Sexual behaviours and STI outcomes in a cohort of HIV negative MSM attending sexual health clinics in England

Short title: Sexual behaviours and STIs among MSM

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ABSTRACT

Men who have sex with men (MSM) attending sexual health (SH) clinics are at high-risk for HIV acquisition and are disproportionately affected by STIs. We collected standardised behavioural data from MSM attending clinics to characterise sexual behaviours and identify predictors for HIV and sexually transmitted infections (STI). In 2012-2013, HIV-negative MSM attending five SH clinics in England reported sexual behaviours in the previous three months via a self-administered questionnaire. Behaviours were linked to the individual's clinical records using national surveillance. The prevalence and incidence of bacterial STIs (gonorrhoea, chlamydia, lymphogranuloma venereum and syphilis) and incidence of HIV were calculated. Adjusted odds ratios and hazard ratios with 95%CI reported for significant predictors. Of 1,278 HIV-negative MSM, 54% were of white ethnicity and UK-born and 43% were 25-34 years old. Almost all men reported at least one partner in the last three months. Half reported condomless anal sex and 36% condomless receptive anal intercourse (CRAI). Incidence of bacterial STIs was 46/100 (95%CI 39-54) person years and of HIV was 3.1/100 (95%CI 1.7-5.6) person years. A STI at baseline and CRAI with increasing numbers of partners were associated with both incident infections. In this cohort of MSM high-risk behaviours and STIs were prevalent. Engagement in CRAI increased the likelihood of subsequent infection, while men diagnosed with a bacterial STI were at increased risk of a future STI. Clinical and behavioural risk assessments to determine an individual's risk of infection could allow a more nuanced prevention approach that has greater success in reducing transmission.

INTRODUCTION

Since the beginning of the HIV epidemic, sex between men has been one of the main transmission routes for HIV in the UK. In 2015, 3,320 men who have sex with men (MSM) were newly diagnosed with HIV (1); a 24% increase in the last decade. Since then, a recent decline in new diagnoses attributed to increased repeat testing and treatment as prevention has been observed (2). In 2016, gonorrhoea diagnoses among MSM attending sexual health (SH) clinics declined though they continue to disproportionally affect MSM, while syphilis has increased (3). MSM attending SH clinics are considered to be a higher risk population than MSM who do not. They report more risk behaviours (4) and HIV incidence is estimated to be 2/100 person-years (py) among clinic attending MSM (5) compared to an incidence of less than 1% in the general MSM population (6, 7). SH clinics are an open-access, free and confidential service offering a comprehensive service of testing, diagnosis and care for STIs.

Over the last decade, sexual behaviours known to increase the risk of HIV and STI transmission have been more frequently reported. Condomless anal intercourse (CAI) increased from 46% to 51% between 2000 and 2013 among HIV negative MSM from social venues in London (8). Concurrently, there is evidence suggesting wider adoption of seroadaptive practices, which are behavioural strategies employed to reduce the risk of HIV acquisition (8-10). Common strategies include serosorting, where CAI is only practiced with partners of the same HIV status and seropositioning, where only insertive CAI is practiced with HIV positive partners. Some observers have promoted these practices as a way of reducing HIV transmission but there is considerable debate on their effectiveness as success is

based on reliable ascertainment of the individual's and partner's HIV statuses (10). Further, by encouraging men to engage in condomless sex, seroadaptation may also inadvertently facilitate STI transmission (11, 12).

The vast majority of sexual behavioural information for MSM in the UK originates from community-based cross-sectional studies and internet surveys. While these surveys provide rich data on behaviours, their cross-sectional design inherently prevents investigation of subsequent clinical outcomes. Though the sexual behaviours of MSM attending SH clinics in England are routinely collected in clinics (13), the data are neither standardised nor reported. Greater insight into the prevalence of sexual behaviours and their role in HIV and STI transmission could be established through existing longitudinal national surveillance in SH clinics in England.

Our aim was to characterise self-reported sexual behaviours, identify predictors of prevalent STIs and prospectively measure STI and HIV incidence in a cohort of MSM who re-attend the same SH clinic to strengthen the evidence base and improve targeting of HIV and STI prevention interventions to MSM attending SH clinics.

METHODS

Data Collection

A short standardised sexual behavioural questionnaire was developed using existing surveys (e.g. Gay Men's Sexual Health Survey and EMIS) and was further discussed by a group of academic, public health and clinical experts. The

questionnaire was tested on a panel of MSM recruited by a community organisation (available in Supplementary material). From September 2012 for six months MSM (>15 years) not known to be HIV positive were recruited from five SH clinics across England; from Manchester, Brighton, and three from London. In four of the clinics, MSM self-completed a paper questionnaire and in the fifth, clinical staff completed the questionnaire with men. Self-reported sexual data items included number of partners, numbers of unprotected ("condomless" hereafter) anal intercourse (CAI) partners, condomless receptive anal intercourse (CRAI) and insertive anal intercourse (CIAI) partners in the last three months and HIV status of partners. Clinical staff completed the date of attendance and patient ID fields. The patient ID was the patient's unique identification number specific to the clinic, which allows patients to be longitudinally followed within (but not across) clinics. No person identifiable information was collected.

Data Management

The sexual behavioural data were linked to clinical outcomes by using the clinic name and patient ID to identify clinical records in the Genitourinary Medicine Clinic Activity Dataset (GUMCAD). GUMCAD is a mandatory patient-level reporting system of all SH clinic attendees in England since 2008 (14). The pseudo-anonymised dataset contains socio-demographic (age group, ethnicity, area of residence) and service use information, which is recorded at each attendance. Once participant clinical records were identified in GUMCAD, demographic and clinical data pertaining to all retrospective and prospective attendances at the same clinic were extracted. Clinical records to the end of March 2014 were included in these analyses.

Data analysis

We reported i) prevalence of sexual behaviours and ii) clinical outcomes among MSM. The outcomes measured were (i) prevalence of bacterial STIs newly diagnosed at baseline (attendance at which behavioural questionnaire was completed) where a bacterial STI was defined as gonorrhoea, chlamydia, lymphogranuloma venereum (LGV) and syphilis (primary, secondary and early latent), ii) incidence of bacterial STIs and iii) incidence of HIV. To identify incident infections, MSM who re-attended the same clinic after baseline were followed from baseline until the last attendance occurring before the end of March 2014 or until the date of the first bacterial STI or HIV diagnosis; whichever came first. Follow-up visits for the same episode of care were excluded. Incidence was expressed per 100 py with 95% confidence intervals (CI).

To explore associations of demographics, previous clinical history and sexual behaviours with i) prevalent STI at baseline and ii) incident outcomes, we conducted univariable analyses using the Chi-squared test and log rank test, respectively. Individuals with missing information were not included in these analyses. Two variables were included for clinical history: a diagnosis of an acute STI in the previous year (defined as a bacterial STI and any of the following: non-gonococcal urethritis, and first episode of genital warts and herpes) and HIV test/STI screen. Variables with marginal associations (p<0.1) were included in multivariable logistic and Cox regression analyses, respectively. A stepwise backward approach was used to sequentially remove variables not significant (p>0.05) in order of the p value magnitude. In the final model, adjusted odds ratios (OR) or hazard ratios (HR) and

95%CI were reported for factors significantly associated with prevalent and incident infection, respectively. Multivariable analyses were only performed for the two bacterial STI outcomes; there were insufficient HIV incident endpoints for this analysis.

Clinic attendees not participating in the survey

HIV negative MSM attending a participating clinic during the study period who were not recruited (e.g. not offered or declined to participate in the survey) were identified using GUMCAD and their demographic profile and clinical history compared to MSM who were recruited to determine representativeness. We also examined outcomes among non-recruited MSM.

All statistical analyses were conducted using STATA 13.1 (StataCorp, College Station, TX).

Ethics

The Medical Director of Health Protection Agency (as Public Health England was known in 2012), who belonged to an internal independent research office, deemed this work public health surveillance and therefore not requiring ethical approval. The information collected in the questionnaire was considered part of normal clinical practice and one of the aims of this study was to standardise collection of this information. Data linkage to GUMCAD, which is a pseudo-anonymised surveillance dataset, was achieved using a clinic-specific patient ID number.

RESULTS

Sample characteristics

In total, 1,601 MSM were recruited and completed the questionnaire; recruitment was 8% (1601/20,340) with higher completion in the clinician-led study clinic (30%). Overall, 22% of questionnaires were from this clinic. Of the 1,601 MSM, 1,278 (80%) could be linked to their clinical records in GUMCAD. The median age was 31 years, 54% were white and UK-born and 53% attended a London clinic (Table 1).At the baseline attendance, 73% took a HIV test. Almost half had attended the clinic in the year prior to their baseline attendance of whom 96% had tested for STIs and/or HIV and 37% were diagnosed with an acute STI.

Table 1 Characteristics of HIV negative MSM recruited from five SH clinics, England, 2012-2013 (n=1,278)

Characteristic	Study participants (%)	Non-recruited MSM (%)	P value*
Age group			
15-24	274 (21)	2,940 (15)	<0.001
25-34	546 (43)	8,150 (42)	
35-49	367 (29)	6,451 (34)	
50+	91 (7)	1,683 (9)	
			<0.001
Ethnicity and birthplace			
White UK-born	717 (56)	8,935 (46)	
White European	233 (18)	3,820 (20)	
White non-European	110 (9)	2,170 (11)	
Non-white UK-born	77 (6)	1,116 (6)	
Non-white born abroad	117 (9)	2,183 (11)	
Unknown	24 (2)	1,000 (5)	
			<0.001
Attendance at clinic			
Outside London	598 (47)	2,289 (12)	
London	680 (53)	16,935 (88)	

Baseline attendance:			
Diagnosis of bacterial STI	305 (24)	2,348 (12)	<0.001
Total	1,278	**19,224**	
In the previous year:			
HIV testing/STI screening	559 (96)	6,511 (89)	<0.001
Diagnosis of acute STI	213 (37)	1,609 (22)	<0.001
Total	**581**	**7,301****	

*P value of comparison of recruited men at baseline with men not recruited
**The first attendance date where a questionnaire could have been completed was considered the baseline attendance and was used to identify the prior year

There were 19,200 MSM who were not recruited; they differed demographically and clinically to recruited men. Recruited men were more likely to be younger (<35 years: 64% vs 57%, p<0.001), white and born in the UK (54% vs 46%, p<0.001) and diagnosed with an acute STI in the prior year (37% vs. 22%, p<0.001) than non-recruited men (Table 1).

Prevalence of sexual behaviours

Three per cent reported no (anal or oral) partners in the last three months while 41% reported 2-4 and 34% more than 4 partners. The median number of total partners was 3 (IQR: 1-6). Fewer men at the clinician-led clinic reported five or more partners (20% vs. 30-43%, p<0.001). Older MSM were more likely to report five or more partners (42% of MSM aged 35-49 vs. 25% aged15-24, p<0.001) as were white MSM born in Europe compared to born in the UK (43% vs. 30%, p=0.004) (Table 2).

Table 2 Overview of sexual behaviours in the last three months reported by HIV negative MSM by sample characteristics*, England, 2012-2013

Characteristic	Number reporting ≥5 sexual partners (%)	Number reporting CAI (%)	Number reporting CRAI (%)	Number reporting CIAI (%)
Age group				
15-24	66 (25)	117 (52)	94 (39)	89 (38)
25-34	168 (32)	258 (56)	198 (41)	204 (44)
35-49	153 (42)	140 (47)	86 (28)	118 (39)
50+	32 (36)	28 (44)	19 (27)	25 (37)
Ethnicity and birthplace				
White UK-born	209 (30)	263 (46)	206 (34)	201 (35)
White European	97 (43)	105 (52)	79 (38)	82 (40)
White non-European	41 (39)	63 (69)	37 (39)	54 (56)
Non-white UK-born	23 (31)	38 (59)	25 (37)	35 (54)
Non-white born abroad	40 (35)	60 (62)	42 (40)	50 (51)
Unknown	9 (38)	14 (67)	8 (38)	14 (64)
Attendance at clinic				
Outside London	153 (26)	171 (41)	147 (32)	136 (31)
London	266 (40)	372 (60)	250 (39)	300 (48)
Total	**419 (34)**	**543 (52)**	**397 (36)**	**436 (41)**

*28 (2%), 173 (14%) and 213 (17%) MSM did not report numbers of sexual partners, CRAI and CIAI partners, respectively

Half of men reported CAI in the last three months (Table 2) with no difference in the clinician-led clinic compared to the others. More young MSM reported CAI (52%) compared to MSM aged 50+ years (44%, p=0.048) and fewer white UK born MSM reported CAI (46%) compared to other groups. Thirty-six per cent of men reported CRAI and 41% reported CIAI in the last three months and a quarter reported last having CRAI in the last month. A quarter reported one CRAI and CIAI partner, 8% and 11% reported 2-4 CRAI and CIAI partners, respectively and the remainder reported more than 4 partners. A greater proportion of young MSM reported CRAI (15-24: 39% vs 50+: 27%, p<0.001), with no other differences by demographics or

previous clinical history. CRAI with a serodiscordant or unknown HIV status partner was reported by 18% of the sample.

Prevalence of diagnosed bacterial STI at baseline, and risk factors

Almost a quarter of men were diagnosed with a bacterial STI at baseline compared to 12% of non-recruited MSM (p<0.001). Bacterial STI prevalence and univariate analyses by sub-groups are shown in Table 3. In multivariable analyses, the odds of being infected at baseline was four times higher among men reporting >4 partners and twice as high among those reporting CRAI with 2-4 partners compared to those reporting no CRAI.

Table 3 Bacterial STI prevalence and incidence with associated risk factors among HIV negative MSM by demographics and clinical history, England, 2012-2013

	Prevalence of and risk factors for bacterial STIs, n=1,278				Incidence of and risk factors for bacterial STIs, n=628				
	Number of infections (%)	Unadjusted OR (95%CI)	Adjusted OR (95%CI)	P value	Number of infections (%)	Incidence/100 person years (95%CI)	Unadjusted HR (95%CI)	Adjusted HR (95%CI)	P value
Age group									
15-24	67 (4)	1	n.s.	n.s.	39 (27)	63.2 (46.2-86.4)	1	n.s.	n.s.
25-34	155 (28)	1.2 (0.9-1.7)	n.s.		65 (23)	44.8 (35.2-57.1)	0.7 (0.5-1.0)	n.s.	
35-49	71 (19)	0.7 (0.5-1.1)	n.s.		35 (20)	38.4 (27.5-53.4)	0.6 (0.4-0.9)	n.s.	
50+	12 (13)	0.5 (0.2-0.9)	n.s.		5 (18)	36.2 (15.1-87.0)	0.6 (0.2-1.4)	n.s.	
Ethnicity and birthplace									
White UK-born	176 (25)	1	n.a.	-	74 (24)	51.6 (41.1-64.8)	1	n.a.	-
White European	59 (25)	1.0 (0.7-1.5)	n.a.		26 (19)	35.2 (24.0-51.7)	0.7 (0.4-1.1)	n.a.	
White non-European	24 (22)	0.9 (0.5-1.4)	n.a.		20 (30)	54.6 (35.2-84.6)	1.0 (0.6-1.7)	n.a.	
Non-white UK-born	14 (18)	0.7 (0.4-1.2)	n.a.		9 (22)	38.7 (20.2-74.5)	0.7 (0.4-1.5)	n.a.	
Non-white born abroad	25 (21)	0.8 (0.5-1.3)	n.a.		12 (18)	40.9 (23.2-72.0)	0.8 (0.4-1.5)	n.a.	
Attending a London clinic									
No	149 (25)	1	n.a	-	51 (24)	69.0 (52.4-90.8)	1	1	<0.002
Yes	156 (23)	0.9 (0.7-1.2)	n.a		93 (22)	39.1 (31.9-47.9)	0.5 (0.3-0.7)	0.5 (0.4-0.8).	
HIV test/STI screen last year									
Attended, no test	4 (18)	1	n.a.	-	2 (18)	27.8 (7.0-111.2)	1	n.a.	-
Attended, test	127 (23)	1.3 (0.4-4.0)	n.a.		88 (25)	48.0 (39.0-59.2)	1.7 (0.4-7.0)	n.a.	
Did not attend	174 (25)	1.5 (0.5-4.5)	n.a.		54 (21)	44.5 (34.1-58.1)	1.6 (0.4-6.8)	n.a.	
Acute STI last year									
Attended, no STI	80 (22)	1	n.a.	-	42 (18)	32.8 (24.2-44.3)	1	1	0.02
Attended, STI	51 (24)	1.1 (0.8-1.7)	n.a.		48 (36)	77.2 (58.1-102.4)	2.4 (1.6-3.6)	1.9 (1.2-3.0)	
Did not attend	174 (25)	1.2 (0.9-1.6)	n.a.		54 (21)	44.5 (34.1-58.1)	1.4 (0.9-2.1)	1.3 (0.9-2.0)	
Sexual partners									
0	3 (8)	1	1	0.006	25 (22)	49.6 (33.5-73.4)	1	n.s.	n.s.
1	48 (17)	2.5 (0.7-8.5)	2.1 (0.6-7.2)		37 (16)	31.1 (22.5-42.9)	0.6 (0.4-1.1)	n.s.	
2-4	120 (23)	3.6 (1.1-12.0)	3.0 (0.9-10.0)		44 (25)	50.0 (37.2-67.1)	1.0 (0.6-1.7)	n.s.	
>4	126 (30)	5.2 (1.6-17.1)	4.0 (1.2-13.5))		33 (42)	81.7 (58.1-114.9)	1.7 (1.0-2.9)	n.s.	
CRAI with no. of partners									
0	151 (20)	1	1	0.006	71 (20)	40.7 (32.2-51.3)	1	1	0.03
1	81 (28)	1.6 (1.2-2.2)	1.6 (1.1-2.2)		33 (22)	40.7 (28.9-57.2)	1.0 (0.6-1.5)	1.0 (0.7-1.5)	
2-4	30 (34)	2.1 (1.3-3.4)	1.8 (1.1-2.9)		20 (40)	76.8 (49.5-119.0)	1.9 (1.1-3.1)	1.7 (1.0-2.8)	
>4	8 (32)	1.9 (0.8-4.5)	1.4 (0.6-3.4)		6 (46)	100.2 (45.0-223.0)	2.6 (1.1-6.0)	2.5 (1.1-6.0)	

CIAI with no. of partners									
0	137 (20)	1	n.s.	n.s.	61 (19)	37.4 (29.1-48.1)	1	n.s.	n.s.
1	70 (25)	1.3 (0.9-1.8)	n.s.		38 (28)	57.8 (42.1-79.5)	1.6 (1.1-2.4)	n.s.	
2-4	37 (33)	1.9 (1.2-2.9)	n.s.		15 (22)	39.2 (23.6-65.0)	1.0 (0.6-1.8)	n.s.	
>4	14 (31)	1.8 (0.9-3.4)	n.s.		10 (42)	85.4 (46.0-158.8)	2.3 (1.2-4.4)	n.s.	
Bacterial STI at baseline									
No	-	-	-	-	89 (18)	36.5 (29.7-45.0)	1	1	<0.001
Yes	-	-	-		55 (36)	80.7 (62.0-105.1)	2.2 (1.6-3.1)	2.2 (1.5-3.2)	
Total	**305**				**144**	**46.2 (39.2-54.4)**			

n.s.: not significant where variables had p<0.1 in univariate analyses but p>0.05 in multivariable analyses
n.a.: not applicable. Only values with p<0.1 included in multivariable analyses

Incidence of bacterial STIs and risk factors

There were 628 MSM who re-attended the same clinic after the baseline attendance; average follow-up time was 185 (standard deviation: 106) and 234 (SD: 114) days among those with and without the outcome, respectively. There were 144 new diagnoses of bacterial STIs during 311 person-years of follow-up, which equated to an incidence of 46.2/100 py (95%CI 39.3-54.4). In comparison, incidence was 18.6/100 py (17.9-19.3) among non-recruited MSM. Bacterial STI incidence was highest among MSM reporting more than four CRAI (100/100 py) and CIAI (85/100 py) partners (Table 3). In multivariable analyses, MSM diagnosed with a bacterial STI at baseline were twice as likely to be diagnosed with an incident bacterial STI in the subsequent year (same or different STI as at baseline) (Table 3). Numbers of CRAI partners was associated with subsequent STI incidence. Men reporting >4 partners were two and a half times more likely to acquire a bacterial STI (95%CI 1.1-6.0).

HIV incidence and associated risk factors

Average follow-up time was 186 (SD: 136) and 246 (SD:116) days among those with and without a HIV diagnosis, respectively. There were 11 incident HIV diagnoses; total person time was 356 years and HIV incidence was 3.1/100 py (95%CI 1.7-5.6) (Table 4). In comparison, among 13,282 non-recruited MSM who re-attended the clinic, 83 new HIV infections were detected and HIV incidence was 0.5/100 py (0.4-0.5). In univariate analyses, men reporting CRAI with more than one partner were four times more likely to acquire HIV than those reporting none or one partner (unadjusted HR: 4.2 95%CI 1.0-17.6) and those diagnosed with a baseline bacterial infection were three times more likely (95%CI 1.0-10.5).

Table 4 HIV incidence and unadjusted hazard ratios among HIV negative MSM by demographics and clinical history, England, 2012-2013

	Number of infections (%)	Incidence/100 person years (95%CI)	Unadjusted HR (95%CI)
Age group			
15-29	7 (1.9)	4.4 (2.2-9.2)	1
30+	4 (1.2)	2.0 (0.8-5.4)	0.5 (0.2-1.9)
Ethnicity and birthplace			
White UK-born	6 (1.9)	3.6 (1.6-8.1)	1
Other	5 (1.6)	2.7 (1.1-6.5)	0.9 (0.3-3.2)
Attending a London clinic			
No	3 (1.4)	3.6 (1.1-11.0)	1
Yes	8 (1.9)	2.9 (1.5-5.9)	0.8 (0.2-3.1)
Acute STI last year			
Attended, no STI	2 (0.8)	1.4 (0.4-5.6)	1
Attended, STI	6 (4.4)	7.5 (3.4-16.7)	4.4 (0.8-22.4)
Did not attend	3 (1.1)	2.3 (0.7-7.0)	1.6 (0.3-9.4)
Bacterial STI at baseline			
No	6 (1.2)	2.2 (1.0-5.0)	1
Yes	5 (3.1)	5.8 (2.4-13.8)	3.0 (1.0-10.5)
Sexual partners			
0-1	2 (1.6)	3.3 (0.8-13.1)	1
≥2	9 (1.8)	3.2 (1.7-6.1)	2.0 (0.2-15.6)
CRAI with no. of partners			
0-1	6 (1.2)	2.0 (0.9-4.7)	1
≥2	3 (4.7)	7.3 (2.4-22.7)	4.2 (1.0-17.6)
CIAI with no. of partners			
0-1	8 (1.7)	3.1 (1.6-6.3)	1
≥2	1 (1.1)	1.6 (0.2-11.5)	0.6 (0.08-5.0)
Total	**11**		

DISCUSSION

Our study uniquely provides sexual behavioural information for an open cohort of HIV negative MSM in England who were followed-up to determine their clinical outcomes. MSM attending clinics had a high burden of STI and reported high levels of risk behaviours with over a third reporting CRAI. Men diagnosed with a STI at

baseline were twice as likely to be diagnosed with another STI within a year highlighting ongoing risk in this population.

The prevalence of sexual behaviours reported in our clinic-based study were comparable to a recent clinic study of MSM, which reported 58% of HIV negative MSM had condomless sex and 13% had engaged in CRAI with a sexual partner of unknown or HIV positive status in the last three months (15). Sexual risk behaviours in our study was, however, higher than those reported from a nationally representative sample of MSM (16). These data further confirm that MSM attending SH clinics engage in high risk sexual behaviours that could also be linked to other risk behaviours including drug use (15).

Bacterial STI incidence was extremely high in our sample and of greater concern, we found men diagnosed at baseline were significantly more likely to be diagnosed with another STI within a year. Recent literature on incidence of new infections among MSM is limited with only one study in England reporting high incidence of new infections among those with a previous bacterial infection (17). There were no changes in testing strategy during the study that might explain the high incidence and it is likely our findings highlight on-going risk in this sub-population despite recent contact with SH services. MSM are recommended to test for STIs at all anatomical sites annually and three-monthly if at high risk (18). Practice, however, differs between clinics and information on the extent of site-specific testing was not available to the investigators. Baseline bacterial STIs were also a risk factor for incident HIV infection; bacterial STIs, especially gonorrhoea, are known predictors for HIV infection (5, 19). These findings argue for more frequent STI and HIV testing

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among MSM diagnosed with bacterial STIs to identify infections earlier and prevention onward transmission.

HIV incidence in our cohort was higher than other available estimates for MSM attending SH clinics in England (5, 20) with the upper confidence estimate suggesting true incidence could be two to three times higher and which would reflect the high risk behaviours reported by the recruited sample. Our point estimate is similar to cohorts of MSM in Spain (21) and the US (22) but higher than in Australia (1.3/100 py) (23). The group of men reporting engaging in CRAI with partners of unknown or serodiscordant HIV status may not necessarily be employing any risk reduction strategies such as seroadaptation. Further, we found increasing numbers of partners with whom men engaged in CRAI with was significantly associated with increased risk of HIV and STI infection. Some of these could be men actively serosorting but successful seroadaptation requires knowledge of the partner's HIV status and with one in eight MSM living with HIV in the UK unaware of their infection (1) and inadequate levels of HIV testing (8, 24), men are more likely to be "seroguessing" rather than serosorting (25). Engagement in condomless sex increases the risk of transmitting and acquiring STIs and STI rates have shown to be higher among those assuming seroconcordance (11). Although studies have shown seroadaptive behaviours are better for HIV prevention than employing no strategy (26, 27), they still represent a significantly increased risk of acquiring an infection.

The observed high risk in this population stresses the need for HIV and STI prevention interventions for MSM attending clinics. In resource limited settings, the objective calculation of an individual's risk based on key characteristics and behaviours could assist clinical decision making and prioritisation of service delivery.

Triaging in clinical practice is becoming increasingly important and has recently been used in the US to aid clinicians in offering HIV prevention services that are tailored to an individual's risk (28, 29) and for determining gonorrhoea and chlamydia screening thresholds (30).

A similar approach could be taken in SH clinics in England whereby a risk assessment tool could inform an individual's current risk of HIV or a STI and assess an individual's need for intensified prevention services including, but not limited to, frequent HIV testing and STI screening, behavioural interventions and prescription of pre-exposure prophylaxis (PrEP), which was found to be highly effective at preventing HIV acquisition among MSM (31). The recent implementation of the IMPACT trial to deliver PrEP to 10,000 people in England is an important step forward for HIV prevention. However, it will be necessary to monitor the impact of taking PrEP on sexual behaviour and STI acquisition given the evidence showing that both might increase when on PrEP (32). Dean Street, a London SH clinic, also recently launched Dean Street Prime a service offered to high risk MSM identified using recent clinical outcomes and sexual behaviours (http://prime.dean.st/). By offering five programmes, it demonstrates how services can be designed and individually tailored to allow men to take control of their sexual health.

There are several limitations to this study. First, the study only achieved 8% recruitment (clinic range: 5%-33%), as the questionnaires were not consistently offered to men due to operational difficulties including other competing studies, large workloads and clinic staff forgetting. We were also unable to measure the proportion that were asked to complete the survey and declined. Recruitment may have

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improved with a dedicated researcher in each clinic or alternative delivery mechanisms such as placing the questionnaire in all men's folders, which may have reminded staff of the survey. The recruited sample was not representative of MSM attendees at the five clinics; participants were younger, white UK born and were potentially higher risk. Reported results are likely to overestimate high risk behaviours and incidence estimates in the wider MSM population.

Second, prospective analyses had to be restricted to men who returned to the same clinic because GUMCAD can only be used to follow individuals within clinics. Movement between clinics is likely to be common in urban areas where the availability of more SH clinics provides greater clinic choice (33). It is therefore possible men attended and were diagnosed with subsequent STI or HIV elsewhere, and which could not be identified through the study. An underestimation of the number of infections will underestimate incidence in the cohort.

Third, reason for attendance is not collected in GUMCAD and for some men attendance may be related to risk. By only following individuals for one year those at risk are more likely to return in a shorter period of time and are thus favoured for selection in the cohort compared to MSM at lower risk (e.g. routine check-up). Our estimates potentially pertain to a cohort of MSM who are higher risk and among whom incidence is higher than in other MSM attending SH clinics. However, our interest lies in this population because most HIV diagnoses are likely to occur among these men and they are most likely to need intensified interventions such as PrEP.

Finally, the study relied on self-reported sexual behaviours and HIV status of partners. Social desirability bias could result in under-reporting of CAI and dilute the role of behaviours on incident infection. The effects may be different between men self-completing the questionnaire and those completing it with staff. Men may under-report risky behaviours to staff. However, cognitive testing of the questionnaire suggested men were accustomed to providing sexual behavioural information at SH clinics and did not think they would respond differently between the two methods.

Our study adds to the evidence base that MSM attending SH clinics report high risk sexual behaviours and a high burden of STI. Despite potential exposure to prevention services at clinics, men diagnosed with a STI at baseline are at increased risk of coming back with another STI. Employment of clinical and behavioural risk triaging of MSM could objectively ascertain an individual's risk of infection and allow a more nuanced and tailored prevention approach that has greater success in reducing transmission.

Declaration of Conflicting Interests
The Authors declare that there is no conflict of interest.

Contributorship statement: AN, ONG and SD devised the study and SD ran the study. AS, AM, DW, AS, DM and GS led the study in their clinics. SD conducted the data management, statistical analyses and prepared the first draft of the manuscript. All authors participated in interpreting the data and contributed to the final manuscript.

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