retrospectively (Fisher's exact test; available as supplementary material at <http://sti.bmj.com/supplemental>). Culture was less sensitive when compared with LCR or SDA for the detection of *C trachomatis* and *N gonorrhoeae* from the pharynx (*N gonorrhoeae* only) and rectum (table 1).

Associations with *C trachomatis* and *N gonorrhoeae* infection

Associations between history of STIs, age, symptoms, signs and sexual behaviour with each infection were tested, adjusting for other risk factors.

Some parameters were missing from the questionnaires.

A high proportion of men reported having had previous STI (75.8%); 8.4% (50/599) reported themselves as being HIV positive. No significant association was found between ever having had any STI or previously having had *C trachomatis* or *N gonorrhoeae* and currently having either *C trachomatis* or *N gonorrhoeae*.

The mean (SD) age was 34.8 (8.4) years (range 18–71 years). We found no significant association between age and having *C trachomatis* at any site, although there was some evidence of declining prevalence of urethral *C trachomatis* with increasing age after adjusting for other risk factors (p = 0.09). A declining prevalence of *N gonorrhoeae* at rectal sites with older age was

Table 1 Sensitivity, specificity, positive and negative predictive value of culture, ligase chain reaction and strand displacement amplification compared with resolved positive tests to detect *Chlamydia trachomatis* and *Neisseria gonorrhoeae*

	Resolved positive			Sensitivity, n (%)	95% CI (%)	Specificity (%)	95% CI (%)	Sample PPV, n (%)	Sample NPV, n (%)
	+	–	Total						
<i>C trachomatis</i>									
Pharynx (prevalence 1.2%)*									
Culture†									
+	1	0	1	1/1 (100)	NA	NA	NA	NA	242/242 (100)
–	0	242	242						
Total	1	242	243						
LCR									
+	7	5	12	7/7 (100)	59.0 to 100	587/592 (99.2)	98.0 to 99.7	7/12 (58.3)	587/587 (100)
–	0	587	587						
Total	7	592	599						
SDA									
+	7	0	7	7/7 (100)	59.0 to 100	592/592 (100)	99.4 to 100	7/7 (100)	592/592 (100)
–	0	592	592						
Total	7	592	599						
Urethra (prevalence 4.3%, 26/599 using LCR)*									
Rectum (prevalence 6.5%)*									
Culture†									
+	3	0	3	3/11 (27.3)	6.0 to 61.0	NA	NA	NA	198/206 (96.1)
–	8	198	206						
Total	11	198	209						
LCR									
+	39	8	47	39/39 (100)	91.0 to 100	552/560 (98.6)	97.2 to 99.4	39/47 (83.0)	552/552 (100)
–	0	552	552						
Total	39	560	599						
SDA									
+	36	3	39	36/39 (92.3)	79.1 to 98.4	557/560 (99.5)	98.4 to 99.9	36/39 (92.3)	557/560 (99.5)
–	3	557	560						
Total	39	560	599						
<i>N gonorrhoeae</i>									
Pharynx (prevalence 7.3%)*									
Culture									
+	17	0	17	17/44 (38.6)	24.4 to 54.5	NA	NA	NA	555/582 (95.4)
–	27	555	582						
Total	44	555	599						
LCR									
+	44	12	56	44/44 (100)	92.0 to 100	543/555 (97.8)	96.3 to 98.9	44/56 (78.6)	543/543 (100)
–	0	543	543						
Total	44	555	599						
SDA									
+	39	25	64	39/44 (88.6)	75.4 to 96.2	530/555 (95.5)	93.4 to 97.1	39/64 (60.9)	530/535 (99.1)
–	5	530	535						
Total	44	555	599						
Urethra (prevalence 7.2%, 43/599 using LCR)*									
Culture‡									
+	39	0	39	39/43 (90.7)	77.9 to 97.4	NA	NA	NA	555/559 (99.3)
–	4	555	560						
Total	43	555	598						
Rectum (prevalence 7.3%)*									
Culture									
+	38	0	38	38/44 (86.4)	72.6 to 94.8	NA	NA	NA	555/561 (98.9)
–	6	555	561						
Total	44	555	599						
LCR									
+	42	5	47	42/44 (95.5)	84.5 to 99.4	550/555 (99.1)	97.9 to 99.7	42/47 (89.4)	550/552 (99.6)
–	2	550	552						
Total	44	555	599						
SDA									
+	43	5	48	43/44 (97.7)	88.0 to 99.9	550/555 (99.1)	97.9 to 99.7	43/48 (89.6)	550/551 (99.8)
–	1	550	551						
Total	44	555	599						

LCR, ligase chain reaction; NA, not applicable; NPV, negative predictive value; PPV, positive predictive value; SDA, strand displacement amplification.

*Prevalence is derived from number of positives according to the definition of a resolved positive test (pharynx and rectum). Prevalence of urethral *C trachomatis* and *N gonorrhoeae* is derived from number of positive LCR samples.

†Culture was performed on the first 270 samples only; 14 pharyngeal and 48 rectal samples were toxic to culture.

‡Performance of culture is compared with LCR.

In all, 21 of 96 (21.9%) people with *N gonorrhoeae* were coinfecting with *C trachomatis*.

Table 2 Associations of age, number of reported sexual partners and frequency of sexual practices in the preceding month, with a diagnosis of pharyngeal *Chlamydia trachomatis* and *Neisseria gonorrhoeae*

<i>C trachomatis</i>			<i>N gonorrhoeae</i>			
	n (%)	OR (95% CI), p Value	Adjusted OR (95% CI), p Value*†		OR (95% CI), p Value	Adjusted OR (95% CI), p Value*
Age (years)						
18–29	3/165 (1.8)	p=0.48 1		16/165 (9.7)	p=0.06 1	p=0.11 1
30–39	4/303 (1.3)	0.72 (0.16 to 3.27)	NA	18/303 (5.9)	0.59 (0.29 to 1.19)	0.61 (0.28 to 1.34)
40–80	0/131 (0)	N/A	N/A	10/131 (7.6)	0.77 (0.34 to 1.76)	0.80 (0.32 to 2.02)
Number of sexual partners in the previous month						
0–1	3/206 (1.5)	p=0.41 1		12/206 (5.8)	p=0.13 1	p=0.95 1
2–5	4/238 (1.7)	1.16 (0.26 to 5.23)	NA	17/238 (7.1)	1.24 (0.58 to 2.67)	0.92 (0.40 to 2.11)
>5	0/121 (0)	NA	NA	12/121 (9.9)	1.78 (0.77 to 4.10)	1.03 (0.41 to 2.61)
Number of sexual practices in the previous month						
Unprotected insertive oral intercourse						
0–2	1/165 (0.6)	p=0.33 1		3/165 (1.8)	p<0.001 1	p=0.005 1
3–9	0/179 (0)	NA	NA	12/179 (6.7)	3.88 (1.08 to 14.0)	3.90 (1.03 to 14.7)
>9	3/184 (1.6)	2.72 (0.28 to 26.4)	NA	24/184 (13.0)	8.10 (2.39 to 27.4)	8.18 (2.21 to 30.3)
Unprotected active oro-anal intercourse						
0	1/272 (0.4)	p=0.45 1		17/272 (6.3)	p=0.25 1	p=0.50 1
1–4	2/188 (1.1)	2.91 (0.26 to 32.4)	NA	14/188 (7.5)	1.21 (0.58 to 2.51)	0.94 (0.42 to 2.09)
>4	1/98 (1.0)	2.79 (0.17 to 45.1)	NA	10/98 (10.2)	1.70 (0.75 to 3.86)	0.85 (0.33 to 2.22)

NA, not available.

*Adjusted OR is adjusted for all other risk factors in this column.

†Adjusted OR not tested, as numbers of people with infection were too small.

found after adjustment for other risk factors ($p = 0.002$; tables 2–4).

A total of 92 of 593 (15.5%) men reported pharyngeal symptoms or signs. These were not predictive of pharyngeal infection (supplementary material available online at <http://www.stijournals.com/supplemental>). If pharyngeal testing was restricted to men with symptoms or signs, only 1 of 6 (16.7%)

and 8 of 44 (18.2%) of those with pharyngeal *C trachomatis* or *N gonorrhoeae*, respectively, would have been identified. In all, 36 of 501 (7.2%) men without pharyngeal symptoms or signs had pharyngeal *N gonorrhoeae* (table 1).

Urethral and rectal symptoms and urethral signs were strongly associated with having urethral or rectal *C trachomatis* or *N gonorrhoeae*. Only 8 of 402 (2.0%) and 3 of 402 (0.8%) men

Table 3 Associations of age, number of reported sexual partners and frequency of sexual practices in the preceding month, with a diagnosis of urethral *Chlamydia trachomatis* and *Neisseria gonorrhoeae*

<i>C trachomatis</i>			<i>N gonorrhoeae</i>			
	n (%)	OR (95% CI), p value	Adjusted OR (95% CI), p value*		OR (95% CI), p value	Adjusted OR (95% CI), p value*
Age (years)						
18–29	9/165 (5.5)	p=0.33 1	p=0.09 1	16/165 (9.7)	p=0.083 1	p=0.053 1
30–39	12/303 (4.0)	0.71 (0.29 to 1.73)	0.66 (0.27 to 1.64)	22/303 (7.3)	0.73 (0.37 to 1.43)	0.73 (0.33 to 1.62)
40–80	5/131 (3.8)	0.69 (0.22 to 2.10)	0.59 (0.19 to 1.85)	5/131 (3.8)	0.37 (0.13 to 1.04)	0.37 (0.11 to 1.21)
Number of sexual partners in the previous month						
0–1	7/206 (2.4)	p=0.74 1	p=0.74 1	11/206 (5.3)	p=0.19 1	p=0.29 1
2–5	15/238 (6.3)	1.91 (0.76 to 4.79)	1.69 (0.64 to 4.44)	19/238 (8.0)	1.54 (0.71 to 3.31)	1.44 (0.58 to 3.58)
>5	4/121 (3.3)	0.97 (0.28 to 3.39)	1.17 (0.31 to 4.45)	10/121 (8.3)	1.60 (0.66 to 3.88)	1.71 (0.62 to 4.79)
Number of sexual practices in the previous month						
Unprotected receptive oral intercourse						
0–2	6/148 (4.1)	p=0.46 1	p=0.61 1	3/148 (2.0)	p=0.03 1	p=0.058 1
3–9	16/184 (8.7)	2.25 (0.86 to 5.91)	1.90 (0.69 to 5.23)	15/184 (8.2)	4.29 (1.22 to 15.1)	3.02 (0.82 to 11.1)
>9	4/187 (2.1)	0.52 (0.14 to 1.87)	0.42 (0.10 to 1.71)	16/187 (8.6)	4.52 (1.29 to 15.8)	2.84 (0.75 to 10.8)
Unprotected insertive anal intercourse						
0	18/419 (4.3)	p=0.57 1	p=0.24 1	18/419 (4.3)	p=0.001 1	p=0.24 1
1–4	6/95 (6.3)	1.50 (0.58 to 3.89)	1.70 (0.64 to 4.55)	15/95 (15.8)	4.18 (2.02 to 8.63)	3.53 (1.60 to 7.83)
>4	2/47 (4.3)	0.99 (0.22 to 4.41)	1.68 (0.34 to 8.34)	4/47 (8.5)	2.07 (0.67 to 6.40)	1.78 (0.54 to 5.88)

*Adjusted OR is adjusted for all other risk factors in this column.

Table 4 Associations of age, number of reported sexual partners and frequency of sexual practices in the preceding month with a diagnosis of rectal *Chlamydia trachomatis* and *Neisseria gonorrhoeae*

	<i>C trachomatis</i>			<i>N gonorrhoeae</i>		
	n (%)	OR (95% CI), p value	Adjusted OR (95% CI), p value*	n (%)	OR (95% CI), p value	Adjusted OR (95% CI), p value*
Age (years)						
18–29	8/165 (4.9)	p=0.60 1	p=0.65 1	19/165 (11.5)	p=0.001 1	p=0.002 1
30–39	24/303 (7.9)	1.69 (0.74 to 3.85)	1.64 (0.66 to 4.06)	22/303 (7.3)	0.60 (0.32 to 1.15)	0.57 (0.27 to 1.19)
40–80	7/131 (5.3)	1.11 (0.39 to 3.14)	1.28 (0.42 to 3.88)	3/131 (2.3)	0.18 (0.05 to 0.62)	0.18 (0.05 to 0.64)
Number of sexual partners in the previous month:						
0–1	12/206 (5.8)	p=0.41 1	p=0.87 1	9/206 (4.4)	p=0.06 1	p=0.27 1
2–5	14/238 (5.9)	1.01 (0.46 to 2.24)	1.27 (0.52 to 3.07)	17/238 (7.1)	1.68 (0.73 to 3.86)	1.63 (0.66 to 4.02)
>5	11/121 (9.1)	1.62 (0.69 to 3.79)	1.57 (0.59 to 4.16)	15/121 (12.4)	3.10 (1.31 to 7.32)	3.37 (1.27 to 8.94)
Number of sexual practices in the previous month:						
Unprotected receptive anal intercourse						
0	20/420 (4.8)	p=0.003 1	p=0.03 1	21/420 (5.0)	p=0.002 1	p=0.12 1
1–4	12/97 (12.4)	2.82 (1.33 to 6.00)	2.71 (1.24 to 5.94)	14/97 (14.4)	3.20 (1.57 to 6.56)	2.67 (1.27 to 5.63)
>4	4/43 (9.3)	2.05 (0.67 to 6.30)	1.87 (0.56 to 6.19)	5/43 (11.6)	2.50 (0.89 to 7.01)	1.88 (0.56 to 6.28)
Unprotected receptive oro-anal intercourse						
0	8/237 (3.4)	p=0.03 1	p=0.26 1	8/237 (3.4)	p=0.02 1	p=0.65 1
1–4	18/210 (8.6)	2.68 (1.14 to 6.31)	2.28 (0.90 to 5.76)	21/210 (10.0)	3.18 (1.38 to 7.34)	2.21 (0.92 to 5.27)
>4	10/109 (9.2)	2.89 (1.11 to 7.54)	2.40 (0.81 to 7.11)	9/109 (8.3)	2.58 (0.97 to 6.87)	1.42 (0.48 to 4.19)

*Adjusted OR is adjusted for all other risk factors in this column.

without urethral symptoms or signs had urethral *C trachomatis* or *N gonorrhoeae*, respectively. Men reporting any urethral symptom (OR 5.40, 95% CI 2.30 to 12.7) or having any urethral sign (OR 8.30, 95% CI 3.69 to 18.7) were more likely to have urethral *C trachomatis* compared with asymptomatic men without any urethral symptoms or signs. This relationship was even stronger for *N gonorrhoeae*; urethral symptom: OR 36.2, 95% CI 11.0 to 119 and urethral sign: OR 79.5, 95% CI 29.8 to 212 (supplementary material).

Men reporting any rectal symptom, 42 of 594 (7.1%), were more likely to have rectal *C trachomatis* (OR 3.95, 95% CI 1.69 to 9.3) or *N gonorrhoeae* (OR 4.76, 95% CI 2.2 to 10.5). The prevalence of rectal *C trachomatis* or *N gonorrhoeae* was 29 of 541 (5.4%) and 33 of 541 (6.1%), respectively, among those without rectal symptoms or signs. In these men, after adjusting for other factors, those reporting 1–4 episodes of unprotected receptive anal intercourse compared with those reporting none were more likely to have rectal *C trachomatis* (OR 3.72, 95% CI 1.56 to 8.86) or *N gonorrhoeae* (OR 2.92, 95% CI 1.28 to 6.66).

Men recruited to this study were highly sexually active. In the preceding month, year and total lifetime, a median of 2, 10 and 80 male partners, respectively, were reported. After adjusting for other risk factors, there were no significant associations between the number of male partners reported and having either *C trachomatis* and *N gonorrhoeae* at any site (tables 2–4).

We found no significant association between those men reporting higher numbers of specific sexual practices in the preceding month and either pharyngeal or urethral *C trachomatis*. After adjustment for other factors, the number of episodes of unprotected receptive anal intercourse was significantly associated with rectal *C trachomatis* ($p = 0.03$). We found a significant association between men reporting higher numbers of specific sexual practices in the preceding month and having *N gonorrhoeae* at all three sites. After adjusting for other risk factors, we found a significant association between those men reporting more episodes of unprotected insertive oral sex and having pharyngeal *N gonorrhoeae* ($p = 0.005$; tables 2–4).

In all, 188 of 558 (33.7%) men reported at least one episode of unprotected anal intercourse in the previous month. HIV-positive men reported significantly more episodes of unprotected anal intercourse in the previous month compared with men of unknown or negative HIV status. Men reporting at least five episodes of unprotected receptive or insertive anal intercourse were more likely to be HIV positive; OR 7.34 (95% CI 3.30 to 16.3, $p < 0.001$) and 4.39 (95% CI 1.88 to 10.2, $p < 0.001$), respectively (more information is available at <http://sti.bmj.com/supplemental>).

DISCUSSION

Testing in MSM routinely includes a urethral specimen or a first-voided urine sample for *C trachomatis* (NAAT or enzyme immunoassay), and microscopy and culture for *N gonorrhoeae* from pharyngeal (culture only), urethral and rectal samples. Currently, NAATs are only licensed for use in men on specimens from the urethra, although several studies demonstrate that LCR performed well for detecting both organisms from the pharynx and rectum.^{16–18} LCR is no longer available but SDA performed well for the detection of both infections from the rectum (in addition to the urethra). The use of either test from the pharynx in a population with low prevalence may result in considerable numbers of false positives.

This testing policy, treatment of people with non-specific urethritis and epidemiological treatment for *C trachomatis* in those with a positive gonococcal culture compared with using LCR from all three sites, failed to identify 20 of 66 (30.3%) and 20 of 96 (20.8%) men with *C trachomatis* and *N gonorrhoeae*, respectively. Similarly, by comparison, using SDA from all three sites we identified 19 of 66 (28.8%) and 18 of 96 (18.8%) men with *C trachomatis* and *N gonorrhoeae*, respectively, who would not have had their infection diagnosed or treated.

We demonstrate that LCR and SDA performs less well for samples from the pharynx than the rectum for the detection of *C trachomatis* and *N gonorrhoeae*. However, 16 of 30 (53.3%) men positive only by LCR for *C trachomatis* and *N gonorrhoeae* from the pharynx and rectum were positive for the same infection at

another site. By comparison, only 4 of 30 (13.3%) men positive only by SDA for *N gonorrhoeae* from the pharynx and rectum were positive at another site (supplementary material available online at <http://sti.bmj.com/supplemental>).

During the study period, 10% of MSM attending our service were recruited to the study. Recruitment required patients to have an additional urethral specimen taken and to undergo proctoscopy to obtain rectal specimens, both of which may have deterred patients to participate in this study. Despite this limitation, the prevalence of urethral *C trachomatis* using LCR and *N gonorrhoeae* by culture observed in this study are similar to a retrospective study of all MSM attending our clinic during a 12-month period.²²

Previous *C trachomatis* or *N gonorrhoeae* infections is one of the greatest predictors of future infection in heterosexuals.²³ However (after adjusting for behavioural risk factors), HIV status and history of STIs were not markedly associated with an individual having either infection in this population. The large proportion of men reporting previous STIs may account for the lack of an association shown by this study.

Urethral and rectal symptoms and urethral signs seem to be strongly associated with infection, whereas pharyngeal symptoms and signs are not. We found significant associations between some sexual practices and both infections at the relevant site. By using these factors alone to identify whom to test, we showed that a marked number of infections would be missed.

A high proportion (33.7%) of men, particularly those who were HIV positive, reported unprotected anal intercourse in the previous month. Recent studies also show similar levels of ongoing high-risk behaviour among potentially serodiscordant men.³ In this study, the HIV status of sexual partners was unknown—that is, how many and which sexual practices occurred with which sexual partner. Therefore, the significance of high-risk sexual practices can only be inferred.

This study clearly shows a high prevalence of both *C trachomatis* and *N gonorrhoeae*, high rates of partner acquisition and, despite safer sex messages, an alarmingly high level of high-risk sexual behaviour among this group of MSM.

Evidence suggests that STIs may enhance transmission of HIV.^{24–28} It is plausible that pharyngeal and rectal *C trachomatis* or *N gonorrhoeae* may enhance HIV acquisition. Improving detection using NAATs for both infections will reduce the duration of infection and reduce the transmission of these STIs and, consequently, may have an effect on transmission of HIV in this population.

Key messages

- We found a high prevalence of *Chlamydia trachomatis* and *Neisseria gonorrhoeae*, high rates of partner acquisition and high-risk sexual behaviour among this group of MSM.
- Comparing our current testing policy for homosexual men with using either ligase chain reaction (LCR) or strand displacement amplification (SDA), we show that a considerable number of men with infections would not have had their infection diagnosed or treated.
- Both LCR and SDA perform well for the detection of *C trachomatis* and *N gonorrhoeae* from rectal as well as urethral samples.
- However, the use of either method from pharyngeal samples may result in considerable numbers of false positives.

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Recommendations: Routine NAAT testing for *Chlamydia trachomatis* and *Neisseria gonorrhoeae* from the rectum, in addition to the urethra, among MSM and associated cost implications must be considered. Further work is required before NAAT testing from the pharynx can be recommended.

Contributors: PDB coordinated the study, tested the samples and wrote the manuscript; GR devised the study and contributed to the manuscript; CC tested the samples and contributed to the manuscript; MB recruited patients; SRS tested the samples; AC undertook statistical analysis and contributed to the manuscript; AJR supervised the study and contributed to the manuscript; and GLR supervised the study and contributed to the manuscript.

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