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Modest rise in chlamydia and gonorrhoea testing did not increase case detection in a clinical HIV cohort in Ontario, Canada

Ann N Burchell,[1,2] Ramandip Grewal,[1] Vanessa G Allen,[3,4] Sandra L Gardner,[1,2] Veronika Moravan,[1] Ahmed M Bayoumi,[5,6,10] Rupert Kaul,[5] Frank McGee,[7] Margaret (Peggy) E Millson,[2] Robert S Remis,[2] Janet Raboud,[2,8] Tony Mazzulli,[3,4,9] Sean B Rourke,[1,10,11] on behalf of the OHTN Cohort Study Team

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For numbered affiliations see end of article.

Correspondence to
Dr Ann N Burchell, Ontario HIV Treatment Network, Suite 600, 1300 Yonge Street, Toronto, ON, Canada M4T 1X3; aburchell@ohtn.on.ca

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ABSTRACT

Objectives We described patterns of testing for chlamydia and gonorrhoea infection among persons in specialty HIV care in Ontario, Canada, from 2008 to 2011.

Methods We analysed data from 3165 participants in the OHTN Cohort Study attending one of seven specialty HIV care clinics. We obtained chlamydia and gonorrhoea test results via record linkage with the provincial public health laboratory. We estimated the proportion of participants who underwent testing annually, the positivity rate among those tested and the proportion diagnosed with chlamydia or gonorrhoea among all under observation. We explored risk factors for testing and diagnosis using multiple logistic regression analysis.

Results The proportion tested annually rose from 15.2% (95% CI 13.6% to 16.7%) in 2008 to 27.0% (95% CI 25.3% to 28.6%) in 2011 (p<0.0001). Virtually all were urine-based nucleic acid amplification tests. Testing was more common among men who have sex with men (MSM), younger adults, Toronto residents, persons attending primary care clinics and persons who had tested in the previous year or who had more clinic visits in the current year. We observed a decrease in test positivity rates over time. However, the annual proportion diagnosed remained stable and in 2011 this was 0.97% (95% CI 0.61% to 1.3%) and 0.79% (95% CI 0.46% to 1.1%) for chlamydia and gonorrhoea, respectively. Virtually all cases were among MSM.

Conclusions Chlamydia and gonorrhoea testing increased over time while test positivity rates declined and the overall proportion diagnosed remained stable, suggesting that the modest increase in testing did not improve case detection.

INTRODUCTION

Since the early 2000s, chlamydia and gonorrhoea incidence has risen in many urban centres, including in Ontario, Canada.[1] Case reporting for chlamydia and gonorrhoea increased 79 and 23%, respectively, from 2002 to 2011, with average annual increases of 10 and 2% per year, respectively, since 2008. Although the majority of chlamydia cases are among young women, gonorrhoea cases are more commonly reported among men (57%), and of these, 42% report sex with other men.[2] High rates of sexually transmitted infections (STIs) have been found among persons living with HIV in similar developed nations such as the USA, Australia and parts of Europe.[3 4] The burden of STI coinfection is especially high among HIV-positive men who have sex with men (MSM).[5 6]

Chlamydia and gonorrhoea infection among persons with HIV is particularly concerning because STIs can enhance HIV infectiousness and sequelae may be more pronounced.[7–9] Regular screening is important in this population. Canadian and US guidelines recommend testing for chlamydia and gonorrhoea at least annually among sexually active gay, bisexual and other MSM, regardless of HIV status.[7 10] For people with HIV, US guidelines recommend annual routine screening for curable STIs and British guidelines recommend offering an annual full sexual health screen.[10 11]

Few published studies have examined patterns of chlamydia and gonorrhoea testing in HIV clinic populations, yet such information is crucial to inform public health strategies and clinical guidelines for people living with HIV. Our first objective was to expand knowledge on testing patterns in this population by estimating rates and correlates of testing among persons in HIV care in Ontario from 2008 to 2011. Since Canada has universal healthcare, any differences seen would reflect non-financial barriers. Our second objective was to determine the burden of and risk factors for a new diagnosis of chlamydia or gonorrhoea, measured as annual positivity rates among those tested and the overall proportion diagnosed among all in care. Given the reported increases in chlamydia and gonorrhoea cases in Ontario since 2002,[2] we hypothesised a priori that testing and new diagnosis rates would increase over the study period.

METHODS

Our setting was the province of Ontario, which has the largest proportion (44%) of new HIV diagnoses in Canada.[12] Our data source was the ongoing Ontario HIV Treatment Network Cohort Study (OCS); its study design has been described previously.[13] Briefly, the OCS source population consists of voluntary, consented participants aged 16 and older diagnosed with HIV infection receiving medical care at 10 specialty HIV clinics.

Participants were interviewed annually using structured questionnaires and clinical data were abstracted from clinic records.[13] The study protocol, research instruments and forms received ethical approval from the University of Toronto Human Subjects Review Committee and from the study sites.

Chlamydia and gonorrhoea testing

We obtained testing data for HIV viral load and bacteriological tests for chlamydia and gonorrhoea through record linkage with the provincial Public Health Ontario Laboratories (PHOL), the sole provider of HIV viral load tests in Ontario and the primary provider for chlamydia and gonorrhoea tests submitted by STI clinics. In other clinical settings such as HIV clinics or primary care clinics, chlamydia and gonorrhoea tests may either be submitted to the PHOL or to private laboratories. The PHOL began keeping computerised records of chlamydia and gonorrhoea tests in 2008 and testing was available by culture or nucleic acid amplification testing (NAAT). Prior to 2009, NAAT was performed using the Becton Dickinson ProbeTec assay (BD Biosciences, Sparks, Maryland, USA). Starting in July 2009, the PHOL used the Gen-Probe Aptima assay (Gen-Prose, San Diego, California, USA). NAAT testing is only performed for urine, endocervical or urethral specimens, whereas culture is offered for genital and non-genital sites (eg, rectal, pharyngeal, conjunctival swabs). Culture is the only diagnostic method that allows for antibiotic resistance testing of *Neisseria gonorrhoeae*.

Each clinic participating in the OCS received a questionnaire to establish to which laboratories they submitted orders for chlamydia and gonorrhoea testing. Seven of 10 clinics responded that they submit all specimens to the PHOL; two were primary care clinics and the remainder were hospital-based clinics.

Analysis

There were 5933 OCS enrolees as of December 2011. We restricted the analysis to persons under observation at any time from 2008 to 2011 (1738 removed) and to participants who attended one of the seven clinics that submitted chlamydia and gonorrhoea tests to the PHOL (1030 removed). The latter exclusion ensured that all chlamydia and gonorrhoea testing ordered by the participating HIV clinic and any STI clinic in Ontario would be observable. The final sample size for analysis was 3165 participants. We conducted all statistical analyses using SAS V.9.3 (SAS Institute, Inc., Cary, North Carolina, USA). All p values were two-sided, and statistical significance was determined using the conventional p value of <0.05.

We used descriptive statistics to characterise participants included in the analysis and compared them with participants attending the three clinics excluded from the analysis. Next, we examined the proportion of participants that underwent testing at least once at any time from 2008 to 2011 and at least once in each calendar year when they were under follow-up ('annual testing').

We defined a case as a participant with ≥ 1 positive test result in a given calendar year. We calculated annual positivity rates among those tested. We calculated the proportion diagnosed with chlamydia or gonorrhoea among all participants under observation in each calendar year whether or not they underwent testing in that year. This is an underestimate of true prevalence since the numerator excludes undetected (likely asymptomatic) cases among untested patients.

We used multiple logistic regression and a generalised estimating equations framework with an autoregressive correlation structure to explore potential correlates of testing and risk factors for diagnosis of chlamydia and gonorrhoea. Each person-year was modelled as a unique observation and all ORs and proportions are reported with 95% CIs. Persons with unknown or missing information for a covariate were excluded from models given the small numbers with missing data. To determine whether a previous gonorrhoea or chlamydia test increased the odds of subsequent testing, we excluded the year 2008 and participants with ≤ 2 years of prospective follow-up (n=341) from our testing analysis. For the diagnosis outcome, we conducted a sensitivity analysis to explore whether there were any differences when restricting to testers. For both the testing and diagnosis outcomes, we first built a multivariable model containing all considered covariates, then excluded those

Table 1 Characteristics of OHTN Cohort Study participants included in the analysis of chlamydia and gonorrhoea testing, 2008–2011

	All participants (n=3165)	MSM (n=2179)
Mean age at baseline (SD)*	45.5 (10.0)	46.7 (9.9)
Sex		
Male: MSM	68.9%	–
Male: non-MSM	12.1%	–
Female	16.9%	–
Unknown†	2.2%	–
Median year of HIV diagnosis (IQR)	1998 (1992–2004)	1996 (1991–2003)
Region of Ontario		
Toronto	83.5%	86.5%
Other	16.5%	13.5%
Ethnicity		
White	61.7%	74.1%
Black/African	14.3%	4.2%
Aboriginal	4.5%	4.4%
Other	16.6%	17.1%
Unknown	3.0%	0.2%
Education		
High school or less	28.6%	23.02%
Trade school or college	29.1%	30.1%
University	35.3%	42.9%
Unknown	7.0%	3.9%
Income		
Less than $20 000	39.2%	34.7%
$20 000–$59 999	34.3%	37.7%
$60 000 or more	17.0%	21.7%
Unknown	9.3%	5.8%
Median # months of prospective follow-up (IQR)	36.0 (26.4–42.0)	36 (27.6–43.2)
Median CD4 cell count/mm^3 at baseline (IQR)*‡	470 (330–640)	480 (340–650)
Antiretroviral medication any time during follow-up	92.8%	93.4%
Viral load at baseline*		
Undetectable (<50 copies/mL)	56.8%	58.8%
Detectable but suppressed (50–199 copies/mL)	7.9%	8.0%
Unsuppressed (200+ copies/mL)	34.1%	32.2%
Unknown	1.2%	1.0%

*Baseline was defined as the later of 1 January 2008 or the date of enrolment.
†Reasons for missing data among persons with unknown sex and MSM status: 0.16% missing data on sex; 2.04% males with missing data on history of sex with men.
‡CD4 cell count was missing for 2.4% of participants.
MSM, men who have sex with men.

Table 2 Annual chlamydia and gonorrhoea testing among participants attending selected clinics of the OHTN Cohort Study, 2008–2011

	2008	2009	2010	2011
Per cent tested for chlamydia/gonorrhoea*				
All†	15.2 (13.7 to 16.7)	20.5 (19.0 to 22.1)	24.1 (22.5 to 25.7)	27.0 (25.3 to 28.6)
MSM†	18.6 (16.6 to 20.6)	23.9 (22.0 to 25.8)	28.9 (26.9 to 30.9)	32.4 (30.3 to 34.4)
Non-MSM male†	3.7 (1.5 to 6.0)	5.6 (3.0 to 8.2)	6.9 (4.1 to 9.7)	10.1 (6.8 to 13.4)
Women†	10.3 (7.1 to 13.4)	17.5 (13.8 to 21.1)	17.5 (14.0 to 20.9)	18.5 (15.0 to 22.0)
Chlamydia positivity rate‡				
All	5.5 (4.6 to 8.1)	4.7 (3.9 to 6.4)	4.8 (4.0 to 6.4)	3.6 (2.9 to 5.0)
MSM	6.1 (4.9 to 9.0)	5.4 (4.4 to 7.4)	5.4 (4.4 to 7.2)	3.7 (2.8 to 5.2)
Non-MSM male	0.0 (0.0 to 36.9)	0.0 (0.0 to 21.7)	0.0 (0.0 to 16.8)	3.1 (0.1 to 17.4)
Women	2.8 (0.1 to 15.5)	1.4 (0.0 to 7.6)	2.5 (0.3 to 9.0)	3.5 (0.7 to 10.1)
Proportion diagnosed with chlamydia§				
All	0.8 (0.5 to 1.8)	1.0 (0.6 to 1.8)	1.2 (0.8 to 2.0)	1.0 (0.6 to 1.7)
MSM	1.1 (0.6 to 2.4)	1.3 (0.8 to 2.3)	1.5 (1.0 to 2.6)	1.2 (0.7 to 2.1)
Non-MSM male	0.0 (0.0 to 1.4)	0.0 (0.0 to 1.2)	0.0 (0.0 to 1.2)	0.3 (0.0 to 1.8)
Women	0.3 (0.0 to 1.3)	0.2 (0.0 to 1.3)	0.4 (0.1 to 1.6)	0.6 (0.1 to 1.9)
Gonorrhoea positivity rate‡				
All	5.4 (2.9 to 7.8)	2.9 (1.5 to 4.3)	2.7 (1.5 to 4.0)	3.0 (1.8 to 4.2)
MSM	5.5 (2.8 to 8.2)	3.5 (1.8 to 5.2)	3.2 (1.8 to 4.7)	3.6 (2.1 to 5.1)
Non-MSM male	10.0 (0.3 to 55.7)	0.0 (0.0 to 21.7)	0.0 (0.0 to 17.6)	0.0 (0.0 to 11.5)
Women	3.0 (0.1 to 16.9)	0.0 (0.0 to 5.1)	0.0 (0.0 to 4.8)	0.0 (0.0 to 4.3)
Proportion diagnosed with gonorrhoea§				
All	0.7 (0.4 to 1.1)	0.6 (0.3 to 0.9)	0.6 (0.4 to 0.9)	0.8 (0.5 to 1.1)
MSM	1.0 (0.5 to 1.5)	0.8 (0.4 to 1.2)	0.9 (0.5 to 1.3)	1.1 (0.7 to 1.6)
Non-MSM male	0.4 (0.0 to 1.7)	0.0 (0.0 to 1.2)	0.0 (0.0 to 1.2)	0.0 (0.0 to 1.2)
Women	0.3 (0.0 to 1.3)	0.0 (0.0 to 0.9)	0.0 (0.0 to 0.8)	0.0 (0.0 to 0.8)

Results shown as percentages with 95% CIs in parentheses.
*Virtually all (99%) tests were simultaneously co-tested for both pathogens.
†Statistically significant increase from 2008–2011 ($p<0.05$).
‡The positivity rate is the per cent with a reactive test among all tested in that year.
§The proportion diagnosed is the per cent with a reactive test among all patients in care and under observation in that year.
MSM, men who have sex with men.

that were neither associated with the outcome nor considered confounders for the remaining covariates.

RESULTS

At the start of follow-up in 2008–2011, participants attending the included clinics were aged 45 years, on average (table 1). The majority were men (81.0%), many of whom self-identified as gay or bisexual or reported sex with other men as an HIV risk factor (85.1%). The 3165 participants were followed a median of 3.0 years for a sum total of 8442 person-years. When compared with the 1030 participants attending clinics excluded from the analysis, included participants were similar in terms of year of HIV diagnosis and CD4 cell count at baseline (see online supplementary table). However, all excluded participants attended clinics outside Toronto, were slightly younger, fewer were MSM and higher proportions reported Aboriginal ethnicity and lower educational achievement and income.

Chlamydia and gonorrhoea testing

We linked 3476 chlamydia and 3449 gonorrhoea tests to participants. Virtually all tests (99%) consisted of simultaneous co-testing for both pathogens. Among all persons tested (n=1041), the majority of tests (87.0%, 3034/3486) were urine-based NAAT. Only 3.9, 4.1 and 4.9% were cultured using specimens from the genital, rectal or pharyngeal tract, respectively.

In all, 38.8% (95% CI 37.1% to 40.5%) of patients were tested at least once in 2008–2011. There was a significant increase in testing from 2008 to 2011 ($p<0.0001$) (table 2). Most tests (86.6%) were ordered by participating HIV clinics; other tests were ordered by sexual health/STI/community health clinics (2.8%) or by other health providers (10.6%) such as non-HIV specialist family physicians. Among those tested, the median number of tests per person per year was 1.0 (IQR 1.0–2.0). Testers underwent testing a median of 2.0 times (75%ile 4.0 times). Among those tested at least twice, the median interest interval was 4.1 months (IQR 2.6–7.8) for persons whose tests were non-reactive and 2.0 months (IQR 0.93–3.7) for persons who had at least one reactive test.

Correlates of testing included younger age, attending a primary care clinic, Toronto residence, having undergone testing in the previous year and being a MSM (table 3). We used the frequency of viral load testing as a proxy for clinic attendance and found that participants who had at least two viral load tests per year had higher odds of having also been tested for chlamydia/gonorrhoea. We observed no associations between testing and socioeconomic status variables (ie, race, education, gross personal income; data not shown). After adjusting for covariates, testing rates were no different among women compared with MSM.

We further examined testing patterns in the subset of participants who were under observation soon after HIV diagnosis and care entry in 2008–2011. Annual testing rates were higher in the year of HIV diagnosis/care entry (38.0%, 35/92) compared with later years (21.9%, 2271/8093; $p<0.0001$). Adjustment for recent HIV diagnosis/care entry did not alter the trend of increased testing over calendar time (data not shown).

Table 3 Correlates of annual testing for chlamydia/gonorrhoea among participants attending selected clinics of the OHTN Cohort Study

	Person years of observation*	Per cent tested	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Each additional calendar year			1.20 (1.14 to 1.25)	1.27 (1.17 to 1.39)
Sex				
Male: MSM	5722	28.5	Referent	Referent
Male: non-MSM	898	7.1	0.19 (0.14 to 0.27)	0.47 (0.35 to 0.64)
Female	1289	17.6	0.54 (0.44 to 0.67)	0.91 (0.73 to 1.14)
Age (years)				
<30	320	40.0	Referent	
30–39	1209	33.3	0.76 (0.56 to 1.03)	
40–49	3309	25.4	0.54 (0.40 to 0.72)	
50+	3218	17.3	0.36 (0.26 to 0.48)	
Each additional decade			0.68 (0.63 to 0.73)	0.72 (0.67 to 0.77)
Region				
Other	1208	3.9	Referent	Referent
Toronto	6848	27.5	9.38 (6.71 to 13.1)	2.27 (1.61 to 3.19)
Viral load tests in calendar year				
1 test	705	15.6	Referent	Referent
2–3 tests	4015	21.9	1.39 (1.16 to 1.68)	1.65 (1.25 to 2.15)
4 or more tests	3172	29.3	1.83 (1.51 to 2.21)	2.72 (2.07 to 3.59)
Clinic type				
Tertiary	4748	9.7	Referent	Referent
Primary	3308	44.4	7.35 (6.31 to 8.56)	3.81 (3.24 to 4.48)
Tested for chlamydia/gonorrhoea in previous year				
No	5799	13.4	Referent	Referent
Yes: non-reactive	1392	59.9	26.4 (22.6 to 30.9)	7.03 (5.92 to 8.34)
Yes: reactive	106	75.5	47.6 (25.3 to 89.4)	15.6 (9.04 to 27.0)

Multiple logistic regression with generalised estimating equations. Each person year was modelled as a unique observation (n=8056 person-years among 2854 participants). We excluded the year 2008 and any participant with less than two years of prospective follow-up to allow for estimation of the effect of having tested in the previous calendar year. See text for details.
*The sum total of years that participants were under observation.
MSM, men who have sex with men.

Diagnosis with chlamydia or gonorrhoea

There were 86 diagnosed cases of chlamydia and 64 cases of gonorrhoea. Among persons tested, the positivity rates decreased from 2008 to 2011 (table 2). Nevertheless, the overall annual proportion diagnosed remained stable. Virtually all cases were among MSM (80/86 chlamydia cases and 62/64 gonorrhoea cases). Not quite half (27/64) of gonorrhoea cases were cultured; none had decreased susceptibility to the first-line oral therapy cefixime (as defined at that time by PHOL as a minimum inhibitory concentration ≥0.25 µg/mL) or to ceftriaxone. Test positivity was high among the few patients who were cultured using extragenital specimens. For oral specimens, 18% (32) and 8.2% (14) were positive for chlamydia or gonorrhoea, respectively. For rectal specimens, 16.0% (23) were chlamydia positive and 19% (28) gonorrhoea positive.

Risk factors for diagnosis with chlamydia or gonorrhoea among gay and other MSM

Risk factor analysis was possible for MSM (table 4). Young age was a risk factor for chlamydia and gonorrhoea; age was not statistically significant for gonorrhoea when restricting to testers (0.79, 95% CI 0.61 to 1.02). A diagnosis of gonorrhoea was more likely among men who had unsuppressed viral load in the same calendar year. Finally, in unadjusted models, attendance at a primary care clinic was associated with a diagnosis of chlamydia, but was no longer statistically significant in the multivariable model (table 4) or when restricting to testers (data not shown).

DISCUSSION

Annual chlamydia and gonorrhoea testing increased among persons in HIV care in Ontario, Canada, from 15.2% in 2008 to 27.0% in 2011. Despite the rise, testing rates observed in this study were less than expected according to Canadian and international guidelines.[7 10 11] Our findings confirm a notable burden of chlamydia and gonorrhoea infection among HIV-positive MSM in our setting. In 2011, the proportion of MSM diagnosed with chlamydia or gonorrhoea was 1.2% (95% CI 0.71% to 1.7%) and 1.1% (95% CI 0.67% to 1.6%), respectively. Among other men and women, chlamydia was less commonly diagnosed (2011, men: 0.32%, 95% CI 0.01% to 1.8%; 2011, women: 0.64%, 95% CI 0.13% to 1.9%) and we observed no cases of gonorrhoea among non-MSM males and women in 2011.

Strengths of our analysis included the use of a large sample of patients from multiple clinics that ordered tests from a single laboratory. Nevertheless, our findings may have excluded some undiagnosed cases because the majority of patients were untested and there was virtually no testing of non-urethral sites. In a US military HIV cohort, diagnoses of chlamydia and gonorrhoea increased after the introduction of routine semiannual urine-based screening although the positivity rates among those tested remained constant.[14] Testing of non-urethral sites merits consideration as it has been shown to be cost-saving due to improved case detection.[15] Among asymptomatic MSM in an urban STI clinic in San Francisco, urethral-only screening missed 84% of infections, whereas screening of the anal and pharyngeal sites missed only 9.8% of cases.[16] Canadian and US

Table 4 Risk factors for diagnosis with chlamydia and gonorrhoea co-infection among HIV-positive MSM among participants attending selected clinics of the OHTN Cohort Study, 2008–2011

		Chlamydia			Gonorrhoea		
	Person years of observation*	Per cent diagnosed†	Unadjusted OR (95% CI)	Adjusted OR (95% CI)‡	Per cent diagnosed†	Unadjusted OR (95% CI)	Adjusted OR (95% CI)‡
Each additional calendar year			1.02 (0.85 to 1.21)	1.03 (0.85 to 1.24)		1.05 (0.84 to 1.31)	1.09 (0.85 to 1.40)
Initiated antiretroviral treatment							
No	562	2.49	Referent	Referent	2.67	Referent	Referent
Yes	6799	1.19	0.48 (0.26 to 0.90)	1.01 (0.50 to 2.07)	0.82	0.31 (0.16 to 0.59)	0.80 (0.38 to 1.69)
Age (years)							
<30	279	6.09	Referent		3.23	Referent	
30–39	888	3.04	0.45 (0.24 to 0.84)		1.58	0.52 (0.14 to 1.89)	
40–49	3034	1.02	0.17 (0.09 to 0.32)		1.15	0.59 (0.19 to 1.84)	
50+	3160	0.63	0.12 (0.06 to 0.23)		0.41	0.20 (0.06 to 0.72)	
Each additional decade			0.47 (0.37 to 0.60)	0.49 (0.38 to 0.64)		0.57 (0.45 to 0.73)	0.64 (0.50 to 0.81)
Max viral load in calendar year							
Undetectable/suppressed (<200 copies/mL)	5605	1.09	Referent	Referent	0.68	Referent	Referent
Unsuppressed (200 copies/mL or greater)	1638	2.01	1.76 (1.13 to 2.74)	1.18 (0.69 to 2.03)	2.01	2.95 (1.81 to 4.83)	2.12 (1.13 to 3.93)
Clinic type							
Tertiary	3767	0.74	Referent	Referent	0.64	Referent	Referent
Primary	3594	1.86	2.47 (1.51 to 4.05)	1.59 (0.84 to 3.00)	1.31	2.10 (1.21 to 3.65)	2.09 (0.90 to 4.85)

Multiple logistic regression with generalised estimating equations. Each person year was modelled as a unique observation (n=7361 person-years among 2179 men).
*The sum total of years that participants were under observation.
†The per cent per year with a reactive test among all patients in care and under observation.
‡Adjusted for all variables shown plus clinic.
MSM, men who have sex with men.

guidelines recommend oral and rectal testing for persons engaging in oral and rectal intercourse[7 10]; however, such tests were rarely done in our setting, limiting their epidemiological interpretation due to likely diagnostic workup bias. Furthermore, some patients likely underwent testing with other healthcare providers who submitted tests to private laboratories unavailable to us. Therefore, we interpret our observed rates of testing and diagnosis as underestimates.

Additional limitations may include selection biases due to volunteer participation and clinic inclusion criteria. OCS participants are generally representative of cumulative HIV diagnoses in Ontario in terms of sex, geographic region, age at diagnosis and HIV exposure category[17]; however, they under-represent the recently diagnosed. Among the clinics included in this analysis, approximately 50% of all clinic patients were active participants in the OCS; compared with non-participants, participants tend to be older, diagnosed in the more distant past, MSM and generally healthier as measured by CD4 cell count and viral load.[18] Participants included in the analysis were similar to those attending excluded clinics for year of HIV diagnosis and CD4 cell count at baseline, but were younger, with higher socioeconomic status, and MSM. Altogether, we propose that our findings would be most generalisable for MSM and women in continuous HIV care, but may not be representative of younger, more recently diagnosed persons, especially those not in HIV care.

We compared our findings with rates of notifiable disease reporting in Ontario in 2011. For men, rates of chlamydia and gonorrhoea case reporting were 0.19 and 0.04%, respectively, and for women these were 0.35 and 0.03%, respectively.[1] Therefore, our observed diagnosis rates among HIV-positive MSM were sixfold higher for chlamydia and 27-fold higher for gonorrhoea than those reported for the general male population in Ontario. Conversely, diagnosis rates among other men and women living with HIV were consistent with rates for the general population.

Among MSM in our cohort, chlamydia and gonorrhoea diagnoses were more likely among younger men, as we have also observed for syphilis.[6] Gonorrhoea was more common among men with unsuppressed viral load in the same calendar year; it is difficult to establish causality for this association as it may be that gonorrhoea infection led to an increase in viral load.[10 19] Nevertheless, HIV infectiousness may have been greater among men with gonorrhoea. Chlamydia was more common among men attending primary care clinics, but we attribute this finding to higher rates of testing. We did not observe differences in proportions diagnosed according to antiretroviral treatment status, similar to HIV cohorts in Madrid and Baltimore.[20 21]

Chlamydia and gonorrhoea testing was more common among patients attending a primary care clinic, which may be due to a greater emphasis on sexual health and STI screening in the primary care setting.[7] Moreover, in 2008 one of the participating primary care clinics instituted a reminder system regarding annual check-ins for STI screening. Higher proportions of testing were seen among MSM and those with more viral load tests in that year, suggesting more opportunities for testing among patients with more HIV care visits. Testing was also more common among younger participants and those tested in the preceding year, similar to the HIV clinic cohort in Baltimore.[22] We also observed similar correlates of testing for syphilis in our cohort, although annual rates of testing for syphilis were considerably higher at 55% per year in 2010.[6] Altogether, this suggests that efforts to improve HIV care engagement may have secondary benefits for sexual health promotion.

Observed diagnosis rates were generally consistent with studies of clinical HIV populations elsewhere based on data

from testing ordered as part of clinical care.[5 22] In the Baltimore cohort, the proportion diagnosed with chlamydia or gonorrhoea between 1999 and 2007 ranged from 0.4 and 1.5%.[22] In an MSM population in two HIV outpatient clinics in the Netherlands, the prevalence of urethral chlamydia and gonorrhoea was 0.3 and 1.4%, respectively.[5] Consistent with our findings of very few cases among women, Remis and colleagues observed zero prevalence of chlamydia and gonorrhoea among 126 HIV-positive women of African-Caribbean ethnicity in Toronto in 2009–2010.[23]

Chlamydia and gonorrhoea testing increased over time while test positivity declined and the overall proportion diagnosed remained stable, suggesting that the modest increase in testing did not improve case detection, contrary to hypothesis. This is comparable to findings in Baltimore where diagnoses remained stable among HIV patients despite a similarly slight increase in testing from 12% in 1999 to 33% in 2007.[22] We propose two competing hypotheses to explain these findings. Either earlier testing patterns were adequate to detect most new cases of chlamydia/gonorrhoea or the modest gains in testing were insufficient to detect a pool of likely asymptomatic infection. One would need to conduct a prevalence study among all patients to determine whether expanded screening is warranted. If the latter proved true, our experience in this setting is that clinical guidelines alone are insufficient to maximise screening uptake,[6 24] as others have observed elsewhere,[21 25] suggesting that systemic changes to healthcare practice would need to be explored.

Our findings of a notable burden of chlamydia and gonorrhoea among HIV-positive MSM have implications for prevention and care. We need to better understand the optimal strategies to promote chlamydia and gonorrhoea testing among MSM living with HIV and ensure that asymptomatic infection does not go undiagnosed. It is concerning that so few were cultured or tested at extragenital sites. Public health agencies in Canada and around the world are pressing for increased vigilance for antibiotic-resistant gonorrhoea strains, which have increased in prevalence.[26 27] This is critical for persons with HIV who may already be challenged by immune suppression. Clinical failures following treatment with cefixime have now been documented in our setting.[28] We support the national recommendation for culture of all symptomatic MSM patients prior to gonorrhoea treatment to monitor antibiotic resistance.[26] We also recommend more frequent collection and testing of pharyngeal and rectal samples—important reservoirs of chlamydia and gonorrhoea infection.[27]

Key messages

- There is a notable burden of chlamydia and gonorrhoea infection among HIV-positive men who have sex with men in care.
- Increased testing did not increase the proportion diagnosed with chlamydia or gonorrhoea; however, testing is still below Canadian and international guidelines.
- Consideration should be given to making systematic changes to healthcare practice and increasing extragenital screening to maximise screening uptake.
- Culturing specimens when testing for gonorrhoea will help monitor the increasing burden of antibiotic resistant gonorrhoea.

Author affiliations
[1]Ontario HIV Treatment Network, Toronto, Ontario, Canada
[2]Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada
[3]Public Health Laboratories, Public Health Ontario, Toronto, Ontario, Canada
[4]Department of Laboratory Medicine and Pathobiology, University of Toronto, Toronto, Ontario, Canada
[5]Department of Medicine, University of Toronto, Toronto, Ontario, Canada
[6]Institute of Health Policy, Management and Evaluation, University of Toronto, Toronto, Ontario, Canada
[7]AIDS Bureau, Ontario Ministry of Health and Long Term Care, Toronto, Ontario, Canada
[8]Toronto General Research Institute, University Health Network, Toronto, Ontario, Canada
[9]Mount Sinai Hospital/University Health Network, Toronto, Ontario, Canada
[10]Centre for Research on Inner City Health, The Keenan Research Centre in the Li KaShing Knowledge Institute, St. Michael's Hospital, Toronto, Ontario, Canada
[11]Department of Psychiatry, University of Toronto, Toronto, Ontario, Canada

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Supplemental Table: Characteristics of included and excluded participants in the analysis of chlamydia and gonorrhea testing, OHTN Cohort Study, 2008-2011

	Included Participants (N=3165)		Excluded Participants (N=1030)		P-value
	N	%	N	%	
Mean age at baseline (SD) [a]		45.5 (10.0)		46.8 (10.3)	0.0003
STI Group					
MSM	2179	68.9%	550	53.4%	
Non-MSM male	383	12.1%	251	24.4%	<.0001
Female	534	16.9%	203	19.7%	
Unknown	69	2.2%	26	2.5%	
Median year of HIV diagnosis (IQR)		1998 (1992-2004)		1997 (1991-2003)	0.05
Region of Ontario					
Toronto	2642	83.5%	0	0.0%	<.0001
Other	523	16.5%	1030	100.0%	
Ethnicity					
White	1953	61.7%	669	65.0%	
Black/African	451	14.3%	100	9.7%	<.0001
Aboriginal	142	4.5%	138	13.4%	
Other	525	16.6%	77	7.5%	
Unknown	94	3.0%	46	4.5%	
Education					
High school or less	904	28.6%	338	32.8%	
Trade school or college	921	29.1%	245	23.8%	<.0001
University	1118	35.3%	224	21.8%	
Unknown	222	7.0%	223	21.7%	
Income					
Less than $20,000	1246	39.2%	387	37.6%	
$20,000 to $59,999	1086	34.3%	289	28.1%	0.0006
$60,000 or more	538	17.0%	118	11.5%	
Unknown	295	9.3%	236	22.9%	
Median # months of prospective follow-up (IQR)		36.0 (26.4-42.0)		22.2 (12.0-37.2)	<.0001
Median CD4 cell count/mm^3 at baseline (IQR) [a,b]		470 (330-640)		468 (325.75-642.50)	0.726
Antiretroviral medication any time during follow-up	2937	92.8%	984	95.5%	0.002
Viral load at baseline [a]					
Undetectable (<50)	1799	56.8%	693	61.5%	
Detectable but suppressed (50-199)	250	7.9%	44	4.3%	<.0001
Unsuppressed (200+)	1079	34.1%	293	28.5%	
Unknown	37	1.2%	60	5.8%	

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SD, standard deviation. IQR, interquartile range.

a) Baseline was defined as later of January 1, 2008 or enrolment date.

b) CD4 cell count was missing for 2.4% of participants for included participants and 20% for excluded participants.