Demographic and behavioural characteristics predict bacterial STI reinfection and coinfection among a cross-sectional sample of laboratory-confirmed gonorrhea cases in a local health region from Saskatchewan, Canada

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ABSTRACT

OBJECTIVES: We aimed to identify demographic and behavioural determinants associated with risk of repeat STI infection and coinfection with gonorrhea and chlamydia in the Regina Qu'Appelle Health Region, Saskatchewan.

METHODS: We extracted data from a cross-sectional sample of laboratory-confirmed gonorrhea cases between 2003 and 2012 from the notifiable disease files of the Regina Qu'Appelle Health Region. Risk factors for repeater status were examined using logistic regression and for coinfection with gonorrhea and chlamydia using mixed-effects logistic regression to account for multiple diagnoses for individual clients.

RESULTS: Data from 1,143 cases (representing 1,027 unique individuals) and 1,524 reported contacts (representing 1,383 unique individuals) were extracted from the 10-year period. Factors associated with repeat infection entries in the database included younger age at first visit ($p = 0.01$), coinfection ($p = 0.01$), and sex trade involvement ($p < 0.01$). Factors associated with coinfection at the time of diagnosis included younger age at diagnosis ($p < 0.001$) and reported alcohol or drug abuse ($p = 0.04$).

CONCLUSION: In one of the first epidemiologic studies on gonorrhea in Saskatchewan, we have identified age, engagement in the sex trade, and drug and alcohol abuse as potential markers to identify clients with a high risk of reinfection and coinfection in the Regina Qu'Appelle Health Region. This information can help health care professionals in Saskatchewan's urban centres personalize their approach to counselling and treatment to optimize patient outcomes and disease control efforts, including potentially using expedited partner therapy and/or dual therapy where indicated.

KEY WORDS: Gonorrhea; sexually transmitted diseases; risk factors; coinfection; chlamydia

La traduction du résumé se trouve à la fin de l'article.

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In spite of the apparent progress to curb gonorrhea during much of the 1990s, reported cases have been slowly increasing in Canada since 1999. According to 2011 data, Saskatchewan's gonorrhea rate of 71.7 per 100,000 is second only to Manitoba among the provinces – more than twice that of Ontario and Quebec, as well as the Canadian national average of 33.1 per 100,000.¹ In addition to possible complications such as pelvic inflammatory disease, infertility, disseminated infection, and the potential for vertical transmission,² infection with gonorrhea also results in an estimated 3–5-fold increase in HIV transmission rates.³ Saskatchewan's extremely high and increasing rates of gonorrhea, coupled with its burgeoning HIV epidemic,⁴ illustrate the critical need for better understanding and control of gonorrhea transmission in the province, especially in light of the emerging threat of untreatable gonorrhea.⁵ A first step toward identifying why gonorrhea infection rates are increasing in Saskatchewan is to characterize the current STI population in the province. However, to date there has been only one published epidemiologic study of STIs in Saskatchewan.⁶

The objectives of this research were to describe demographic and behavioural risk factors from gonorrhea cases in the Regina

Qu'Appelle Health Region (RQHR), and to identify predictors of repeat infection and coinfection with gonorrhea and chlamydia.

RQHR is located in south-central Saskatchewan and serves 260,000 residents, including those of Saskatchewan's capital city, Regina. It is the second largest health region in Saskatchewan,

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and has recorded an average of roughly 100 cases of gonorrhea and 1,000 cases of chlamydia each year since 2008.

METHODS

Sample

Gonorrhea is a notifiable disease in all Canadian provinces; in Saskatchewan, all cases confirmed by the provincial Saskatchewan Disease Control Laboratory are reported to public health authorities. In accordance with national guidelines, contact tracing is initiated in the event of a positive laboratory diagnosis, and includes individuals who were contacts within 60 days prior to the test date. Contact tracing is generally carried out by public health staff in the event that index cases do not notify their contacts.

We accessed the notifiable STI files from RQHR to extract the records for all laboratory-confirmed gonorrhea cases – including those concurrently infected with chlamydia – from January 1, 2003– December 31, 2012. Every positive gonorrhea case recorded in RQHR over this time period was included in the dataset. The files contain demographic information, including name, health services number (HSN), age, date of birth, and address; event-related information, including diagnosing facility, laboratory tests reported, and type and date of treatment; and risk factor information, including sexual history, drug and alcohol use, and number of partners. Information on sexual contacts and their follow-up was also recorded. All contacts who presented and had a laboratory-confirmed infection also became part of the case file.

Data management and analysis

Microsoft Access⁷ was used to create a digital database that preserved the linkage between cases and their named contacts. Because files were in hardcopy format for the first eight years of the dataset, all data abstraction was done on-site at health region offices. This study was approved by the research ethics boards of both the University of Saskatchewan and RQHR (No. 12–323 and 12–98 respectively). Prior to removal from health region offices, personal identifiers, including last name and address, were removed. Additionally, an algorithm was applied to scramble clients' HSNs to anonymize them while preserving the ability to recognize repeat occurrences of disease in individuals during the 10-year study period. Urban versus rural place of residence was abstracted using the first three digits of cases' reported postal codes; a "0" as the middle digit indicates a rural area, while any other number indicates an urban area.⁸

After the data were de-identified, descriptive analyses were carried out using Microsoft Excel⁹ and Stata IC/12.1.¹⁰ The continuous variable age was categorized prior to analysis. For the purpose of this analysis, we defined "repeater" as someone who appeared two or more times in the 10-year database. For repeat infections occurring at intervals of 2 months or less, we verified that appropriate, observed therapy (dual azithromycin and cefixime) was administered for the prior infection, to rule out persistent as opposed to repeat infection. Based on Saskatchewan's extremely low levels of antibiotic resistance,¹¹ treatment failure is unlikely in these cases. Differences in characteristics between males and females were investigated using chi-square tests. Observations for two cases with outlying ages (4 months and 78 years of age) were dropped prior to multivariable analysis.

A multivariable logistic regression model was built to identify factors associated with having repeat entries in the database, using one entry per person, based on characteristics at first entry and controlling for amount of follow-up time.

To identify variables associated with being coinfecting with gonorrhea and chlamydia at the time of visit, a mixed-effects multivariable logistic regression model was built using a random intercept to account for clustering by participant identification (anonymized HSN) due to repeat entries.

Both models were built using manual backwards elimination and only potential risk factors unconditionally associated with the outcome ($p \leq 0.2$) were considered as candidates in building the final multivariable models for each outcome. For multiple-category predictors, inclusion in the model was based on the results of a type 3 Wald test. Only significant independent risk factors ($p < 0.05$) and important confounders were retained in the final multivariable model for each outcome. Confounding was recognized when the difference between crude odds ratio for a risk factor–outcome association of interest and the same odds ratio adjusted for the potential confounder was $>10\%$. After establishing main effects models for each outcome, all possible two-way interactions were considered; only interactions significant at $p < 0.05$ were retained in the final models.

The intraclass correlation coefficient (ICC) was estimated as $\sigma^2_{\text{patientID}} / (\sigma^2_{\text{patientID}} + \pi^2/3)$ for the final coinfection model.¹² Plots of standardized residuals were examined for each model to check for outliers.

RESULTS

Study population

There were 1,143 occurrences of laboratory-confirmed gonorrhea infection in the health region from 2003–2012, representing 1,027 unique individuals. From these 1,143 case visits, 1,524 contacts were elicited, representing 1,383 unique individuals. Just over half of cases (55.2%) were female. Male cases were older than female cases ($p < 0.001$) and were less likely to be coinfecting than females ($p < 0.01$) (Table 1). The mean age difference

Table 1. Demographic and behavioural characteristics of study population ($n = 1143$ cases)

Characteristic	Male	Female	<i>p</i>
Age, years	512 (44.8%)	631 (55.2%)	
≤ 19	119 (23.2%)	295 (46.8%)	
20–24	157 (30.7%)	193 (30.63%)	
≥ 25	236 (46.1%)	142 (22.5%)	
Urban	449 (89.1%)	537 (86.8%)	0.22
Infection type			<0.01
Gonorrhea	308 (60.2%)	325 (51.5%)	
Gonorrhea/chlamydia coinfection	204 (39.8%)	306 (48.5%)	
Provided information on contacts	456 (89.1%)	565 (89.5%)	0.80
Pregnant	–	52 (8.2%)	
Risk factors			
Reported 2 or more contacts	176 (34.4%)	192 (30.4%)	0.16
Same sex partner	45 (8.8%)	5 (0.8%)	<0.001
Unprotected sex	318 (62.1%)	387 (61.3%)	0.79
Sex trade	15 (2.9%)	28 (4.4%)	0.18
Alcohol and/or drug abuse	69 (13.5%)	75 (11.9%)	0.42
Previous STI	44 (8.6%)	87 (13.8%)	<0.01
Location of initial visit			0.16
STI clinic	189 (37.0%)	208 (33.0%)	
Other	323 (63.1%)	423 (67.3%)	

between partners was 4 years (SD 4.9 years, data not shown). Most cases came from urban areas. Roughly 8% of female cases were pregnant at the time of diagnosis. The most frequently reported risk factors for both sexes were unprotected sex and having had two or more partners in the last 6 months. Least frequently reported risk factors were sex trade involvement (for either the case or their contact) and same sex partnerships. Males were more likely than females to report same sex partners ($p < 0.001$) and less likely to have had a previous STI ($p < 0.01$). The majority of cases were treated at locations other than an STI clinic (e.g., family physician's office) (Table 1).

Repeated infection with gonorrhea

Of the 1,027 unique individuals represented in the dataset, 934 appeared once only, while 93 (9%) had repeat entries (either single infections or coinfections with gonorrhea and chlamydia). These 93 repeaters represented 209 infections, or 18% of the total infections reported during the study period (data not shown). Table 2 presents a comparison of repeaters and non-repeaters in the database. Based on unconditional or univariable analysis, repeaters were younger ($p = 0.001$) and were more likely to be coinfecting ($p = 0.001$), to have reported 2 or more partners in the last 6 months ($p = 0.03$), to have reported sex trade involvement (either case or contact) ($p = 0.001$), and to have reported alcohol or

Table 2. Unconditional analysis of characteristics at time of first reported diagnosis of individuals with single and repeat infections ($n = 1027$ individuals)

	Non-repeaters ($n = 934$, 91%) n (%)	Repeaters ($n = 93$, 9%) n (%)	OR (CI)	p
Age, years				<0.01
≤19	324 (34.7)	48 (51.6)	2.71 (1.54–4.75)	0.001
20–24	280 (30.1)	27 (29.0)	1.76 (0.95–3.27)	0.07
≥25	329 (35.3)	18 (19.4)	Reference category	
Sex				
Male	439 (47.0)	34 (36.8)	Reference category	
Female	495 (53.0)	59 (63.4)	1.54 (0.99–2.40)	0.06
Infection				
Gonorrhea	528 (56.5)	36 (38.7)	Reference category	
Ct/Gc* coinfection	406 (43.5)	57 (61.3)	2.05 (1.33–3.19)	0.001
Received correct treatment				
No	143 (15.31)	10 (10.75)	Reference category	
Yes	792 (84.69)	83 (89.25)	1.50 (0.76–3.0)	0.24
Number of sex partners in last 6 months				
1	639 (68.4)	53 (57.0)	Reference category	
≥2	295 (31.6)	40 (43.0)	1.63 (1.06–2.52)	0.03
Previous STI†				
No	919 (98.4)	93 (100)	Reference category	
Yes	15 (1.6)	–	0.47 (0–2.21)	0.27
Sex trade involvement				
No	907 (97.1)	84 (90.3)	Reference category	
Yes	27 (2.9)	9 (9.7)	3.60 (1.64–7.91)	0.001
Alcohol or drug abuse				
No	826 (88.4)	74 (79.6)	Reference category	
Yes	108 (11.6)	19 (20.4)	1.96 (1.14–3.38)	0.02
Same sex relationship reported				
No	891 (95.4)	90 (96.8)	Reference category	
Yes	43 (4.6)	3 (3.2)	0.69 (0.21–2.27)	0.54
Place of residence				
Urban	792 (86.4)	85 (93.4)	Reference category	
Rural	125 (13.6)	6 (6.6)	2.24 (0.96–5.23)	0.06
Initial visit location				
Clinic	325 (34.8)	30 (32.26)	Reference category	
Other	609 (65.2)	63 (65.4)	0.89 (0.57–1.40)	0.62

*Ct/Gc = Chlamydia trachomatis/Neisseria gonorrhoeae.

†Previous STI statistics calculated using exact logistic regression.

drug abuse ($p = 0.02$). In the final multivariable model (Table 3), being under age 20 (OR = 2.3), being coinfecting with gonorrhea and chlamydia (OR = 1.8), and reporting sex trade involvement (OR = 3.6) were associated with identified repeat infection during the 10-year study period.

Coinfection with gonorrhea and chlamydia

Of the 1,143 cases of gonorrhea reported between 2003 and 2012, just under half (45%) were coinfecting with chlamydia. Table 4 presents a comparison of singly infected and coinfecting cases in the database. Based on unconditional or univariable analysis, coinfecting individuals were younger ($p < 0.001$) and more likely to be female ($p < 0.01$), to have reported 2 or more partners in the last 6 months ($p = 0.04$), and to have reported alcohol or drug abuse ($p < 0.01$). Those who reported a same sex partnership were less likely to be coinfecting ($p = 0.01$).

In the final multivariable model (Table 5), being under age 25 (OR = 2–3.5) and reporting alcohol or drug abuse (OR = 1.5) were significantly associated with being coinfecting with chlamydia at the time of diagnosis. Reporting a same sex partner was associated with a lower odds (OR = 0.5) of being coinfecting.

Table 3. Final multivariable model for predictors of repeat infection ($n = 1005$)

Variable	OR	p	95% CI
Age, years (2 df)		0.01	
12–19	2.30	0.01	1.28–4.13
20–24	1.45	0.26	0.76–2.74
≥25		Reference category	
Coinfection	1.81	0.01	1.14–2.87
Urban	2.31	0.06	0.98–5.46
Sex trade involvement	3.62	<0.01	1.61–8.15

Table 4. Unconditional analysis of characteristics of gonorrhea- and gonorrhea/chlamydia-coinfecting cases ($n = 1143$)

	Gonorrhea ($n = 633$, 55%) n (%)	Coinfection ($n = 510$, 45%) n (%)	OR (CI)	p
Age, years				
≤19	169 (26.7)	245 (48.1)	3.67 (2.73–4.94)	<0.001
20–24	193 (30.5)	157 (30.8)	2.06 (1.52–2.80)	<0.001
≥25	271 (42.8)	107 (21.0)	Reference category	
Sex				
Male	308 (48.7)	204 (40.0)	Reference category	
Female	325 (51.3)	306 (60.0)	1.44 (1.12–1.85)	<0.01
Number of sex partners in last 6 months				
1	446 (70.5)	329 (64.5)	Reference category	
≥2	187 (29.5)	181 (45.5)	1.33 (1.02–1.73)	0.04
Previous STI				
No	556 (87.8)	456 (89.4)	Reference category	
Yes	77 (12.16)	54 (41.2)	0.78 (0.50–1.22)	0.28
Sex trade involvement				
No	611 (96.5)	489 (95.9)	Reference category	
Yes	22 (3.5)	21 (4.1)	1.20 (0.63–2.29)	0.6
Alcohol or drug abuse				
No	570 (90.1)	429 (84.1)	Reference category	
Yes	63 (10.0)	81 (15.9)	1.72 (1.19–2.47)	<0.01
Same sex relationship reported				
No	596 (94.2)	497 (97.5)	Reference category	
Yes	37 (5.9)	13 (2.6)	0.41 (0.21–0.81)	0.01
Place of residence				
Urban	71 (11.5)	66 (13.20)	Reference category	
Rural	552 (88.6)	434 (86.8)	0.84 (0.57–1.22)	0.36

Table 5. Final multivariable model for predictors of coinfection with gonorrhea and chlamydia ($n = 1140$)

Variable	OR	<i>p</i>	95% CI
Age, years (2 df)		<0.001	
12–19	3.52	<0.001	2.61–4.75
20–24	2.02	<0.001	1.48–2.75
≥25		Reference category	
Alcohol and/or drug abuse	1.48	0.04	1.02–2.13
Same sex partner	0.52	0.05	0.27–1.00
ICC*		4.5081E–12	

*ICC = Intraclass correlation coefficient.

DISCUSSION

Among our study population, roughly 36% of cases overall (and 46% of female cases) were 19 or under, and 67% were under 25 years of age, at the time of diagnosis, which is reflective of Canadian national data that indicate that the largest proportion of gonorrhea infections is among people under 30.¹ In our dataset, the overall ratio of male cases to female cases was 0.8:1. While Canada's overall male-to-female rate ratio for gonorrhea was 1.3:1, our male-to-female case ratio is closer to the rate ratio of 0.7:1 reported for the province of Saskatchewan as a whole in 2010.¹³ The higher rate of infection among women than among men in Saskatchewan is the opposite of that reported by many other jurisdictions, including the United States, Australia and the United Kingdom,^{14–16} and implies that female-focused prevention efforts should be considered, especially those aimed at young women, i.e., under 20 years of age.

The finding that 9% of individuals in the database were subsequently reinfected during the 10-year study period is similar to the findings from a 2007 study in Alberta, Canada,¹⁷ as well as from a 2009 systematic review of reinfection rates among industrialized nations.¹⁸ The association between being under 20 at initial diagnosis and increased risk of reinfection (OR = 2.3) also supports previous reports.^{17–20} Our finding that coinfection at time of initial diagnosis was associated with increased odds (OR = 1.8) of repeat infection could indicate that being coinfecting is a marker for riskier sexual behaviours, making individuals more susceptible to repeat infection based on sexual network. While the relatively high risk of reinfection in the context of sex trade involvement is not surprising, and has been reported before,²⁰ it does underscore the need to rapidly and appropriately treat individuals reporting such risk factors. Targeted efforts among those at greatest risk – such as follow-up screening and enhanced contact tracing efforts – could reduce the risk and subsequent transmission of reinfection among these risk groups. Current Canadian recommendations include rescreening 6 months after treatment;²¹ however, for those clients reporting sex trade involvement, or other circumstances where partners are impossible to reach (many are single encounters and unknown by the case), expedited partner therapy (EPT) could provide an effective approach to reducing the risk of reinfection from an untreated partner.²² The Centers for Disease Control and Prevention in the United States recommend EPT as an effective partner management strategy;²³ it is currently not an implemented policy in RQHR.

It is not surprising that a large proportion of our sample population was coinfecting with both gonorrhea and chlamydia; this supports the findings of previous North American studies^{24,25} and Canadian national guidelines that gonorrhea infections should be treated with combination therapy (ceftriaxone or cefixime with azithromycin) to target both infections.²¹ Our finding that individuals under age 25 had increased odds of coinfection (OR = 2–3.5) also supports previous research^{24–26} and could be related to the fact that younger women are thought to be more susceptible to chlamydia than are older women, due to increased cervical ectopy.²⁷ This could also account for younger males being more likely to be coinfecting, if the local sexual networks exhibit age homogeneity, as implied by our finding that the mean age difference between cases and their contacts was just four years. The increased odds of coinfection among those who reported alcohol or drug abuse does not have a plausible biological explanation. However, it could be a marker for sexual network, indicating that coinfection is more prevalent in networks of individuals with higher risk behaviours, such as alcohol or drug abuse.

Last, the apparent protective influence of having reported a same sex partnership on the risk of coinfection is also not clearly related to any biologically plausible phenomenon, although it has been reported previously.²⁸ It is possible that this association could result from memberships in sexual networks in which chlamydia infections are less common.

Low positive response rates for some risk factors, including sex trade involvement and a history of same sex partners, could have limited the power to evaluate the effect of these factors on the outcomes of interest. Also, because this study used previously-collected information from notifiable disease files, the collection of risk factor and other information from patients was not standardized. A large number of health care workers from different facilities recorded data over the study period. Different approaches could have affected the amount or quality of information gathered from patients presenting at different times and different facilities. Also, potential movement from one health region to another could have limited our ability to identify repeat infections over the study period, as could asymptomatic or other undiagnosed infection. Finally, potentially stigmatizing behaviours, including alcohol and drug use or purchasing commercial sex, could have been under- or misreported.²⁹

We were able to identify several factors associated with increased risk of reinfection and coinfection with gonorrhea and chlamydia among STI patients in RQHR, and our findings are directly relevant to prevention and control efforts in the region – and, potentially, in other Saskatchewan health regions with larger urban centres. Because the risk of reinfection is heightened among those individuals who are under 20 years of age, who are coinfecting, or who report sex trade involvement for themselves or their partners, health care workers in RQHR could use this information to guide their counselling and treatment choices. Targeted counselling efforts focused on those at high risk of reinfection could have an effect on reinfection rates; however, factors beyond the control of the individual, such as external pressures and group norms, will likely still play a strong role in influencing choices. Treatment protocols could have a great effect. For example, EPT might be an appropriate choice for

clients with these risk factors to prevent potential reinfection from untreated partners.²² Similarly, clients who are under 25 or report alcohol or drug abuse could be good candidates for empirical dual therapy, given the increased odds of coinfection among this demographic. Additionally, regular review of some of the parameters identified here to be associated with reinfection and coinfection could assist in measurement of STI intervention effectiveness in RQHR.

REFERENCES

- Public Health Agency of Canada. Report on Sexually Transmitted Infections in Canada: 2011. Ottawa, ON: PHAC, 2014.
- Hook EW, Handsfield HH. Gonococcal infections in the adult. In: Holmes KK, Sparling PF, Mardh P, et al. (Eds.), *Sexually Transmitted Diseases*, 3rd edition. New York, NY: McGraw Hill, 1999:451–66.
- Wasserheit J. Epidemiological synergy: Interrelationships between human immunodeficiency virus infection and other sexually transmitted diseases. *Sex Transm Dis* 1992;19:61–77. PMID: 1595015.
- Population Health Branch. HIV and AIDS in Saskatchewan, 2010. Regina, SK: Saskatchewan Ministry of Health, 2011.
- Unemo M, Nicholas RA. Emergence of multidrug-resistant, extensively drug-resistant and untreatable gonorrhea. *Future Microbiol* 2012;7:1401–22. PMID: 23231489. doi: 10.2217/fmb.12.117.
- Lemstra M, Neudorf C, Opondo J, deBruin P, Grauer K, Wright J. Epidemiological analysis of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* in Saskatoon Health Region. *Can J Public Health* 2006;98(2): 134–37. PMID: 17441538.
- Microsoft Corporation. Microsoft Access. Redmond, WA: Microsoft, 2010.
- Statistics Canada. How postal codes map to geographic areas: Glossary. Ottawa: Statistics Canada, 2007. Available at: <http://www.statcan.gc.ca/pub/92f0138m/2007001/4054931-eng.htm> (Accessed July 15, 2014).
- Microsoft Corporation. Microsoft Excel. Redmond, WA: Microsoft, 2010.
- StataCorp. Stata Statistical Software: Release 12. College Station, TX: StataCorp, 2011.
- Thakur SD, Levett PN, Horsman GB, Dillon JR. Molecular epidemiology of *Neisseria gonorrhoeae* isolates from Saskatchewan, Canada: Utility of NG-MAST in predicting antimicrobial susceptibility regionally. *Sex Transm Infect* 2014;90:297–302. PMID: 24503900. doi: 10.1136/sextrans-2013-051229.
- Dohoo I, Martin W, Stryhn H. *Methods in Epidemiologic Research*. Charlottetown, PEI: VER Inc., 2012.
- Public Health Agency of Canada. Report on Sexually Transmitted Infections in Canada: 2010. Ottawa: PHAC, 2012.
- Communicable Diseases Australia (CDA). National Notifiable Diseases Surveillance System. Available at: <http://www9.health.gov.au/cda/source/cda-index.cfm> (Accessed June 22, 2014).
- Public Health England. Sexually Transmitted Infections Annual Data. Available at: http://www.hpa.org.uk/web/HPAweb&HPAwebStandard/HPAweb_C/1203348026613 (Accessed June 22, 2014).
- Centers for Disease Control and Prevention. Sexually Transmitted Disease Surveillance, 2008. Atlanta, GA: US Dept of Health and Human Services, 2009. Available at: <http://www.cdc.gov/std/stats08/default.htm> (Accessed June 22, 2014).
- De P, Singh AE, Wong T, Kaida A. Predictors of gonorrhea reinfection in a cohort of sexually transmitted disease patients in Alberta, Canada, 1991–2003. *Sex Transm Dis* 2007;34(1):30–36. doi: 10.1097/01.olq.0000230485.85132.e9.
- Hosenfeld CB, Workowski KA, Berman S, Zaidi A, Dyson J, Mosure D, et al. Repeat infection with chlamydia and gonorrhea among females: A systematic review of the literature. *Sex Transm Dis* 2009;36(8):478–89. PMID: 19617871. doi: 10.1097/OLQ.0b013e3181a2a933.
- Rietmeijer CA, Van Bemmelen R, Judson FN, Douglas JM. Incidence and repeat infection rates of *Chlamydia trachomatis* among male and female patients in an STD clinic: Implications for screening and rescreening. *Sex Transm Dis* 2002;29(2):65–72. PMID: 11818890.
- Newman LM, Warner L, Weinstock HS. Predicting subsequent infection in patients attending sexually transmitted disease clinics. *Sex Transm Dis* 2006;33(12):737–42. PMID: 16708054.
- Public Health Agency of Canada. Gonococcal Infections: Revised July 2013 – Section 5 – Management and Treatment of Specific Infections. Ottawa: PHAC, 2013.
- Golden MR, Whittington WL, Handsfield HH, Hughes JP, Stamm WE, Hogben M, et al. Effect of expedited treatment of sex partners on recurrent or persistent gonorrhea or chlamydial infection. *N Engl J Med* 2005; 352(7):676–85. PMID: 15716561. doi: 10.1056/NEJMoa041681.
- Centers for Disease Control and Prevention. Expedited partner therapy. Available at: <http://www.cdc.gov/std/ept/> (Accessed June 22, 2014).
- Lyss SB, Kamb ML, Peterman TA, Moran JS, Newman DR, Bolan G, et al. *Chlamydia trachomatis* among patients infected with and treated for *Neisseria gonorrhoeae* in sexually transmitted disease clinics in the United States. *Ann Intern Med* 2003;139(3):178–85. PMID: 12899585.
- Kahn RH, Mosure DJ, Blank S, Kent CK, Chow JM, Boudov MR, et al. *Chlamydia trachomatis* and *Neisseria gonorrhoeae* prevalence and coinfection in adolescents entering selected US juvenile detention centers, 1997–2002. *Sex Transm Dis* 2005;32(4):255–59. PMID: 15788927.
- Dragovic B, Greaves K, Vashisht A, Straughair G, Sabin C, Smith NA. Chlamydial co-infection among patients with gonorrhoea. *Int J STD AIDS* 2002;13(4):261–63. PMID: 22877601. doi: 10.1071/SH11146.
- Peipert JF. Genital chlamydial infections. *N Engl J Med* 2003;349(25):2424–30. PMID: 14681509.
- Hijazi L, Thow C, Winter A. Factors affecting co-infection with genital chlamydia and genital gonorrhoea in an urban genitourinary medicine clinic. *Sex Transm Infect* 2002;78(5):387. doi: 10.1136/sti.78.5.387.
- Fenton KA, Johnson AM, McManus S, Erens B. Measuring sexual behaviour: Methodological challenges in survey research. *Sex Transm Infect* 2001; 77(2):84–92. doi: 10.1136/sti.77.2.84.

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RÉSUMÉ

OBJECTIFS : Notre but était d'identifier les déterminants démographiques et comportementaux associés au risque d'infection sexuellement transmissible répétée et de coinfection par la gonorrhée et la chlamydie dans la région sanitaire de Regina Qu'Appelle (Saskatchewan).

MÉTHODE : Nous avons extrait des dossiers des maladies à déclaration obligatoire de la région sanitaire de Regina Qu'Appelle les données d'un échantillon transversal de cas de gonorrhée confirmés en laboratoire survenus entre 2003 et 2012. Les facteurs de risque d'infection répétée ont été examinés par régression logistique, et les facteurs de coinfection par la gonorrhée et la chlamydie, par régression logistique à effets mixtes, afin d'expliquer les diagnostics multiples sur une base individuelle.

RÉSULTATS : Les données de 1 143 cas (représentant 1 027 personnes distinctes) et de 1 524 contacts déclarés (représentant 1 383 personnes distinctes) ont été extraites sur la période d'étude de 10 ans. Les facteurs associés aux infections répétées dans la base de données étaient le jeune âge à la première visite ($p = 0,01$), la coinfection ($p = 0,01$) et la participation au commerce du sexe ($p < 0,01$). Les facteurs associés à la coinfection lors du diagnostic étaient le jeune âge au diagnostic ($p < 0,001$) et l'abus d'alcool ou de drogue déclaré ($p = 0,04$).

CONCLUSION : Dans cette étude, qui est l'une des premières études épidémiologiques sur la gonorrhée en Saskatchewan, nous avons identifié l'âge, la participation au commerce du sexe et l'abus de drogue et d'alcool comme étant des marqueurs potentiels pour identifier les clients présentant un risque élevé de réinfection et de coinfection dans la région sanitaire de Regina Qu'Appelle. Cette information peut aider les professionnels de la santé des centres urbains de la Saskatchewan à personnaliser leurs approches de counseling et de traitement pour optimiser leur effet sur les patients et les efforts de lutte contre les maladies, potentiellement en utilisant la thérapie accélérée pour les partenaires et/ou la bithérapie, selon le cas.

MOTS CLÉS : gonorrhée; maladies sexuellement transmissibles; facteurs de risque; coinfection; chlamydia