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Sex Transm Infect. Author manuscript; available in PMC 2019 May 01.

Published in final edited form as:

Sex Transm Infect. 2019 May ; 95(3): 201–211. doi:10.1136/sextrans-2018-053613.

Prevalence and correlates of and a risk score to identify asymptomatic anorectal gonorrhoea and chlamydia infection among men who have sex with men in Kisumu, Kenya

Laura A S Quilter[1,2], **Eve Obondi**[3], **Colin Kunzweiler**[4], **Duncan Okall**[3], **Robert C Bailey**[4], **Gaston Djomand**[5], **Boaz Otieno-Nyunya**[6], **Fredrick Otieno**[3], and **Susan M Graham**[1,2,7]

[1]Department of Medicine, Division of Allergy and infectious Diseases, University of Washington, Seattle, Washington, USA

[2]Department of Global Health, University of Washington, Seattle, Washington, USA

[3]Nyanza Reproductive Health Society, Kisumu, Kenya

[4]Division of Epidemiology and Biostatistics, School of Public Health, University of illinois at Chicago, Chicago, illinois, USA

[5]Centers for Disease Control and Prevention, Atlanta, Georgia, USA

[6]Centers for Disease Control and Prevention, Kisumu, Kenya

[7]Department of Epidemiology, University of Washington, Seattle, WA, USA

Abstract

Objectives—In settings where laboratory capacity is limited, the WHO recommends presumptive treatment for *Neisseria gonorrhoeae* (NG) and *Chlamydia trachomatis* (CT) in asymptomatic men who have sex with men (MSM) at high risk for these infections. However, little is known about how best to target this intervention. We aimed to identify correlates of anorectal

Correspondence to Laura A S Quilter, Division of Allergy and infectious Diseases, University of Washington, Seattle, WA 98195, USA; lquilter@uw.edu.

Contributors LASQ and SMG designed the study. FO and DO oversaw implementation of STi testing. EO and CK assisted with data management and cleaning. LASQ and SMG conducted the analyses. RCB, GD and BON contributed to study implementation and oversight. All authors contributed to and approved the final manuscript.

Handling editor Khalil G Ghanem

Competing interests None declared.

Patient consent Not required.

Ethics approval The *Anza Mapema* Study obtained ethics approval from the Maseno University Ethics Review Committee (Reference MSU/DRPC/ MUERC/00104/14), the University of Washington institutional review board (Protocol 48148) and the University of illinois-Chicago institutional review board (iRB Protocol 2014–0778). All participants gave informed consent before taking part in the study.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement Researchers requesting access to data/resources will be asked to submit a request in writing describing their qualifications including their certification by their local IRB, analytic plans and other uses of the data/resources, and plans to secure the confidentiality and safety of the data. They will be required to agree in writing that they will not share the data with others, will use it only for the research purpose(s) delineated and will return or destroy the data on completion. in order to maintain protection of our participants' privacy, no directly identifying information will be shared with outside investigators. Given the sensitive nature of the data we are collecting, including HiV diagnosis and same-sex behaviors, no public access file is available.

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NG/CT infection in Kenyan MSM with and without anorectal symptoms and evaluate the performance of an empirical, model-based risk score to identify cases in asymptomatic men.

Methods—Anorectal NG/CT infections were diagnosed by the Abbott RealTime NG/CT nucleic acid amplification testamong 698 MSM at enrolment into the Anza Mapema study. Multivariable logistic regression was used to identify correlates of anorectal NG/CT infection in men with and without anorectal symptoms. Using coefficients from the final multivariable model for asymptomatic men, we calculated a risk score for each participant. Risk score performance was determined by calculating the sensitivity, specificity and number needed to treat (NNT) to identify one NG/CT infection.

Results—Overall anorectal NG/CT infection prevalence was 5.2% (n=36), of which 58.3% (n=21) were asymptomatic. Factors associated with anorectal NG/CT infection in asymptomatic men were aged 18–24 years (aOR=7.6; 95% CI: 1.7 to 33.2), HIV positive serostatus (aOR=6.9; 95% CI: 2.2 to 21.6) and unprotected anal sex in the past 3 months (aOR=3.8; 95% CI: 1.2 to 11.9). Sensitivity and specificity were optimal (81.0% and 66.1%, respectively) at a model-derived risk score cut-point ≥3, and the NNT was 12.

Conclusions—A model-derived risk score based on correlates of anorectal NG/CT infection in asymptomatic participants would be sensitive and efficient (i.e, low NNT) for targeting presumptive treatment. If validated in other settings, this risk score could improve on the WHO algorithm and help reduce the burden of asymptomatic anorectal NG/CT infections among MSM in settings where diagnostic testing is not available.

INTRODUCTION

A high prevalence of STIs has been reported among men who have sex with men (MSM) across sub-Saharan Africa.[1,2] *Neisseria gonorrhoeae* (NG) and *Chlamydia trachomatis* (CT) anorectal infection prevalence among African MSM ranges from 1% to 15%,[3–5] and most infections are asymptomatic.[6,7] Among MSM in Coastal Kenya, anorectal NG infection in the past 6 months was associated with HIV acquisition.[8] Collectively, these studies have drawn attention to the crucial need for effective anorectal STI management in African MSM.

Based on expert consensus, the WHO recommends that clinicians in resource-limited settings use syndromic management to treat symptomatic anorectal infections in MSM and presumptive treatment (PT) for asymptomatic MSM reporting unprotected receptive anal intercourse and either multiple sex partners or a sex partner with an STI in the past 6 months.[9] To date, the WHO PT algorithm for asymptomatic men has only been validated in one small study in Coastal Kenya, in which prevalence was 11.7% among 240 asymptomatic men and application of the PT algorithm compared with NG/CT nucleic acid amplification testing (NAAT) demonstrated 74% sensitivity and 46% specificity.[10] In the authors' estimation, for every four MSM who qualified for PT using WHO guidelines, one asymptomatic infection would be treated.[10] Additional studies of the correlates of anorectal NG/CT infection and optimisation of PT targeting are needed.

We analysed data from *Anza Mapema*, an observational cohort of 711 MSM in Kisumu, Kenya, with the primary objective of determining anorectal NG/CT infection prevalence and identifying correlates both in symptomatic participants and asymptomatic participants, who

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would not be treated using a syndromic approach. Our secondary objective was to develop an empirical, model-based risk score for identifying anorectal NG/CT infections among asymptomatic MSM and evaluate its performance.

MATERIALS AND METHODS

Study Population

Eligibility criteria for the *Anza Mapema* study included: male sex at birth, oral or anal sex with a man in the past 6 months, ≥18 years of age and resident in Kisumu, Kenya. Men already enrolled in HIV care or participating in another study were excluded. Recruitment occurred between August 2015 and September 2016 through peer networks, snowballing and recruitment at 'hotspots' such as bars or discos, assisted by local lesbian, gay, bisexual and transgender organisations. For this analysis, 698 men with available baseline NAAT results were included (98.2% of 711 participants).

Clinical procedures

All participants underwent audio computer-assisted self-interview (ACASI), a standardised physical examination and collection of samples including urine and rectal swabs for NG/CT screening.[11] Pharyngeal swabs were not collected. The ACASI included questions on sociodemographic background, sexual behaviour, and alcohol and drug use. All men were asked about rectal discharge in the past 3 months. Men who reported anal intercourse were asked additional questions about rectal pain, pain with defecation and pain while having sex. Syndromic STI treatment was provided to symptomatic men immediately, while asymptomatic men with laboratory-diagnosed STI were treated when results became available. WHO treatment guidelines were used.[12,13]

Rectal swab procedures

Rectal swab specimens were clinician-collected by proctoscopy or, for men refusing proctoscopy, self-collected according to published procedures.[14] From August 2015 to January 2016, a single sterile dry Dacron swab was collected for NAAT. From January 2016 on, two specimens were obtained: one Abbott Multi-Collect swab for NAAT and one sterile Dacron swab for Gram stain (GS). Swabs were stored at 2°C-8°C until transport to the CDC-KEMRI laboratory within 12 hours of collection.

Laboratory procedures

The Abbott M2000 RealTime CT/NG Assay (Abbott Molecular, Des Plaines, Illinois, USA) was used to detect *C. trachomatis* and *N. gonorrhoeae* in urine and rectal swab specimens. Microscopy was used to count leucocytes per high-power field and detect Gram-negative intracellular diplococci (GNID) on GS slides of rectal secretions. Culture and susceptibility testing for *N. gonor-rhoeae* and lymphogranuloma venereum typing for CT-positive specimens were not available.

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Outcomes

The primary outcome was anorectal NG/CT infection, defined as a positive NG and/or CT NAAT result on a rectal swab specimen.

Correlates

Potential correlates of anorectal NG/CT infection analysed included: age group, education, ever married to female partner, current cohabitation with male partner, HIV-seropositive status, ever had sex with female partner, current female sex partner, any anal sex in past 3 months, multiple current male partners, condomless anal sex with male partner in past 3 months, usual position during anal intercourse (insertive, receptive or versatile), transactional sex (for money, food or housing) in past 3 months, male partner ejaculated inside rectum at last sex, male partner inserted fingers in rectum at last sex, male partner put mouth/tongue on rectum at last sex, treated for any STI in past 3 months, disclosure of MSM status to provider at last STI treatment, physical or sexual violence in past 3 months, and alcohol use, other drug use, or injection drug use in past year. Manifestations of anorectal NG/CT infection analysed included purulent rectal discharge, rectal mucosal erythema and detection of GNID or leucocytes on rectal GS.

Data analysis

95% CIs were calculated for prevalence estimates using exact binomial distributions. χ^2 or Fisher's exact tests were used to evaluate associations between categorical variables. Bivariable logistic regression was used to estimate unadjusted ORs for potential correlates of anorectal NG/CT infection, stratifying by the presence or absence of anorectal symptoms. For each strata, a multivariable logistic regression model was constructed including HIV status a priori plus other variables associated with the outcome at $p<0.2$ in bivariable analysis. A final multivariable model for anorectal NG/CT infection in asymptomatic men included only correlates associated with the outcome at $p<0.05$.

Risk scores and cut-points

Using the final multivariable model for asymptomatic men, a score for each correlate was derived from its adjusted beta coefficient, rounded to the nearest integer. A total risk score was calculated for each participant by summing scores for each correlate present. Sensitivity, specificity and number needed to treat (NNT) one true anorectal NG/CT infection were calculated for the model-derived risk score at each potential cut-point. In addition, the receiver operating characteristics (ROC) curve was examined to determine the optimal cut-point of the calculated risk score (ie, the point at which sensitivity and specificity were optimised) and calculate the area under the ROC curve. Stata 14.1 was used for statistical analyses.

RESULTS

Participants

Among the 698 men included, median age was 23 years (IQR, 21–28) and most were single (73%). Men reported many different sexual orientations (table 1); of note, no anorectal

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infections were diagnosed in heterosexual-identified men (1.4%). Overall, HIV-1 prevalence was 10.6% (95% CI: 8.4% to 13.1%). Table 1 presents data on the sociodemographic and behavioural risk factors reported at *Anza Mapema* enrolment, stratified by anorectal symptom status. Symptoms were reported by 166 men (24%).

NG/CT prevalence

At enrolment, 36 participants (*5*.2%, *95*% CI: 3.*6*% to 7.1%) had an anorectal NG/CT infection: 17 participants (47.2%) had NG only, 9 (25.0%) CT only and 10 (27.8%) had both infections. Of 36 participants with anorectal NG/CT, 21 men (*5*8.3%) did not report symptoms. The prevalence of anorectal NG/CT infection among asymptomatic men was 3.9% (*95*% CI: 2.*5*% to *6.0*%). The prevalence of urethral NG/CT in the entire study population was 12.8% (*95*% CI: 10.4% to 15.5%). Overall, 73 men had only urethral NG/CT, 16 men had both urethral and anorectal NG/CT and 20 men had only anorectal NG/CT.

Correlates of anorectal NG/CT in symptomatic men

In multivariable modelling, HIV-positive serostatus (adjusted OR (aOR) = 17.1; 95% CI: 3.5 to 84.0) and receptive or versatile sex position during anal sex with a male partner (aOR=53.5, 95% CI: 6.4 to 444.9; aOR=24.2, 95% CI:2.0 to 294.8, respectively) were associated with increased odds of anorectal NG/CT infection in symptomatic men (table 2).

Correlates of anorectal NG/CT in asymptomatic men

In multivariable modelling, the following correlates were associated with increased odds of infection in asymptomatic participants: age 18–24 years (aOR=7.6; 95% CI: 1.7 to 33.2), HIV-positive serostatus (aOR=6.9; 95% CI: 2.2 to 21.6) and unprotected anal intercourse in past 3 months (aOR=3.8; 95% CI: 1.2 to 11.9) (table 3).

Examination and laboratory findings

Proctoscopy and GS findings are presented in table 1. Among 122 men reporting anorectal symptoms who accepted proctoscopy, no anorectal discharge or erythema was noted. Among 154 symptomatic men with rectal GS results, detection of leucocytes was associated with infection ($\chi^2 = 7.12$, p = 0.03), but GNID detection was not (Fisher's exact test p = 0.12). When added to the multivariable model presented in table 2, neither variable was a significant correlate of anorectal NG/CT in symptomatic men. Among 366 men without symptoms who accepted proctoscopy, no discharge was noted, and the only man with anorectal erythema was not infected. Among 493 asymptomatic men with rectal GS results, detection of leucocytes or GNID was not associated with infection ($\chi^2 = 5.30$, p = 0.16 and Fisher's exact p=0.06, respectively). When added to the multivariable models presented in table 3, neither variable was a significant correlate of anorectal NG/CT in asymptomatic men.

Correlate scores and cut-points

The final multivariable model for anorectal NG/CT infection in asymptomatic men included HIV-positive serostatus (coef-ficient=1.93, score=2), age 18–24 years (coefficient=2.03,

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score=2), and unprotected anal sex in the past 3 months (coefficient = 1.33, score = 1, table 3). Figure 1 presents risk-score performance. With a cut-point of 2, 85.7% of cases would be treated; however, PT would be provided to 61.4% of asymptomatic participants and 24 participants would need to receive PT to treat one infection. With a cut-point of 3, 81.0% of cases would be treated, but PT would be provided to fewer asymptomatic participants (35.7%). A cut-point of 3 optimises sensitivity and specificity, reducing the NNT to 12 asymptomatic men receiving PT to treat one true infection.

DISCUSSION

In this MSM population in Kisumu, Kenya, the overall prevalence of anorectal NG/CT infections (5.2%) was modest and over half (58.3%) were detected among asymptomatic men. HIV-positive serostatus and usual receptive or versatile sex position during anal sex with a male partner were associated with higher odds of anorectal NG/CT infection among symptomatic men. Significant correlates of anorectal NG/CT infection among asymptomatic men were HIV-positive serostatus, age 18–24 years and unprotected anal intercourse in the past 3 months. A risk score based on these three factors performed most favourably at a cut-point of 3, at which 81.0% of cases would be treated and 12 men would need PT to treat one true infection. If this risk score approach were applied, 35.7% of asymptomatic participants would receive PT.

Prior studies have described associations between anorectal NG/CT infections and the correlates we identified. For example, in a study among Thai MSM, HIV infection was an independent risk factor for anorectal NG (aOR=2.0, 95% CI: 1.3 to 3.1) and anorectal CT (aOR=2.4, 95% CI: 1.2 to 4.7).[15] HlV-pos-itive serostatus was associated with a combined outcome of rectal/urethral NG/CT and syphilis in a Ugandan study of MSM (aOR=3.46, 95% CI: 1.03 to 11.64).[4] While not specifically measured in *Anza Mapema,* unprotected receptive anal intercourse (RAI) is a known risk factor for rectal NG/CT in MSM.[1617] In a Tanzanian study, recent unprotected RAI was associated with anorectal NG/CT infection (χ^2 = 10.5, p = 0.001) and predicted a combined outcome of NG/CT at any site and syphilis (aOR=3.69, 95% CI: 1.47 to 9.25).[3] Younger age has been associated with increased anorectal NG/CT risk. In a cohort of asymptomatic HIV-infected MSM in the USA, older age was protective against incident STI including anorectal NG/ CT (per 10 years; OR=0.55, 95% CI: 0.37 to 0.83).[18] In a study of Nigerian MSM and transgender women, age >30 years was protective against rectal/urethral NG/CT (aOR=0.48, 95% CI: 0.29 to 0.82).[19]

This is the first study to evaluate the burden of anorectal NG/ CT infections among MSM in Kisumu, Kenya. Overall prevalence (5.2%, 95% CI: 3.6% to 7.1%) was lower compared with prior studies of anorectal NG/CT among Kenyan MSM. Anorectal NG/CT infection prevalence may differ across studies due to variations in sexual behaviour. Among 147 MSM in coastal Kenya, of whom 75% reported RAI (compared with 45% of *Anza Mapema* participants reporting usual receptive or versatile position), anorectal NG/CT prevalence was estimated at 18.4% (95% CI: 12.5% to 25.6%).[10] Among 563 MSM in Nairobi, of whom 45% reported RAI with male partners, anorectal NG/CT prevalence was 8.5% (95% CI: 6.4% to 11.1%).[5] The CI for this estimate overlaps with our CI. Reported transactional sex (75% in coastal Kenya, 48% in Nairobi and 63% in Kisumu) and HIV prevalence (40% in

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coastal Kenya, 26% in Nairobi and 11% in our cohort) also differed across these study populations.[5 10] Higher rates of antibiotic use or other unmeasured correlates could explain the relatively low rate of anorectal NG/CT infection in this population.

The majority of anorectal NG/CT infections in the *Anza Mapema* population were asymptomatic, consistent with prior studies among MSM in sub-Saharan Africa.[671019] A better understanding of the correlates of asymptomatic anorectal NG/ CT is crucial to understand the potential impact of WHO PT guidelines in settings where syndromic STI treatment is used. In Sanders *et al,* the only other African study to evaluate WHO PT algorithm performance, no risk factors were predictive of asymptomatic infection, but sample size (n=147) was limited.[10] Notably, 33% of participants were eligible to receive PT by the WHO algorithm, which had a sensitivity of 74% and NNT of 4.[10] In *Anza Mapema,* the ACASI questionnaire did not include all WHO PT criteria, and we therefore could not evaluate WHO PT algorithm performance in this analysis. Application of the WHO PT algorithm, which uses a 6-month recall period, could be challenging due to recall and reporting bias. In addition, since even symptomatic anorectal infections are underdiagnosed in Kenya due to limited diagnostic and clinical capacity, most men are unaware that they or their partners had a recent STI (only 6.8% of participants in Sanders *et al* reported a partner with a recent STI).[10] For this reason, targeting PT based on a patient's or partner's prior STI diagnosis may not be of great utility in resource-limited settings and further evaluation of the WHO PT algorithm is needed.

This is the first study to develop a risk score algorithm for the prediction of anorectal NG/CT to guide PT for asymptomatic MSM. PT for STIs has been used in public health settings, including for sex partners of index cases and for periodic presumptive therapy (PPT) in female sex workers (FSWs).[20] PPT can reduce the burden of NG/CT infection in targeted populations and is recommended by WHO to rapidly reduce STI prevalence in sex-work settings.[20] While high cure rates can be achieved, concerns about overtreatment remain, including increased antibiotic resistance in *N. gonorrhoeae.* In a meta-analysis of FSW PPT studies, increased antibiotic resistance was not reported, although few studies monitored for this outcome and existing surveillance is inadequate.[20] When PPT is used, antimicrobial susceptibility should be monitored to ensure that high cure rates are achieved. In addition, adherence should be monitored and single-dose directly administered regimens used whenever possible. In settings that lack access to NAAT testing, PT remains a strategy of considerable importance for preventing STI sequelae and reducing ongoing transmission. As pre-exposure prophylaxis for HIV prevention is scaled up in such settings, PT may become increasingly important in STI control.

Affordable diagnostic tests are greatly needed in resource-limited settings to target STI treatment more efficiently and reduce time to treatment. Because microscopy is widely available, we evaluated its utility in this study. We found that symptomatic men with anorectal infection were more likely than symptomatic men without infection to have leucocytes on rectal GS (53.8% vs 21.6%). However, detection of leukocytes and detection of GNID on rectal GS were not independent correlates of anorectal infection in multivariable regression analyses. We therefore do not recommend microscopy of rectal secretions to

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target PT for anorectal NG/CT among asymptomatic MSM in resource-limited settings. Low-cost point-of-care tests to diagnose NG and CT infections remain a priority.

Anza Mapema is one of the largest studies of MSM in sub-Saharan Africa, which strengthened our ability to evaluate associations between sociodemographic and behavioural risk factors and anorectal NG/CT infection. Research funding enabled us to diagnose cases using highly sensitive and specific NAATs. However, our study has several limitations. First, the ACASI was not developed with this analysis in mind and therefore not all questions we would like to have asked (eg, condom use specifically for RAI, serosorting) were available. Second, social desirability may limit disclosure of sexual risk and other behaviours, although use of ACASI may have reduced this problem.[21] Third, of 21 anorectal NG/CT cases in asymptomatic men, 6 (28.6%) did not report anal sex to the provider and were therefore not asked about anorectal symptoms other than discharge. It is therefore possible that we misclassified some men as asymptomatic, leading to an overestimation of anorectal NG/CT infection among asymptomatic men. Fourth, we could not determine optimal frequency of PT provision, since STI treatment in the *Anza Mapema* cohort was based on NAAT results. PPT has been shown to be effective at decreasing STI prevalence when provided at monthly intervals, although optimal frequency among MSM remains unknown.[22] Fifth, because peer networks were used to recruit study participants, our results may have been impacted by infections clustering among men in the same sexual networks. Finally, our study population was composed of MSM attending one of two study clinics in western Kenya. Most MSM in Kenya are hidden and difficult to access, such that the *Anza Mapema* population may differ in important aspects from other MSM communities.

In conclusion, a model-derived risk score to guide PT of anorectal NG/CT in asymptomatic MSM would be sensitive and efficient (ie, low NNT) if applied to this study population. This risk score requires validation in different populations of asymptomatic MSM in sub-Saharan Africa, as risk factors for anorectal NG/CT infection may vary in different settings and populations. PT should be considered to reduce anorectal NG/ CT infection burden among MSM in settings where diagnostic testing is unavailable. Our findings highlight the importance of developing effective low-cost diagnostic tests for use in vulnerable high-risk populations in resource-limited settings.

Acknowledgements

The authors thank the *Anza Mapema* participants and research team, the Nyanza Reproductive Health Society, and the Centers for Disease Control and Prevention for their support of the *Anza Mapema* Study.

Funding The Anza Mapema Study was supported through funding provided by the Centers for Disease Control and Prevention (U01GH000762) and by Evidence for HiV Prevention in Southern Africa (MM/EHPSA/NRHS/0515008). LASQ was supported through funding by the Centers for Disease Control and Prevention (1U 62 PS 004584–01) and the University of Washington Thomas Francis, Jr. Global Health Fellowship.

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Key messages

- Anorectal *Neisseria gonorrhoeae* (NG) and/or *Chlamydia trachomatis* (CT) infection prevalence in men who have sex with men (MSM) in Kisumu, Kenya, was 5.2%, with >50% in asymptomatic men.
- Significant correlates of anorectal NG/CT infection in asymptomatic participants included HIV infection, younger age (18–24) and unprotected anal sex.
- A risk score algorithm based on correlates of anorectal NG/CT infection in asymptomatic men was sensitive (81%), moderately specific (66%) and efficient (number needed to treat=12).
- Additional research is needed to validate these findings and optimise targeting of presumptive treatment among MSM where diagnostic testing is unavailable.

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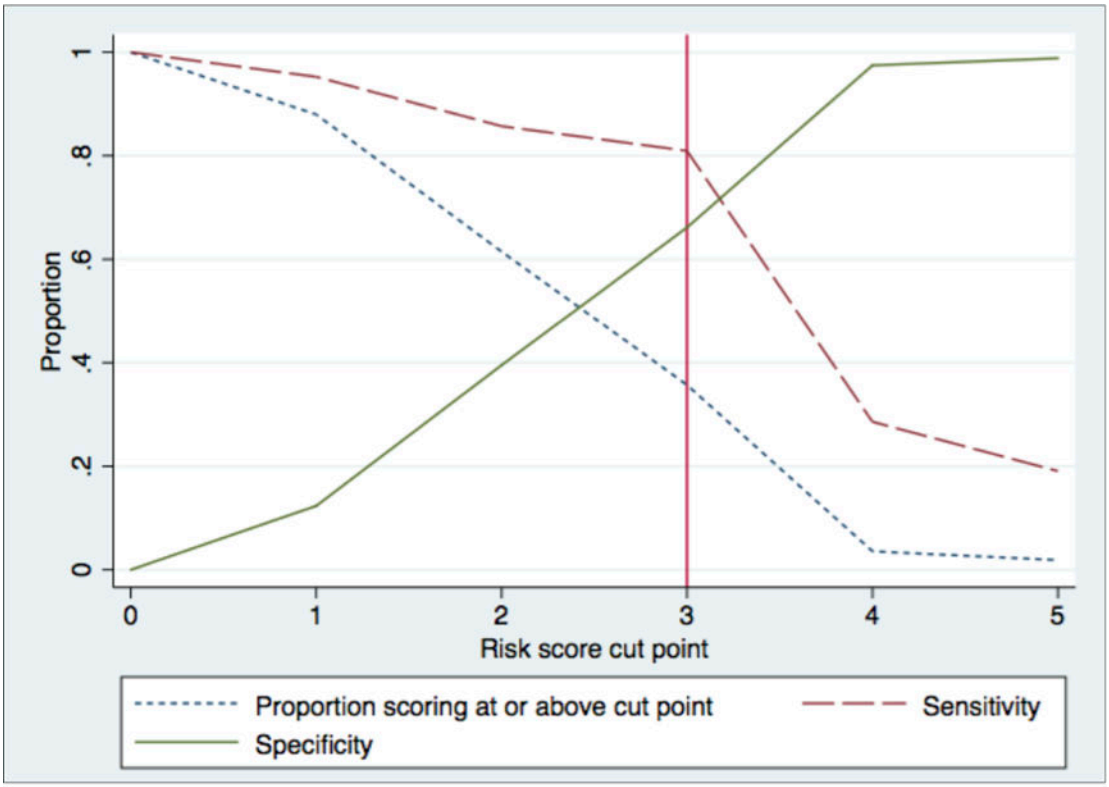

Sensitivity, Specificity, NNT, and Predictive Values of Risk Score at Different Cut Points

Risk Score Cut Point	Sensitivity	Specificity	Proportion Offered PT	NNT	PPV	NPV
1	95.2%	12.3%	88.0%	36	4.3%	98.4%
2	85.7%	39.5%	61.4%	24	5.5%	98.5%
3	81.0%	66.1%	35.7%	12	8.9%	98.8%
4	28.6%	97.5%	3.6%	3	31.6%	97.1%
5	19.1%	98.8%	1.9%	2	40.0%	96.7%

Abbreviations: NNT = number needed to treat; NPV = negative predictive value; PPV = positive predictive value

Figure 1.

Sensitivity, specificity and proportion meeting presumptive treatment (PT) criteria. The horizontal axis displays all risk score cut-points that could be chosen, given a risk score total ranging from 0 to 5, based on our model-derived risk scores for individual risk factors. Using a PT approach, all men with risk scores at or above a chosen cut-point would receive treatment for *Neisseria gonorrhoeae* (NG) and *Chlamydia trachomatis* (CT). The vertical axis displays the proportion of *Anza Mapema* participants who would be eligible for PT at a given cut-point had diagnostic testing been unavailable. Sensitivity refers to the proportion

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of NG/CT cases with risk scores at or above a given cut-point. Specificity refers to the proportion of participants without NG/CT anorectal infection who had risk scores lower than a given cut-point.

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Table 1

Outcomes, characteristics and behaviours, examination findings and laboratory findings at enrolment among 698 MSM

	Ah participants (n=698)	Men reporting anorectal symptoms (n=166)	Men not reporting anorectal symptoms (n=532)
	n (%)	n (%)	n (%)
Outcomes			
Anorectal NG/CT infection	36 (5.2)	15 (9.0)	21 (4.0)
NG infection only	17 (47.2)	7 (46.7)	10 (47.6)
CT infection only	9 (25.0)	3 (20.0)	6 (28.6)
NG/CT coinfection	10 (27.8)	5 (33.3)	5 (23.8)
Urethral NG/CT infection	89 (12.8)	36 (21.7)	53 (10.0)
Characteristics and behaviours			
Age group			
>25 years	304 (43.6)	73 (44.0)	231 (43.4)
18–24 years	394 (56.4)	93 (56.0)	301 (56.6)
Highest education level completed			
Primary or less	149 (21.3)	51 (30.7)	98 (18.4)
Secondary	348 (49.9)	79 (47.6)	269 (50.6)
Higher/tertiary	201 (28.8)	36 (21.7)	165 (31.0)
Ever married to female partner			
No	511 (73.2)	119 (71.7)	392 (73.7)
Yes	187 (26.8)	47 (28.3)	140 (26.3)
Sexual orientation *			
Heterosexual	10 (1.4)		
Non-heterosexual	688 (98.6)		
Currently living with male sex partner			
No	440 (63.0)	79 (47.6)	361 (67.9)
Yes	258 (37.0)	87 (52.4)	171 (32.1)
HIV seropositive			
No	624 (89.4)	137 (82.5)	487 (91.5)
Yes	74 (10.6)	29 (17.5)	45 (8.5)
Ever had sex with female partner			

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	Ah participants (n=698)	Men reporting anorectal symptoms (n=166)	Men not reporting anorectal symptoms (n=532)
	n (%)	n (%)	n (%)
No	198 (28.4)	67 (40.4)	131 (24.6)
Yes	500 (71.6)	99 (59.6)	401 (75.4)
Current female sex partner			
No	181 (25.9)	34 (20.5)	147 (27.6)
Yes	517 (74.1)	132 (79.5)	385 (72.4)
Reported anal sex, past **3** months			
No	234 (33.5)	20 (12.1)	214 (40.2)
Yes	464 (66.5)	146 (87.9)	318 (59.8)
Multiple male sex partners, current			
No	323 (46.3)	62 (37.4)	261 (49.1)
Yes	356 (51.0)	100 (60.2)	256 (48.1)
Missing	19 (2.7)	4 (2.4)	15 (2.8)
Had condomless anal sex with male partner, past **3** months			
No	251 (36.0)	41 (24.7)	210 (39.5)
Yes	447 (64.0)	125 (75.3)	322 (60.5)
Usual sexual position, anal sex with male partner			
Inserting partner	380 (54.4)	68 (41.0)	312 (58.6)
Receiving partner	150 (21.5)	59 (35.5)	91 (17.1)
Versatile	155 (22.2)	38 (22.9)	117 (22.0)
Missing	13 (1.9)	1 (0.6)	12 (2.3)
Transactional sex, past 3 months (sex for money, food or housing)			
No	245 (35.1)	36 (21.7)	209 (39.3)
Yes	453 (64.9)	130 (78.3)	323 (60.7)
Male partner ejaculated inside rectum, at last sex			
No	406 (58.2)	58 (34.9)	348 (65.4)
Yes	283 (40.5)	107 (64.5)	176 (33.1)
Missing	9 (1.3)	1 (0.6)	8 (1.5)
Male partner put mouth/tongue on rectum, at last sex			
No	532 (76.2)	99 (59.6)	433 (81.4)
Yes	156 (22.4)	66 (39.8)	90 (16.9)

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	Ah participants (n=698)	Men reporting anorectal symptoms (n=166)	Men not reporting anorectal symptoms (n=532)
	n (%)	n (%)	n (%)
Missing	10 (1.4)	1 (0.6)	9 (1.7)
Male partner put fingers in rectum, at last sex			
No	383 (54.9)	62 (37.4)	321 (60.3)
Yes	305 (43.7)	104 (62.6)	201 (37.8)
Missing	10 (1.4)	0 (0)	10 (1.9)
Treated for any STI, past 3 months			
No	613 (87.8)	125 (75.3)	488 (91.7)
Yes	85 (12.2)	41 (24.7)	44 (8.3)
Disclosure of MSM status to provider at last STI treatment			
No	525 (75.2)	120 (72.3)	405 (76.1)
Yes	162 (23.2)	46 (27.7)	116 (21.8)
Missing	11 (1.6)	0 (0)	11 (2.1)
Physical violence, past 3 months			
No physical assault	509 (72.9)	95 (57.2)	414 (77.8)
Physically assaulted	141 (20.2)	56 (33.7)	85 (16.0)
Refused/do not know/no response	48 (6.9)	15 (9.0)	33 (6.2)
Sexual assault, past 3 months			
No sexual assault	529 (75.8)	104 (62.7)	425 (79.9)
Sexually assaulted	117 (16.8)	48 (28.9)	69 (13.0)
Refused/do not know/no response	52 (7.4)	14 (8.4)	38 (7.1)
Any alcohol use, past year			
No	243 (34.8)	56 (33.7)	187 (35.1)
Yes	455 (65.2)	110 (66.3)	345 (64.9)
Any drug use, past year			
No	405 (58.0)	96 (57.8)	309 (58.1)
Yes	293 (42.0)	70 (42.2)	223 (41.9)
Injection drug use, past year			
No	614 (88.0)	142 (85.5)	472 (88.7)
Yes	44 (6.3)	15 (9.0)	29 (5.5)
Refused/do not know/no response	40 (5.7)	9 (5.4)	31 (5.8)

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	Ah participants (n=698)	Men reporting anorectal symptoms (n=166)	Men not reporting anorectal symptoms (n=532)
	n (%)	n (%)	n (%)
Examination findings			
Rectal mucosal erythema			
No	492 (70.5)	122 (73.5)	370 (69.5)
Yes	1 (0.1)	0 (0)	1 (0.2)
Refused proctoscopy	205 (29.4)	44 (26.5)	161 (30.3)
Rectal purulent discharge			
No	493 (70.6)	122 (73.5)	371 (69.7)
Yes	0 (0)	0 (0)	0 (0)
Refused proctoscopy	205 (29.4)	44 (26.5)	161 (30.3)
Microscopy findings			
Leucocytes on rectal Gram stain			
No	538 (77.1)	115 (69.3)	423 (79.5)
Yes	106 (15.2)	36 (21.7)	70 (13.2)
Missing results	54 (7.7)	15 (9.0)	39 (7.3)
Gram-negative intracellular diplococci on rectal Gram stain			
No	609 (87.3)	139 (83.7)	470 (88.4)
Yes	38 (5.4)	15 (9.0)	23 (4.3)
Missing results	51 (7.3)	12 (7.2)	39 (7.3)

*Non-heterosexual orientations included: gay (249), homosexual (94), bisexual (200), shoga (43), basha (8), hanithi (1), kuchu (49), trans-sexual (11), queen (3), king (14), other (16).

CT, *Chlamydia trachomatis;* MSM, men who have sex with men; NG, *Neisseria gonorrhoeae.*

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Table 2

Correlates associated with symptomatic NG/CT anorectal infections at enrolment among 166 MSM

		Bivariate analysis		Multivariate analysis	
Characteristics and behaviours	**NG/CT cases, proportion (%)**	**OR (95% CI)**	**P values**	**aOR (95% CI)**	**P values**
Age group			0.39		
>25 years	10/93 (10.8)	Reference			
18–24 years	5/73 (6.8)	1.6 (0.5 to 5.0)			
Highest education level completed			0.52		
Primary or less	6/51 (11.8)	Reference			
Secondary	5/79 (6.3)	0.5 (0.1 to 1.8)			
Higher/tertiary	4/36 (11.1)	0.9 (0.2 to 3.6)			
Ever married to female partner			0.03		0.42
No	7/119 (5.9)	Reference		Reference	
Yes	8/47 (17.0)	3.3 (1.1 to 9.7)		1.8 (0.5 to 6.9)	
Currently living with male sex partner			0.13		0.12
No	10/79 (12.7)	Reference		Reference	
Yes	5/87 (5.7)	0.4 (0.1 to 1.3)		0.3 (0.1 to 1.4)	
HIV seropositive			<0.001		<0.001
No	6/137 (4.4)	Reference		Reference	
Yes	9/29 (31.0)	9.8 (3.1 to 30.7)		17.1 (3.5 to 84.0)	
Ever had sex with female partner			0.98		
No	6/67 (9.0)	Reference			
Yes	9/99 (9.1)	1.0 (0.3 to 3.0)			
Current female sex partner			0.21		
No	5/34 (14.7)	Reference			
Yes	10/132 (7.6)	0.5 (0.2 to 1.5)			
Reported anal sex, past 3 months			0.87		
No	2/20 (10.0)	Reference			
Yes	13/146 (8.9)	0.9 (0.2 to 4.2)			
Multiple male sex partners, current			0.14		0.23
No	8/62 (12.9)	Reference		Reference	

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		Bivariate analysis		Multivariate analysis	
Characteristics and behaviours	**NG/CT cases, proportion (%)**	**OR (95% CI)**	**P values**	**aOR (95% CI)**	**P values**
Yes	6/100 (6.0)	0.4 (0.1 to 1.3)		0.4 (0.1 to 1.7)	
Had condomless anal sex with male partner, past 3 months			0.13		0.23
No	1/41 (2.4)	Reference		Reference	
Yes	14/125 (11.2)	5.0 (0.6 to 39.9)		12.1 (0.2 to 725.2)	
Usual sexual position, anal sex with male partner			0.07		0.001
Inserting partner	1/68 (1.5)	Reference		Reference	
Receiving partner	8/59 (13.6)	10.5 (1.3 to 87.3)		53.5 (6.4 to 444.9)	
Versatile	6/38 (15.8)	12.6 (1.4 to 109.5)		24.2 (2.0 to 294.8)	
Transactional sex, past 3 months			0.08		0.65
No	6/36 (16.7)	Reference		Reference	
Yes	9/130 (6.9)	0.4 (0.1 to 1.1)		0.6 (0.1 to 4.5)	
Male partner ejaculated inside rectum, last sex encounter			0.88		
No	5/58 (8.6)	Reference			
Yes	10/107 (9.3)	1.1 (0.4 to 3.4)			
Male partner put mouth/tongue on rectum, last sex encounter			0.02		0.08
No	14/99 (14.1)	Reference		Reference	
Yes	1/66 (1.5)	0.1 (0.01 to 0.7)		0.1 (0.01 to 1.4)	
Male partner put fingers in rectum, last sex encounter			0.07		0.58
No	9/62 (14.5)	Reference		Reference	
Yes	6/104 (5.8)	0.4 (0.1 to 1.1)		0.7 (0.2 to 2.4)	
Treated for any STI, past 3 months			0.13		0.79
No	14/125 (11.2)	Reference		Reference	
Yes	1/41 (2.4)	0.2 (0.03 to 1.6)		0.6 (0.01 to 28.4)	
Disclosure of MSM status at last STI treatment			0.93		
No	11/120 (9.2)	Reference			
Yes	4/46 (8.7)	0.9 (0.3 to 3.1)			
Physical violence, past 3 months			0.94		
No physical assault	9/95 (9.5)	Reference			
Physically assaulted	5/56 (8.9)	0.9 (0.3 to 3.0)			
Refused/do not know/no response	1/15 (6.7)	0.7 (0.08 to 5.8)			

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		Bivariate analysis		Multivariate analysis	
Characteristics and behaviours	**NG/CT cases, proportion (%)**	**OR (95% CI)**	**P values**	**aOR (95% CI)**	**P values**
Sexual assault, past 3 months			0.67		
No sexual assault	11/104 (10.6)	Reference			
Sexually assaulted	3/48 (6.3)	0.6 (0.1 to 2.1)			
Refused/do not know/no response	1/14 (7.1)	0.7 (0.1 to 5.5)			
Any alcohol use, past year			0.55		
No	4/56 (7.1)	Reference			
Yes	11/110 (10.0)	1.4 (0.4 to 4.8)			
Any drug use, past year			0.08		0.11
No	12/96 (12.5)	Reference		Reference	
Yes	3/79 (3.8)	0.3 (0.1 to 1.2)		0.3 (0.05 to 1.3)	
Injection drug use, past year			0.90		
No	14/142 (9.9)	Reference			
Yes	0/15 (0)	Undefined			
Refused/do not know/no response	1/9 (11.1)	1.1 (0.1 to 9.9)			

aOR, adjusted OR; CT, *Chlamydia trachomatis;* MSM, men who have sex with men; NG, *Neisseria gonorrhoeae* RAI, receptive anal intercourse.

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Table 3

Correlates associated with asymptomatic NG/CT anorectal infections at enrolment among 532 MSM

Characteristics and behaviours	NG/CT cases, proportion (%)	Bivariate analysis		Multivariate analysis		Final model		Adjusted beta coefficient	Correlate score
		OR (95% CI)	P values	aOR (95% CI)	P values	aOR (95% CI)	P values		
Age group			0.01		0.02		0.007	2.03	2
>25 years	3/231 (1.3)	Reference		Reference		Reference			
18–24 years	18/231 (7.8)	4.8 (1.4 to 16.6)		8.2 (1.5 to 45.6)		7.6 (1.7 to 33.2)			
Highest education level completed			0.54						
Primary or less	2/98 (2.0)	Reference							
Secondary	11/269 (4.1)	2.0 (0.4 to 9.4)							
Higher/tertiary	8/165 (4.8)	2.4 (0.5 to 11.8)							
Ever married to female partner			0.09		0.14				
No	19/392 (4.8)	Reference		Reference					
Yes	2/140 (1.4)	0.3 (0.1 to 1.2)		0.2 (0.02 to 1.7)					
Currently living with male sex partner			0.41						
No	16/361 (4.4)	Reference							
Yes	5/171 (2.9)	0.6 (0.2 to 1.8)							
HIV seropositive			0.002		0.001		0.001	1.93	2
No	15/487 (2.9)	Reference		Reference		Reference			
Yes	6/45 (13.3)	4.8 (1.8 to 13.2)		8.0 (2.5 to 26.5)		6.9 (2.2 to 21.6			
Ever had sex with female partner			0.02		0.23				
No	10/131 (7.6)	Reference		Reference					
Yes	11/401 (2.7)	0.3 (0.1 to 0.8)		0.6 (0.2 to 1.4)					
Current female sex partner			0.69						
No	5/147 (3.4)	Reference							
Yes	16/385 (4.2)	1.2 (0.4 to 3.4)							
Reported anal sex, past 3 months			0.27						
No		Reference							
Yes		1.7 (0.7 to 4.5)							
Multiple male sex partners, current			0.97						
No	10/261 (3.8)	Reference							

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Characteristics and behaviours	NG/CT cases, proportion (%)	Bivariate analysis		Multivariate analysis		Final model		Adjusted beta coefficient	Correlate score
		OR (95% CI)	P values	aOR (95% CI)	P values	aOR (95% CI)	P values		
Yes	10/256 (3.9)	1.0 (0.4 to 2.5)							
Had condomless anal sex with male partner, past 3 months			0.06		0.03		0.02	1.33	1
No	4/210 (1.9)	Reference		Reference		Reference			
Yes	17/322 (5.3)	2.9 (1.0 to 8.7)		3.8 (1.1 to 13.2)		3.8 (1.2 to 11.9)			
Usual sexual position, anal sex with male partner			0.24						
Inserting partner	9/312 (2.9)	Reference							
Receiving partner	6/91 (6.6)	2.4 (0.8 to 6.9)							
Versatile	6/117 (5.1)	1.8 (0.6 to 5.2)							
Transactional sex, past 3 months			0.22						
No	11/209 (5.3)	Reference							
Yes	10/323 (3.1)	0.6 (0.2 to 1.4)							
Male partner ejaculated inside rectum, last sex encounter			0.12		0.26				
No	10/348 (2.9)	Reference		Reference					
Yes	10/176 (5.7)	2.0 (0.8 to 5.0)		1.7 (0.7 to 4.5)					
Male partner put mouth/tongue on rectum, last sex encounter			0.16		0.15				
No	20/433 (4.6)	Reference		Reference					
Yes	1/90 (1.1)	0.2 (0.03 to 1.8)		0.2 (0.03 to 1.8)					
Male partner put fingers in rectum, last sex encounter			0.34						
No	15/321 (4.7)	Reference							
Yes	6/201 (3.0)	0.6 (0.2 to 1.6)							
Treated for any STI, past 3 months			0.83						
No	19/488 (3.9)	Reference							
Yes	2/44 (4.5)	1.2 (0.3 to 5.2)							
Disclosure of MSM status at last STI treatment			0.38						
No	18/405 (4.4)	Reference							
Yes	3/116 (2.6)	0.6 (0.2 to 2.0)							
Physical violence, past 3 months			0.38						

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Characteristics and behaviours	NG/CT cases, proportion (%)	Bivariate analysis		Multivariate analysis		Final model		Adjusted beta coefficient	Correlate score
		OR (95% CI)	P values	aOR (95% CI)	P values	aOR (95% CI)	P values		
No physical assault	19/414 (4.6)	Reference							
Physically assaulted	1/85 (1.2)	0.2 (0.03 to 1.9)							
Refused/do not know/no response	1/33 (3.0)	0.6 (0.1 to 5.0)							
Sexual assault, past 3 months			0.48						
No sexual assault	19/425 (4.5)	Reference							
Sexually assaulted	1/69 (1.4)	0.3 (0.04 to 2.4)							
Refused/do not know/no response	1/38 (2.6)	0.6 (0.1 to 4.4)							
Any alcohol use, past year			0.23						
No	10/187 (5.3)	Reference							
Yes	1 1/345 (3.2)	0.6 (0.2 to 1.4)							
Any drug use, past year			0.42						
No	14/309 (4.5)	Reference							
Yes	7/223 (3.1)	0.7 (0.3 to 1.7)							
Injection drug use, past year			0.79						
No	20/472 (4.2)	Reference							
Yes	0/29 (0)	Undefined							
Refused/do not know/no response	1/31 (3.2)	0.8 (0.1 to 5.8)							

aOR, adjusted OR; CT, *Chlamydia trachomatis;* MSM, men who have sex with men; NG, *Neisseria gonorrhoeae.*