BMJ Open

Sexually transmitted infections among patients attending a sexual assault centre: a cohort study from Oslo, Norway

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To cite: Skjælaaen K, Nesvold H, Brekke M, *et al*. Sexually transmitted infections among patients attending a sexual assault centre: a cohort study from Oslo, Norway. *BMJ Open* 2022;**12**:e064934. doi:10.1136/bmjopen-2022-064934

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2022-064934).

Received 20 May 2022
Accepted 03 November 2022

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ABSTRACT

Objectives We estimate the prevalence of sexually transmitted infection (STI) among patients after sexual assault, assess the possible value of azithromycin prophylaxis, and identify risk factors for assault-related STI and for not presenting at follow-up.

Design Prospective observational cohort study.

Setting Sexual assault centre in Oslo, Norway.

Participants 645 patients, 602 (93.3%) women and 43 (6.7%) men, attending the centre from May 2017 to July 2019.

Outcome measures Microbiological testing at the primary examination and at follow-up consultations after 2, 5 and 12 weeks. Estimated relative risk for assault-related STI and for not presenting at follow-up.

Results At primary examination, the prevalence of genital chlamydia was 8.4%, *Mycoplasma genitalium* 6.4% and gonorrhoea 0.6%. In addition, the prevalence of bacterial STI diagnosed at follow-up and possibly from the assault was 3.0% in total: 2.5% for *M. genitalium,* 1.4% for genital chlamydia and 0.2% for gonorrhoea. This prevalence did not change when azithromycin was no longer recommended from January 2018. There were no new cases of hepatitis B, hepatitis C, HIV or syphilis. We found no specific risk factors for assault-related STI. Patients with previous contact with child welfare service less often presented to follow-up (relative risk (RR) 2.0 (95% CI 1.1 to 3.5)), as did patients with a history of sex work (RR 3.6 (1.2 to 11.0)) or substance abuse (RR 1.7 (1.1 to 2.7)).

Conclusions Most bacterial STIs were diagnosed at the primary examination, hence not influenced by prophylaxis. There was no increase in bacterial STI diagnosed at follow-up when azithromycin prophylaxis was not routinely recommended, supporting a strategy of starting treatment only when infection is diagnosed or when the patient is considered at high risk. Sex work, substance abuse and previous contact with child welfare services were associated with not presenting to follow-up.

Trial registration number ClinicalTrials.gov Registry (NCT03132389).

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Microbiological samples were taken both at the primary examination and at follow-up consultations.
⇒ The study population is representative for patients attending the Oslo Sexual Assault Centre, apart from migrants probably being under-represented.
⇒ As only about 10% of sexual assault victims attend a sexual assault centre, the results may not be representative for sexual assault victims in general.
⇒ A sexually transmitted infection might stem from other sexual contacts than the assault, information we did not gather.
⇒ The study may be underpowered for identifying risk factors.

INTRODUCTION

Sexual violence is a fundamental violation of human rights and a global public health problem.[1 2] A broad range of physical and psychological health consequences after sexual assault may have significant and long-lasting effects on an individual's well-being and functioning.[1 2] In a European survey, 3%–14% of women reported having been raped, varying between countries.[3] In a Norwegian survey, 9% of women and 1% of men reported having been raped (sexual assault with penetration), and 34% of women and 11% of men reported having been sexually assaulted or abused.[4]

After a sexual assault, the risk of sexually transmitted infection (STI) often causes great concern to the individual. The WHO describes a 50%–80% increased risk of STI among women exposed to sexual violence.[1] Reviews from 2000 report STI prevalence in the range of 0%–56% after sexual assault, probably reflecting variations in local population prevalence and study inclusion criteria.[5 6] More recent European studies report prevalences of *Chlamydia trachomatis* after sexual assault at 6%–15%, *Mycoplasma genitalium* at 2% and *Neisseria gonorrhoeae* at 0%–5%.[7–13] The prevalence of STI is higher among

patients at sexual assault centres than in the general population,[11 12 14] though similar to or lower than among patients tested for STI for other clinical reasons.[11 13]

Screening for and managing STI are well-established procedures after sexual assault.[5 6 15–21] Over the last century, the main concern has shifted from syphilis and gonorrhoea to HIV and hepatitis and the increase in multiresistant bacteria. Accordingly, recommendations for screening and prophylaxis need to be reconsidered from time to time. Since the prevalence of STI varies between geographical areas, recommendations should be adapted to the local STI panorama and medical services.[6] Hence, there is a continuous need for updated studies from different areas. Current Norwegian guidelines recommend screening for chlamydia, gonorrhoea, syphilis, HIV, hepatitis B and C, and other infections if indicated.[21]

The International Federation of Gynecology and Obstetrics (FIGO) and the US Centers for Disease Control and Prevention (CDC) recommend empirical prophylactic treatment with antibiotics against chlamydia, gonorrhoea and trichomoniasis after a sexual assault.[15 20] At the Oslo Sexual Assault Centre (SAC), a single dose of azithromycin for chlamydia was routinely recommended, in line with Norwegian guidelines. Increasing macrolide resistance in *M. genitalium* led to the end of this procedure in January 2018,[22] giving us the opportunity to evaluate any concurrent change in the prevalence of STI.

Objectives

Our main objective was to estimate the prevalence of STI after sexual assault in the Oslo area in Norway. Our secondary objectives were to identify risk factors for assault-related STI and for not presenting at follow-up consultations, and to evaluate the change in azithromycin prophylaxis policy. We also describe patient and assault characteristics.

METHODS

Design

Prospective observational cohort study among patients attending an SAC from May 2017 to July 2019.

Setting

The Oslo SAC sees about 600 patients per year and serves a population of about 1.2 million. It is integrated in a large primary care emergency clinic. The SAC services are available for persons alleging sexual assault, free of charge and independent of police reporting. Patients younger than 14 years are examined at paediatric hospital departments.

At the primary examination, the patient's history is systematically obtained, including details of the assault and the assailant(s), medical history and vulnerability factors. Medical and medicolegal examinations include microbiological testing, pregnancy test, forensic swabs and injury documentation. Necessary treatment is provided, including emergency contraception. Psychosocial counselling includes one to six follow-up consultations with a nurse or social worker.

In addition to the primary examination, the Oslo SAC offers three medical follow-up consultations, at 2, 5 and 12 weeks. Both medical and psychosocial issues are addressed, including relevant microbiological sampling and necessary treatment.

Until 20 January 2018, azithromycin 1000 mg was routinely recommended as chlamydia prophylaxis to patients presenting within a week of the assault. Since then, chlamydia prophylaxis has not been generally recommended. Hepatitis B vaccination is offered at the primary examination and repeated twice during follow-up. HIV post-exposure prophylaxis (4 weeks of emtricitabine, tenofovir and raltegravir) is recommended based on individual risk in patients presenting within 72 hours of the assault.[21]

Participants

Patients 14 years of age and older presenting at the Oslo SAC were eligible for inclusion in the study. Based on an estimated prevalence of STI of 7% among SAC patients, we calculated that a sample size of 625 participants was needed to make comparisons with the general population. Patients were recruited by SAC nurses and doctors, at the primary examination or at follow-up. During the recruitment period, 1374 patients presented at the Oslo SAC, among whom 645 (46.9%) consented to participate.

Data collection and classification

Data were collected from the patients' electronic medical records and archived paper files. We registered age at primary examination, sex, time since assault, previous contact with health and social services, vulnerability factors (as reported by the patient or from the medical records), type of crime scene, assault characteristics, number of assailants, assailant's relation to victim, oral/genital/anal injuries, symptoms of STI, microbiological tests, prophylaxis/treatment given at primary examination and/or follow-up consultations, and whether the patient presented at follow-up consultations.

Microbiological sample collection

At the primary examination, samples were obtained using genital swabs (preferably collected from the cervix and vagina, otherwise in urine or by vaginal self-testing, and in urine or from the urethra for men). Oropharyngeal swabs were routinely taken for *N. gonorrhoeae* only. Anorectal swabs were taken in cases with anal penetration or suspected anal penetration, or when the circumstances were unclear. Samples were collected using Sigma Transwab Liquid Amies. Furthermore, blood samples were collected for serological testing for hepatitis B, hepatitis C, HIV and syphilis. Other STIs were tested for if clinically indicated.

During follow-up, samples were repeated: at 5 weeks if azithromycin had been given, at 2 weeks if not. At 12

weeks of follow-up, serology was taken for hepatitis B, hepatitis C and syphilis. HIV serology was repeated at all follow-up consultations. If a patient did not present to follow-up, repeated active outreach was tried and testing offered at a later consultation.

Microbiological diagnostic tests

Microbiological analyses were performed at the Department of Microbiology at Oslo University Hospital. PCR was used for the detection of *C. trachomatis, M. genitalium* (until 10 April 2019) and *N. gonorrhoeae* (AmpliSens Chlamydia trachomatis-FRT for the former, in-house real-time PCR assays for the latter two and in some cases fast-track diagnostics for confirmation of *N. gonorrhoeae*). For *N. gonorrhoeae*, swabs were also cultured, independent of the PCR result. Lymphogranuloma venereum PCR was performed on anorectal samples positive for *C. trachomatis*, and *M. genitalium*-positive specimens were examined with PCR for macrolide resistance (both in-house real-time PCR assays).

Blood samples were examined for serological markers for HIV (HIV antigen/antibody combined), hepatitis B (hepatitis B surface antigen and antibody and core antibody), hepatitis C (hepatitis C antibody) and syphilis (*Treponema pallidum* antibody) (all using Abbott Architect assays). Positive results were confirmed with alternative tests (available upon request).

Outcome measures

We calculated the prevalence of STI at the primary examination as the rate of detected infections among the patients tested for each specific agent.

To estimate the prevalence of bacterial STI possibly from the assault and assess the azithromycin prophylaxis policy, we defined prevalence within different time frames from assault to primary examination, and prevalence at follow-up:

1. Within 2 days: positive tests possibly representing infections transmitted before the assault. However, due to the high sensitivity of PCR testing, an early positive test might also represent infected body fluids deposited at the assault.[18 23] Newly deposited agents can be detected for a period, then enter an undetectable incubation phase before becoming manifest infections. The 2-day time frame was set based on the 2 days when semen is likely to be retrieved.[23]
2. Days 3–7: incubation period. Infections from the assault probably not yet detectable (except gonorrhoea). Positive tests probably representing infections transmitted before the assault.
3. Weeks 1–4: positive tests possibly representing infection transmitted at assault, manifest after incubation, but possibly also pre-existing infection.
4. At follow-up, infection possibly transmitted at the assault: positive test for genital chlamydia or *M. genitalium* at follow-up combined with negative test at primary examination within a week of the assault. Cases negative both at primary examination and at follow-up were considered not infected. Cases negative at primary examination but not tested at follow-up were considered not infected if the primary examination was more than a week after the assault, otherwise they were excluded. The same definition was used for gonorrhoea, but with the cut-off set at 2 days. This definition probably misses some assault-related infections as the incubation time may be longer than a week (2 days for gonorrhoea).

The results in definitions 1, 2 and 3 will not be affected by prophylaxis, but these patients will need treatment. In definition 4, test results at follow-up will be affected by whether azithromycin was given or not.

Definition 4 was used when estimating risk factors for assault-related STI. Risk factors were estimated as relative risks (RRs).

Seroconversion assessment was based on serological tests done at 12-week follow-up.

Statistical analyses

Statistical analyses were performed using SPSS V.27 or an online calculator from Epitools (https://epitools.ausvet.com.au). Associations between categorical variables were established from the X^2 test, or Fisher's exact test when appropriate. Age comparisons were done using Mann-Whitney U test. RRs were estimated in Stata SE V.17.

Patient and public involvement

No patient involvement.

RESULTS

Among the 645 patients included, 602 (93.3%) were female, and 43 (6.7%) were male. Median age was 23 years (IQR 19–28) among women, and 26 years (22–32) among men (p=0.003).

In total, 191 (29.6%) patients had previously been in contact with psychiatric outpatient services for adults, and 106 (16.4%) with similar services for children/adolescents (table 1). There was a history of mental disorder among 288 (44.7%) patients, previous trauma (including sexual assault) among 247 (38.3%) and substance abuse among 74 (11.5%). Of the assailants, 98.9% were male (table 2).

Most patients (563, 87.3%) presented to primary examination within 1 week of the assault, 452 (70.2%) within 48 hours and 350 (54.3%) within 24 hours. Only 42 (6.5%) presented later than 4 weeks. In total, 497 (77.1%) patients presented to at least one follow-up consultation, 270 (41.9%) presented to all three. Patients with previous contact with child welfare services less often presented to follow-up (RR 2.0 (95% CI 1.1 to 3.5)), as did patients with a history of sex work (RR 3.6 (1.2 to 11.0)) or substance abuse (RR 1.7 (1.1 to 2.7)) (online supplemental table 1).

At the primary examination, *C. trachomatis* was diagnosed in 52 of 620 (8.4%) patients, *M. genitalium* in 34 of 529 (6.4%) and *N. gonorrhoeae* in 4 of 635 (0.6%) (table 3). There were no new cases of hepatitis B, hepatitis C, HIV or syphilis. Five patients had pelvic inflammatory disease;

Table 1 Background data and assault characteristics for patients attending a sexual assault centre in Oslo, Norway

	Female	Male	Total
	n (%)	n (%)	n (%)
Vulnerability factors			
Mental disorder*	271 (45.0)	17 (39.5)	288 (44.7)
Previous trauma	232 (38.5)	15 (34.9)	247 (38.3)
Substance abuse	64 (10.6)	10 (23.3)*	74 (11.5)
Sex work	12 (2.0)	–	12 (1.9)
Physical/mental disability	3 (0.5)	1 (2.3)	4 (0.6)
Resident at institution	3 (0.5)	–	3 (0.5)
Other	24 (4.0)	2 (4.7)	26 (4.0)
No vulnerability factors reported	229 (38.0)	18 (41.9)	247 (38.3)
Previous contact with health/social services			
Adult psychiatric outpatient service	179 (29.7)	12 (27.9)	191 (29.6)
Child/adolescent psychiatry service	105 (17.4)	1 (2.3)*	106 (16.4)
Admitted psychiatric hospital	45 (7.5)	3 (7.0)	48 (7.4)
Child welfare service	45 (7.5)	1 (2.3)	46 (7.1)
Addiction outpatient service	35 (5.8)	7 (16.3)*	42 (6.5)
Crime scene†			
Assailant's residence	195 (32.4)	10 (23.3)	205 (31.8)
Patient's residence	121 (20.1)	7 (16.3)	128 (19.8)
Other person's residence	98 (16.3)	8 (18.6)	106 (16.4)
Public place indoors‡	73 (12.1)	11 (25.6)*	84 (13.0)
Outdoors	57 (9.5)	–*	57 (8.8)
Vehicle	25 (4.2)	3 (7.0)	28 (4.3)
Other/no information	33 (5.5)	4 (9.3)	37 (5.7)
Type of assault			
Penetration total	459 (76.2)	25 (58.1)*	484 (75.0)
Penetration attempted	13 (2.2)	1 (2.3)	14 (2.2)
Penetration suspected	121 (20.1)	14 (32.6)	135 (20.9)
No penetration	9 (1.5)	3 (7.0)*	12 (1.9)
Penetration in vagina	460 (76.4)	1 (0.2)***	461 (71.5)
Penetration in mouth	129 (21.4)	18 (41.9)**	147 (22.8)
Penetration in anus	94 (15.6)	26 (60.5)***	120 (18.6)
Penetration with penis	438 (72.8)	26 (60.5)	464 (71.9)
Penetration with fingers	169 (28.1)	10 (23.3)	179 (27.8)
Penetration with foreign object	7 (1.2)	4 (9.3)**	11 (1.7)
Penetration not further specified	106 (17.6)	10 (23.3)	116 (18.0)
Patient had to penetrate other person	1 (0.2)	5 (11.6)***	6 (0.9)
Patient had to execute other sexual action	67 (11.1)	15 (34.9)***	82 (12.7)
Other kind of assault	26 (4.3)	5 (11.6)*	31 (4.8)
Amnesia but strong suspicion of assault	154 (25.6)	13 (30.2)	167 (25.9)
Injuries sustained§			
Genital injuries	140 (23.3)	–***	140 (21.7)
Anal injuries	46 (7.6)	6 (14.0)	52 (8.1)
Oral injuries	35 (5.8)	1 (2.3)	36 (5.6)
Total	602 (100)	43 (100)	645 (100)

Penetration where and with what also registered for cases with attempted or suspected penetration.
Comparisons between sexes: *p<0.05; **p<0.01; ***p<0.001.
*Encompassing personality disorders, depression, post-traumatic stress syndrome, severe anxiety disorders, attention deficit hyperactivity disorder and a few patients with psychotic disorders.
†More than one crime scene in six cases.
‡Mainly hotels, bars, clubs.
§Mainly minor and few, for example, superficial small tears, ecchymoses and abrasions.

Table 2 Assailant characteristics in sexual assaults on patients attending a sexual assault centre in Oslo, Norway

	Female patients n (%)	Male patients n (%)	Patients total n (%)
Gender*			
Male	671 (99.3)	44 (93.6)*	715 (98.9)
Female	5 (0.7)	3 (6.4)*	8 (1.1)
Relation			
Met same day	188 (26.9)	9 (16.4)	197 (26.2)
Stranger	161 (23.1)	19 (34.5)	180 (23.9)
Acquaintance	167 (23.9)	7 (12.7)	174 (23.1)
Friend	57 (8.2)	2 (3.6)	59 (7.8)
Met via the internet	34 (4.9)	8 (14.5)**	42 (5.6)
Intimate partner present/past	33 (4.7)	2 (3.6)	35 (4.6)
Authority figure	16 (2.3)	–	16 (2.1)
Family member	6 (0.9)	1 (1.8)	7 (0.9)
Other/no information	36 (5.2)	7 (12.7)	43 (5.7)
Total†	698 (100)	55 (100)	753 (100)

Comparisons between sexes: *p<0.05; **p<0.01; ***p<0.001.
*Missing information in 30 cases; 22 among female and 8 among male.
†One assailant in 537 (83.3%) cases, two in 40 (6.2%), three or more in 23 (3.6%), unknown in 45 (7.0%).

only one of whom had STI diagnosed (positive for *C. trachomatis*, *M. genitalium* and *N. gonorrhoeae*).

Azithromycin prophylaxis was given to 153 of 645 (23.7%) patients (131 of 218 (60.1%) before 20 January 2018 and 22 of 427 (5.2%) after), hepatitis B vaccination to 415 of 645 (64.3%), and HIV post-exposition prophylaxis to 144 of 602 (23.9%) women and 20 of 43 (46.5%) men. Antibiotic treatment was ascertained for all diagnosed patients except 2 of 58 with genital chlamydia, 8 of 45 with *M. genitalium* and 1 of 5 with gonorrhoea (online supplemental table 2).

Bacterial STI possibly from the assault was diagnosed at the primary examination in 55 of 447 (12.3%) patients using definition 1 and in 5 of 56 (8.9%) using definition 3, and at follow-up in 15 of 495 (3.0%) patients using definition 4 (table 4). Changing the azithromycin prophylaxis recommendation did not affect the prevalence. We found no specific risk factors for assault-related STI.

DISCUSSION

Summary of main findings

At the primary examination, the prevalence of genital chlamydia was 8.4%, *M. genitalium* 6.4% and gonorrhoea 0.6%. In addition, the prevalence of bacterial STI possibly from the assault diagnosed at follow-up was 3.0% in total: 2.5% for *M. genitalium*, 1.4% for genital chlamydia and 0.2% for gonorrhoea. Not recommending azithromycin prophylaxis did not increase the prevalence of STI.

STI prevalence

The prevalence of genital chlamydia and gonorrhoea among our patients was higher than in the general Norwegian population of similar age (8.4% vs 2.4% and 0.6% vs 0.1%, respectively),[24] in line with previous studies.[11 12 14] Compared with other SAC studies, our findings are in the same range as a previous Norwegian study from Trondheim in 2003–2010 reporting genital chlamydia in 6% and no cases of gonorrhoea[11]; as well as UK, Belgian, and Dutch studies reporting genital chlamydia in 6%–10% and gonorrhoea in 1%–2%,[7–10 13] though lower than a French study reporting genital chlamydia in 15% and gonorrhoea in 5%.[12] Few SAC studies report *M. genitalium* prevalence. In comparison with the 6.4% in our study, 2% was reported in the Trondheim study[11] and 8% in a Korean study from 2010 to 2019.[14]

No patients were diagnosed with trichomoniasis or bacterial vaginosis. This may partly result from limited testing, as these infections were only tested for when clinically suspected, in line with Norwegian recommendations.[21] However, similar findings were also done in the Trondheim study.[11] This contrasts to the high prevalence of trichomoniasis and bacterial vaginosis reported in US studies from the 1990s,[25 26] though the prevalence seems to have been lower in Europe.[5 7 9]

Antimicrobial prophylaxis

As most bacterial STIs were diagnosed at the primary examination (table 4), their prevalence would not be affected by prophylactic treatment. Hence, the recommended azithromycin was as much an empirical treatment of pre-existing infection as a prophylactic, yet still resulting in overtreatment. Not recommending azithromycin treatment did not increase the prevalence of assault-related bacterial STI. This supports a strategy of

Table 3 Sexually transmitted infections at primary examination among patients attending a sexual assault centre in Oslo, Norway

	Female n/N (%)	Male n/N (%)	Total n/N (%)
Chlamydia trachomatis			
Patients total	50/578 (8.7)	2/42 (4.8)	52/620 (8.4)
Cervix/vagina/urethra/urine*	49/573 (8.6)	0/42*	49/615 (8.0)
Anus	12/243 (4.9)	2/30 (6.7)	14/273 (5.1)
Mycoplasma genitalium			
Patients total	34/494 (6.9)†	0/35	34/529 (6.4)†
Cervix/vagina/urethra/urine*	28/490 (5.7)‡	0/34	28/524 (5.3)‡
Anus	8/212 (3.8)§	0/25	8/237 (3.4)§
Neisseria gonorrhoeae			
Patients total	4/593 (0.7)	0/42	4/635 (0.6)
Cervix/vagina/urethra/urine*	2/573 (0.3)	0/41	2/614 (0.3%)
Anus	1/238 (0.4)	0/30	1/268 (0.4)
Oropharynx	4/522 (0.8)	0/36	4/558 (0.7)
Hepatitis B			
Known chronic contagious infection	1/584 (0.2)	1/42 (2.4)	2/626 (0.3)
Previous infection	10/584 (1.7)	1/42 (2.4)	11/626 (1.8)
Previously vaccinated	181/584 (31.0)	15/42 (35.7)	196/626 (31.3)
Positive vaccination status during follow-up¶	360/420 (85.7)	24/32 (75.0)	384/452 (85.0)
Hepatitis C			
Known previous infection	12/585 (2.1)	2/42 (4.8)	14/627 (2.2)
HIV			
Known infection	1/586 (0.2)	0/42	1/628 (0.2)
Syphilis			
Known previous infection	1/576 (0.2)	2/39 (5.1)*	3/615 (0.5)

Proportions stated as positive tests (n) per patient tested (N).
Fourteen patients were tested for lymphogranuloma venereum, all negative.
Seven patients were tested for *Trichomonas vaginalis*, all negative.
No condylomas were diagnosed (visual inspection).
Comparisons between sexes: *p<0.05; **p<0.01; ***p<0.001.
*Women sampled from cervix and/or vagina or in urine, men sampled from urethra or in urine.
†Fourteen cases macrolide resistant.
‡Twelve cases macrolide resistant.
§Four cases macrolide resistant.
¶Seroconversion assessment 3 months after primary examination.

treating STI only when diagnosed, in countries with well-developed health services. Still, the FIGO and the CDC recommend empirical prophylactic antimicrobial treatment,[15 20] arguing that many patients do not return for follow-up consultations, making it difficult to base treatment on results from the initial screening. In our study population, 77.1% presented to at least one follow-up consultation, compared with the 30%–60% more commonly reported.[6 7 27–29] The Oslo SAC keeps an active outreach approach if patients do not show up. Patients may also seek help elsewhere. Testing and treatment for STI are easily available and free of charge in Norway, and widely accepted by adolescents and young adults.

Targeted prophylactic empirical antibiotic treatment might be considered for patients especially at risk of not presenting at follow-up (in our study sex work, substance abuse and previous contact with child welfare services). These patients often are particularly vulnerable.[28]

In 2013, when *M. genitalium* was included in the Oslo SAC screening programme, azithromycin was an effective treatment. As macrolide resistance increased, moxifloxacin was introduced. The clinical significance of detecting *M. genitalium* was increasingly questioned, and the Oslo SAC stopped screening asymptomatic patients for *M. genitalium* in April 2019 in line with changing international and national guidelines.[21 22] This development highlights

Table 4 Sexually transmitted infections diagnosed after assault among patients attending a sexual assault centre in Oslo, Norway

	Azithromycin prophylaxis recommended n/N (%)	Azithromycin prophylaxis not recommended n/N (%)	P value	Total n/N (%)
1. Positive test at primary examination within 2 days of assault. Infectious agents possibly deposited at assault.				
Genital chlamydia	13/138 (9.4)	21/297 (7.1)	0.51	34/435 (7.8)
Mycoplasma genitalium	8/138 (5.8)	17/228 (7.5)	0.69	25/366 (6.8)
Gonorrhoea	0/142	4/304 (1.3)	0.31	4/446 (0.9)
Any of the above	19/142 (13.4)*	36/305 (11.8)*	0.75	55/447 (12.3)*
2. Positive test at primary examination 3–7 days after assault. Incubation period—infection probably from before assault.				
Genital chlamydia	3/39 (7.7)	8/68 (11.8)	0.74	11/107 (10.3)
M. genitalium	1/38 (2.6)	4/55 (7.3)	0.65	5/93 (5.4)
Gonorrhoea	0/41	0/68	–	0/109
Any of the above	4/41 (9.8)	10/68 (14.7)*	0.65	14/109 (12.8)*
3. Positive test at primary examination 1–4 weeks after assault. Infection possibly from assault, manifest after incubation.				
Genital chlamydia	1/18 (5.6)	3/36 (8.3)	1.00	4/54 (7.4)
M. genitalium	1/17 (5.9)	1/31 (3.2)	1.00	2/48 (4.2)
Gonorrhoea	0/19	0/37	–	0/56
Any of the above	2/19 (10.5)	3/37 (8.1)*	1.00	5/56 (8.9)*
4. Negative test at primary examination within a week of assault†, positive at follow-up. Infection possibly from assault.				
Genital chlamydia	1/138 (0.7)	5/289 (1.7)	0.67	6/427 (1.4)
M. genitalium	2/139 (1.4)	7/222 (3.2)	0.49	9/361 (2.5)
Gonorrhoea	1/162 (0.6)	0/328	0.33	1/490 (0.2)
Any of the above	4/162 (2.5)	11/333 (3.3)*	0.78	15/495 (3.0)*

*Some patients were infected with more than one agent.
†Two days for gonorrhoea.

that the risk and harm of antimicrobial resistance and overtreatment must be considered when deciding on prophylactic empirical antibiotic treatment after sexual assault. Reduced antibiotic use may also be beneficial to the individual patients by avoiding potential side effects.

We found no new cases of hepatitis B or HIV. This mainly reflects low prevalence in the population, but also suggests that the vaccination and post-exposure prophylaxis are sufficiently extensive.

Medicolegal aspects

Consequences of STI may be serious, especially in countries with less available health services. Bacterial infections, often conceived as less serious diseases in high-income countries, are becoming more difficult to treat as antimicrobial resistance is increasing. The sexual crime legislation in Norway explicitly states that transmission of an STI is an aggravating circumstance, carrying stricter custodial penalties. While it may be impossible to ascertain the exact time for STI transmission, and thus difficult to conclude with certainty in medical terms whether the STI resulted from the assault, the courts may still find this information pertinent to their proceedings. This supports the case for addressing possibly assault-related STI in medicolegal reports.

Strengths and limitations

Comparing with annual reports from the Oslo SAC,[30] our study population is similar concerning age, sex and relation to the assailant. While we expected vulnerable patients to be less likely to consent to participation, 62% of the patients in our study reported at least one vulnerability factor, compared with 56%–59% in previous Norwegian studies.[31 32] Migrants are probably underrepresented, as the information/consent form was available only in Norwegian and English. Otherwise, our study population seems representative for the Oslo SAC population. However, as it is estimated that only 10% of sexual assault victims attend an SAC,[4 31] it is uncertain to what extent our results are representative for sexual assault victims in general.

Estimating the risk of assault-related STI is complicated. A strength of our study is that we have samples both from the primary examination and from follow-up consultations, as retesting often is necessary to establish whether an infection has been transmitted. Prophylactic antibiotic treatment may hinder development of infection, consequently obscuring the risk. An STI might stem from other sexual contacts than the assault, information we did not gather. Some of the STI diagnosed at the primary examination may be assault related, but probably a minority. Among early examined patients, samples may catch newly deposited infected body fluids,[18] but not all assailants are STI carriers, and not all sexual contacts will transfer an infection. We consider definition 4 our best estimate of assault-related STI, though probably on the lower side.

Surprisingly, we found no increased risk for assault-related STI among patients with genital injury or exposed to multiple assailants. However, as the study sample size was calculated for comparisons with the general population, the study may be underpowered for identifying risk factors. This would especially apply to risk factors for assault-related STI, as the number of assault-related STIs was small. Hence, there is clearly a possibility of type II errors, and risk factors may have gone undetected, as may a possible protective effect of recommending azithromycin prophylaxis.

Samples for microbiological testing were obtained from genital swabs performed by health personnel, from self-testing and in urine specimens. The choice of method is based on the patient's preferences and what is most appropriate and convenient then and there, in line with the pragmatic approach at the Oslo SAC, though swabs performed by health personnel is the preferred method at the primary examination. In systematic reviews, self-swabbing and other non-invasive sampling methods have been shown to be equivalent to conventional testing by health personnel.[33 34]

CONCLUSION

About 3% of patients attending the Oslo SAC had an STI possibly from the assault, mainly genital chlamydia and *M. genitalium*. There was no increase in STI when azithromycin prophylaxis was no longer recommended, supporting a strategy of treating only diagnosed infections, thus avoiding overtreatment. However, as the most vulnerable patients seem most at risk of not presenting to follow-up, targeting prophylactic empirical treatment to them may be a reasonable strategy.

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Acknowledgements We thank the patients for participating in the study, the nurses and doctors at the Oslo SAC for including patients in the study, and the staff at the Department of Microbiology at Oslo University Hospital for their work with the microbiological analyses. This work was performed on the TSD (Tjeneste for sensitive data) facilities, owned by the University of Oslo, operated and developed by the TSD service group at the University of Oslo IT Department (USIT) (tsd-drift@usit.uio.no).

Contributors KS, HN, MB and OMV conceived the study. All authors contributed to the design. KS, HN and OMV collected the data. KS, HN, IM and OMV analysed the data. KS and OMV drafted the manuscript. All authors contributed substantially to revising the manuscript and approved the final version. OMV is the guarantor of the study.

Funding KS received funding from the Norwegian Committee on Research in General Practice (a committee of the Norwegian College of General Practitioners) (grant number N/A), and from the Rolf Geir Gjertsens minnefond (UNIFOR) (grant number N/A).

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not required.

Ethics approval This study involves human participants and was approved by the Regional Committee South-East A for Medical and Health Research Ethics (REK no. 2016/2279). Patients were included after informed written consent. Patients were approached for inclusion only if considered in an appropriate state of mind.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. The dataset cannot be made openly available due to conditions set by the Regional Committee South-East A for Medical and Health Research Ethics prior to collecting the data. Inquiries about the data and conditions for access can be made to the corresponding author.

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