Prevalence and Predictors of Urethral Chlamydia and Gonorrhea Infection in Male Inmates in an Ontario Correctional Facility

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ABSTRACT

Objectives: To determine the prevalence of urethral chlamydia and gonorrhea in males in a correctional facility in Ontario, Canada, and to explore risk factors for infection.

Methods: Between June and December, 2009, 500 adult males who had been newly admitted at a correctional facility in southern Ontario completed a survey of risk factors and provided a urine sample for testing. Those who tested positive were treated and their names were provided to the local public health unit for follow-up including contact tracing. Prevalence and 95% confidence intervals were calculated for infection with chlamydia and gonorrhea, respectively, and a multivariable model was used to look at risk factors for infection.

Results: The study population reported high levels of sexual risk behaviours and drug use. The overall chlamydia prevalence was 2.9% (95% CI 1.6-4.8) and the overall gonorrhea prevalence was 0.6% (95% CI 0.1-1.8). Rates were particularly high for chlamydia in younger males, at 16% (95% CI 4.5-36) in 18-19 year olds and 3.7% (95% CI 1.0-9.3) in 20-24 year olds, and for gonorrhea in males aged 20-24 at 1.9% (95% CI 0.2-6.6). A multivariable logistic regression model revealed that though not statistically significant, younger age was associated with infection.

Conclusion: The relatively high prevalence of chlamydia and gonorrhea found in this study suggests that primary and secondary prevention programs should be instituted for males in correctional facilities, in particular among younger inmates. Further research is required to ensure internal and external generalizability of these results, as well as to determine the cost-effectiveness of potential interventions.

Key words: Prisons; chlamydia; gonorrhea; mass screening; prevention and control

Around the world, effective control of the bacterial sexually transmitted infections (STIs) chlamydia and gonorrhea remains elusive, despite the fact that they are easy to prevent, test for and treat. In Canada, reported rates have increased in the past decade.[1,2] A potential control strategy is to identify populations at high risk of infection and tailor primary and secondary prevention programs for these groups, a method that has been shown to be both effective and cost-effective.[3]

One such high-risk population is people who are incarcerated. Studies of HIV in Canada[4] and of chlamydia and gonorrhea in the UK[5] and US[6-8] consistently show that STIs are more common in incarcerated persons, indicating a prevalence of chlamydia ranging from 2.8% to 13% and a prevalence of gonorrhea ranging from 0.1% to 2.6% in males.

Reported rates likely underestimate the true prevalence of these STIs, in particular in incarcerated men, due to barriers to testing, including high rates of asymptomatic infection,[9] a lack of routine screening[7] in men in the community and in correctional facilities, and poor access to health care.[10] Nonetheless, reported rates serve as a proxy for population-based rates, which are not available for Canada, and the reported rates of chlamydia and gonorrhea in Canada are relatively high for the incarcerated population. In males and females in Canadian federal penitentiaries in 2002, chlamydia was reported for 0.32% and gonorrhea for 0.12% of the population, respectively.[10] In the general population of Canadian males in 2008, the reported rate of infection was 168.7 per 100,000 (0.17%) for chlamydia and 42.9 per 100,000 (0.04%) for gonorrhea,[1,2] with higher rates in the age groups 20-24 and 25-29 for both diseases: for chlamydia, 884.2 per 100,000 (0.9%) and 538.7 per 100,000 (0.5%), respectively; and for gonorrhea, 165.4 per 100,000 (0.2%) and 122.5 per 100,000 (0.1%), respectively. The reported overall and age-specific rates were similar but consistently lower for males in the jurisdiction in which the study took place as compared with the rates for Canada;[11,12] the overall prevalence was 163.9 per 100,000 (0.16%) for chlamydia and 25.8 per 100,000 (0.02%) for gonorrhea, and the highest age-specific rates for the two diseases, respectively, were for 20 to 24 year olds at 804.5 per 100,000 (0.8%) and 109.7 per 100,000 (0.11%).

Given the relatively high rates of infection in incarcerated males, screening programs may function as an effective secondary prevention measure for inmates and for their sexual contacts, and also potentially lead to primary prevention at the level of the popula-

Table 1. Sexual Behaviours Reported by Sexually Active Men

Risk Behaviour		Past 3 Months,* N=390	Past 12 Months,* N=452
Number of partners, mean (SD), range		1.97 (5.3), 1-100	3.32 (8), 1-110
Frequency of condom use	Always	12.8%	13.7%
	Usually	11.5%	12.0%
	Occasionally	9.0%	17.5%
	Never	66.2%	56.2%
Risky sexual behaviour†	Yes	83.6%	84.1%
	No	16.2%	15.5%
Use of condom during last intercourse	Yes	–	22.6%
	No	–	77.4%
Gender of sexual partner	Female only	–	98.7%
	Male only	–	0.2%
	Male and female	–	0.7%
Involvement in commercial sex	Yes	2.8%	3.1%
	No	93.4%	87.4%
Sex while drunk or high	Yes	74.1%	78.5%
	No	24.6%	20.1%

* Of those sexually active during the specified period.
† Defined as having more than one partner and not always using condoms.

tion. However, relatively little research has been done on this subject. The value of routine screening has been demonstrated by a study in San Francisco which found that greater density of testing in jails was associated with a decrease in chlamydia rates in females attending neighbourhood medical clinics.[13] Also, cost-effectiveness analyses of screening incarcerated males and providing notification services to partners have shown that screening programs may be cost-saving,[14,15] depending on the prevalence of the STIs.

Screening may be more cost-effective if it is targeted based on risk factors. Within the population of incarcerated males, several potential risk factors for these STIs have been investigated, including age, race, charge at the time of arrest, recent drug use, the presence of symptoms, prevalence of the STIs in the jurisdiction of residence of the inmate, the number of sexual partners, the recency of sexual encounter, previous STI, and condom use.[6-8] Younger age (for those older than 15 years), having a greater number of sexual partners, and having symptoms have been associated with infection,[6-8] though a lack of consistency in the inclusion and definition of these variables across studies precludes a clear understanding of the independent contribution of each of these factors to risk.

There are no studies in the published literature that systematically determine the prevalence in Canada of these STIs in incarcerated males. For this reason and given the potential population health value of primary and secondary prevention programs, the objectives of this study were to define the prevalence of urethral chlamydia and gonorrhea infection in adult male inmates on admission to an Ontario correctional facility, and to explore predictors of infection.

METHODS

The study was conducted in a correctional facility in southern Ontario, which receives approximately 5% of the total population of people who are arrested in Ontario each year. Between June and December 2009, a study nurse attended the correctional facility on approximately every third day to recruit participants. Initially, the jail nursing staff invited all inmates to participate at the time of admission, and the study nurse followed up to determine eligibility and obtain consent. However, due to low recruitment with this method, the protocol was modified in July 2009 such that inmates were invited to participate directly by the study nurse in the days subsequent to admission. Under this modified protocol, a list of inmates who had been admitted since the study nurse's previous visit and who were still in the facility (i.e., had not been discharged or transferred in the interim) was generated. All those on this list were approached regarding participation, with the exception of those who were deemed to present a risk to the study nurse as determined by the jail staff. For inmates who were at court at the time the study nurse was present, the study nurse attempted follow-up at each subsequent visit until 14 days after admission. Inmates were eligible to participate if they were at least 18 years old and understood English well enough to consent. Participation in the study was voluntary. The nurse obtained written consent for participation, and then orally conducted a survey of risk factors. The nurse then obtained a first-void urine specimen for gonorrhea and chlamydia testing. Testing was conducted using the Becton Dickinson ProbeTec Amplified DNA Assay (Franklin Lakes, New Jersey), according to the manufacturer's instructions. Results were reported to participants either while they were incarcerated or in the community subsequent to their release. Treatment was offered to those who tested positive and any positive tests were reported to the local public health unit for follow-up including contact tracing. Enrollment continued until there were 500 participants. This sample size was calculated *a priori* to allow detection with 95% confidence of a prevalence of chlamydia of 5% +/- 2% or 2% +/-1%.

A descriptive analysis was conducted of the survey data. For participants who submitted a urine sample, the prevalence and 95% confidence intervals were calculated using the exact method. For participants who had been sexually active in the past year and who had provided a urine sample, bivariate odds ratios and 95% confidence intervals were calculated to look at the association between each variable and infection with chlamydia or gonorrhea. Using this same population, a multivariable logistic regression model was developed which included all putative risk factors, and a final model was determined by comparing nested models and selecting the model that best fit the data.

Approval was obtained for the study from the Research Ethics Boards at McMaster University and the University of Toronto, as well as from the Ontario Ministry of Community Safety and Correctional Services.

RESULTS

Only 15 men were recruited in June and July 2009 prior to the modification of the recruitment protocol. Subsequent to the modifica-

Table 2. Prevalence of STIs, Overall and by Age Category (Years), N=488

	Overall, % (95% CI)	18-19, % (95% CI)	20-24, % (95% CI)	25-29, % (95% CI)	30-39, % (95% CI)	≥40, % (95% CI)
Chlamydia	2.9 (1.6-4.8)	16 (4.5-36)	3.7 (1.0-9.3)	3 (0.6-8.5)	1.8 (0.2-6.2)	0.7 (0-3.8)
Gonorrhea	0.6 (0.1-1.8)	0 (0-13.7)	1.9 (0.2-6.6)	1 (0-5.4)	0 (0-3.2)	0 (0-2.5)
Either STI	3.5 (2.0-5.5)	16 (4.5-36)	5.6 (2.1-11.8)	4.0 (1.1-9.9)	1.8 (0.2-6.2)	0.7 (0-3.8)

Table 3. Logistic Regression of Infection With Chlamydia or Gonorrhea*

Variable		Bivariate Models	Multivariable Model Containing All Variables
Age (years)	≥40	1	1
	30-39	2.56 (0.23-28.58)	1.74 (0.14-20.99)
	25-29	5.92 (0.65-53.75)	5.42 (0.53-54.99)
	20-24	**8.44 (1-71.15)**	6.99 (0.68-71.57)
	18-19	**27.05 (2.88-253.74)**	**22.32 (1.70-292.81)**
Sex while drunk or high in past 12 months	No	1	1
	Yes	3.92 (0.51-30.08)	2.88 (0.34-24.78)
Risky sexual behaviour	No	1	1
	Yes	0.42 (0.14-1.24)	0.50 (0.14-1.8)
Marital status	Common-law	1	1
	Married	1.55 (0.14-17.74)	5.02 (0.28-89.32)
	Single	2.13 (0.47-9.68)	2.88 (0.35-23.8)
	Separated	3.46 (0.46-25.78)	10.39 (0.79-136.46)
Drug use in past 12 months	Any drug	1.75 (0.61-5.07)	2.99 (0.78-11.48)
	Heroin	0.78 (0.10-6.03)	–
	Other opioids	**2.69 (1.01-7.20)**	–
	Cocaine use	2.44 (0.91-6.54)	–
	Crack use	0.51 (0.14-1.79)	–
	Crystal meth	0.99 (0.13-7.71)	–
History of previous STIs	Any STI	0.66 (0.21-2.09)	1.16 (0.33-4.10)
	Chlamydia	0.91 (0.20-4.08)	–
	Genital herpes	5.19 (0.57-47.02)	–
	Hepatitis C	1.01 (0.23-4.57)	–

* Bold indicates statistical significance at p<0.05.

tion, 241 men were released or transferred before being contacted to participate and 131 were ineligible to participate because of psychiatric or other illness, inability to speak English, or potential safety risk to the nurse. Of the 921 who were eligible to participate and were contacted by the study nurse, 485 (52.7%) agreed to participate. All 500 participants completed the survey and 488 (97.6%) provided a urine sample for testing. The sexual risk behaviour and drug use characteristics of the 12 men who refused to provide a urine sample were similar to those of the 488 men who provided a urine sample (data not shown).

The mean age of the 500 participants was 33.6 years and the median age was 30.5 years, with a standard deviation of 11.8 and a range of 18 to 90 years. The majority (61.6%) of participants were single, 19% were in common-law relationships, 7.2% were married, 6.4% were separated, and 5% were divorced.

The majority of the men (78%; 390/500) had had intercourse in the past 3 months, and 90.4% (452/500) had had intercourse in the past 12 months. As shown in Table 1, most of those who had been sexually active within the past year had had multiple partners and had not used condoms. A variable was generated for risky sexual behaviour, defined as having more than one partner and not always using condoms, and more than 80% of sexually active men had engaged in such risky behaviours. A minority of sexually active participants reported commercial sex involvement, defined as having given or taken money, drugs, shelter or food in exchange for sex. About three quarters of men had had sex while drunk or high in both the past 3 and 12 months.

When asked about drug use in the previous 12 months, 56.6% (283/500) reported any recreational drug use. Of the 500 participants, 37.6% (188) had used cocaine, 35.2% (176) had used opi-

oids other than heroin, 29% (145) had used crack, 7.4% (37) had used heroin, and 6% (30) had used crystal meth.

Regarding STI history, 13% (65/500) reported having ever been diagnosed with chlamydia, and 6.4% (32/500) with gonorrhea. Twelve point six percent (12.6%) reported having been infected with hepatitis C (63/500), 5.8% (29/500) with genital warts, and 1.4% (7/500) with genital herpes. One percent or less of participants reported a history of infection with hepatitis B (5/500), HIV (2/500), trichomonas (2/500), or syphilis (1/500).

As shown in Table 2, of the 488 participants who provided a urine sample, 2.9% tested positive for chlamydia (95% CI 1.6-4.8) and 0.6% tested positive for gonorrhea (95% CI 0.1-1.8), with 3.5% testing positive for either of these infections (95% CI 2.0-5.5). No participants were co-infected with chlamydia and gonorrhea. The rate of infection for each of these STIs was highest for participants who were younger than 30 years old, with rates of chlamydia of 4.7% (95% CI 2.4-8.3), of gonorrhea of 1.3% (95% CI 0.3-3.7), and of either infection of 6.0% (95% CI 3.3-9.9).

In the logistic regression, it was not possible to look at the odds ratios for involvement in commercial sex, for having had male partners or male and female partners in the past year, or for a self-reported history of gonorrhea, HIV/AIDS, syphilis, genital warts, trichomonas, or hepatitis B, since there were no cases of gonorrhea or chlamydia in those inmates who reported these potential risk factors. As shown in Table 3, younger age and use of cocaine were each associated with infection in bivariate but not multivariable logistic regression, but these associations were not statistically significant at p<0.05. Use of opioids other than heroin was significantly associated with infection in the bivariate model. Any drug use was positively associated with infection in the bivariate and full

multivariable models, though was not statistically significant. Risky sexual behaviour, defined as having more than one partner and not always using condoms, was associated with lower odds of infection compared with those who always used condoms or had only one partner in both bivariate and multivariable analyses, though this was not significant. The best fit model for the data included only younger age as a predictor of infection.

DISCUSSION

This is the first published study to systematically investigate the prevalence of chlamydia and gonorrhea in a Canadian correctional facility. The study reveals very high rates of these STIs in male inmates on admission to a correctional facility in Ontario, in particular for younger males. The study also indicates high levels of risky sexual behaviours and drug use in this population.

The high prevalence of gonorrhea and chlamydia and the identification of younger age as a potential risk factor are consistent with studies of incarcerated men internationally.[5-8] In fact, the STI rates in this study are on the low end of the range found in studies in the US and UK, which may reflect differences in the general epidemics across these regions. Regarding the risk factors explored in the study, it is unclear why risky sexual behaviour would be associated with a decreased risk of infection; this relationship may be spurious, may reflect residual negative confounding, or could reflect that some males are able to appropriately identify specific situations where they would be at particularly high risk of STIs and use condoms in these circumstances. The associations between recent drug use and infection are of interest, as drug use may be associated with risky sexual behaviours that were not adequately accounted for in the study.

A limitation of the study is that not all newly admitted inmates were included, for the following four reasons: recruitment occurred only approximately every third day; some inmates were not available for interview prior to release because of scheduled appointments at court; some inmates were ineligible to participate; and since participation was voluntary, some inmates refused to participate. It is not clear whether a more comprehensive inclusion protocol would affect the rate of these STIs. However, the age distribution of all admitted inmates during the period was not significantly different from the age distribution of those who were included in the study (data not shown), which supports the supposition that these results are internally generalizable. Also of note, this study was conducted in a single correctional facility in Ontario, and the results may not accurately reflect the rates of STIs in male inmates in facilities across Ontario and Canada. However, given that the population at this correctional facility represents a large proportion of the inmates admitted in Ontario and that the study results are consistent with findings of international studies, the true rates across correctional facilities are likely to be high in comparison with the rates in males in the general population. Finally, it would be valuable to compare the STI rates found in this study to population-based rates from active screening programs instead of reported rates, however, these data are not available due to the lack of population-based studies of these STIs in Canada.

This study begins to address the substantial gap in information regarding these bacterial STIs in people in correctional facilities in Canada, and may significantly impact policy and practice regarding testing and treatment. Further research is needed to ensure the generalizability of these findings, as well as to determine the cost-effectiveness of screening in this population. Given the high prevalence of chlamydia in particular in males aged 18 to 19 years, research should also be done to determine the prevalence of these STIs in juvenile detention centres. However, the extremely high rates of gonorrhea and chlamydia detected in the study also indicate the need for prompt action. Given the sizeable population of persons incarcerated annually in Canada as well as the network of sexual contacts who could be offered testing and treatment, a screening program could significantly contribute to population-level control of chlamydia and gonorrhea in Canada.

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RÉSUMÉ

Objectifs : Déterminer la prévalence de la chlamydiose urétrale et de la gonorrhée dans la population masculine d'un établissement de correction en Ontario, au Canada, et étudier les facteurs de risque d'infection.

Méthode : Entre juin et décembre 2009, nous avons administré un sondage sur les facteurs de risque à 500 hommes adultes nouvellement incarcérés dans un établissement de correction du Sud de l'Ontario et nous leur avons prélevé un échantillon d'urine. Ceux dont le test de dépistage était positif ont été traités, et leurs noms ont été fournis au bureau de santé publique local à des fins de suivi, y compris pour le retraçage des contacts. Nous avons calculé la prévalence et les intervalles de confiance de 95 % pour l'infection à Chlamydia et la gonorrhée, respectivement, et utilisé un modèle multivarié pour examiner les facteurs de risque d'infection.

Résultats : La population à l'étude a déclaré de hauts niveaux de comportements sexuels à risque et de consommation de drogue. La prévalence globale de la chlamydiose était de 2,9 % (IC de 95 %=1,6-4,8), et la prévalence globale de la gonorrhée, de 0,6 % (IC de 95 %=0,1-1,8). Des taux de chlamydiose particulièrement élevés ont été observés chez les jeunes hommes, soit de 16 % (IC de 95 %=4,5-36) chez les 18-19 ans et de 3,7 % (IC de 95 %=1,0-9,3) chez les 20-24 ans, et des taux élevés de gonorrhée ont été observés chez les hommes de 20-24 ans, à 1,9 % (IC de 95 %=0,2-6,6). Selon notre modèle de régression logistique multivariée, la jeunesse était associée à l'infection, mais pas de manière significative.

Conclusion : La prévalence relativement élevée de la chlamydiose et de la gonorrhée observée dans notre étude donne à penser qu'il faudrait instituer des programmes de prévention primaire et secondaire pour la population masculine des établissements de correction, en particulier les jeunes détenus. Il faudrait pousser la recherche pour veiller à la généralisabilité interne et externe de ces résultats et pour déterminer le rapport coût-efficacité des interventions possibles.

Mots clés : prison; chlamydia; gonorrhée; dépistage de masse; prévention et contrôle