February 1, 2018 • Volume 44-2

CCDR

CANADA COMMUNICABLE DISEASE REPORT

SEXUALLY TRANSMITTED INFECTIONS

Guest editor: Toju Ogunremi

Public Health Agency of Canada
Agence de la santé publique du Canada

Canada

CCDR
CANADA COMMUNICABLE DISEASE REPORT

The *Canada Communicable Disease Report* (CCDR) is a bilingual, peer-reviewed, open-access, online scientific journal published by the Public Health Agency of Canada (PHAC). It provides timely, authoritative and practical information on infectious diseases to clinicians, public health professionals, and policy-makers to inform policy, program development and practice.

The CCDR Editorial Board is composed of 11 members based in Canada, United States of America, European Union and Australia. Board members are internationally renowned and active experts in the fields of infectious disease, public health and clinical research. They meet four times a year, and provide advice and guidance to the Editor-in-Chief.

Editorial Team

Photo Credit

xxxxxxx (https://www.shutterstock.com/image-photo/social-problem-male-diseases-portrait-doctor-339392126).

Contact the Editorial Office

ccdr-rmtc@phac-aspc.gc.ca
613.301.9930

CCDR Editorial Board members

ISSN 1481-8531 Pub.150005

CCDR
CANADA COMMUNICABLE DISEASE REPORT

SEXUALLY TRANSMITTED INFECTIONS

TABLE OF CONTENTS

Gonorrhea in Canada, 2010–2015

Y Choudhri[1], J Miller[1], J Sandhu[1], A Leon[1], J Aho[1]*

Affiliation

[1] Centre for Communicable Diseases and Infection Control, Public Health Agency of Canada, Ottawa, ON

***Correspondence:** josephine.aho@canada.ca

Abstract

Background: Gonorrhea is the second most commonly reported sexually transmitted infection (STI) in Canada after chlamydia, and rates for this STI have been increasing since 1997.

Objective: To summarize trends observed in gonorrhea rates for 2010–2015 in Canada.

Methods: Laboratory-confirmed cases of gonorrhea are reported to the Public Health Agency of Canada (PHAC) by all of the Canadian provinces and territories. The overall national rate was computed, as were rates per sex, age group and province/territory.

Results: In 2015, 19,845 cases of gonorrhea were reported in Canada, corresponding to a rate of 55.4 cases per 100,000 population and a 65.4% increase from 2010 (33.5 cases per 100,000 population). Males had consistently higher rates than did females (70.2 per 100,000 versus 40.6 per 100,000 in 2015) and faster rising rates (85.2% versus 39.5% in 2010–2015). Rates among adults 60 years and older increased faster than rates among younger people, although the highest rates were among those 15–29 years of age. The Northwest Territories, Nunavut and Yukon had the highest gonorrhea rates in 2015.

Conclusion: Males, adolescents and young adults continue to represent the majority of gonorrhea cases. Research is needed to better understand the current trends in gonorrhea infection in order to maintain, evaluate and improve primary and secondary STI prevention activities.

Suggested citation: Choudhri Y, Miller J, Sandhu J, Leon A, Aho J. Gonorrhea in Canada, 2010–2015. Can Commun Dis Rep. 2018;44(2):37-42. https://doi.org/10.14745/ccdr.v44i02a01

Introduction

Gonorrhea, caused by the bacterium *Neisseria gonorrhoeae*, is the second most commonly reported sexually transmitted infection (STI) in Canada, after chlamydia. Globally, there were an estimated 78 million cases of gonorrhea in 2012 (1). Most infections are genital, but pharyngeal and anorectal infections may occur. Gonococcal infections are usually asymptomatic in females, but symptomatic in males (2). In females, symptoms can include vaginal discharge; in males, symptoms often present as painful urination, abnormal urethral discharge and swollen testicles (3). Untreated gonorrhea may lead to reactive arthritis, disseminated gonococcal infection and infertility in both sexes (although infertility is rare for men) (2). Clinical outcomes of untreated gonorrhea include pelvic inflammatory disease, chronic pelvic pain and ectopic pregnancy in females; in males, clinical outcomes include epididymo-orchitis (2). Mother-to-child transmission at birth can result in conjunctivitis in newborns, with a possible progression to blindness if the infection is not detected and treated rapidly (4). Gonorrhea also increases the infectiousness of and susceptibility to HIV by increasing the number of HIV target cells in the genital tract and by amplifying HIV shedding (an infected cell releases viral particles, which in turn can infect new cells) (5,6).

Since 1997, Canada has seen a rise in gonorrhea rates in most jurisdictions, increasing the burden of the disease on our health care system (2). In 2012, the overall rate of gonorrhea was 36.2 per 100,000, a 38.9% increase from the rate in 2003 (7). As in previous years, more cases were reported in males than females (at a ratio of 1:1.3), but the relative rate increase was greater among females (7). Moreover, the control and treatment of gonorrhea have become more complex due to the development of antimicrobial resistance in several countries, including Canada (8). The recent emergence of strains resistant to azithromycin and with decreased susceptibility to cephalosporins are threatening the last available treatment options (9). In 2014, 52.4% of *N. gonorrhoeae* isolates in Canada were resistant to at least one antibiotic tested.

The objective of this article is to summarize observed trends in reported gonorrhea infection rates across Canada in the period 2010–2015.

Methods

Data sources

Gonorrhea has been nationally notifiable since 1924. Provincial and territorial health authorities provide non-nominal data on laboratory-confirmed cases to the Public Health Agency of Canada (PHAC) through the Canadian Notifiable Disease

Surveillance System (CNDSS) (10). Confirmed case definitions are shown in the **Appendix** (11).

Variables submitted along with the diagnosis include age at diagnosis, year of diagnosis, province/territory of diagnosis and sex. The received data are validated in collaboration with the corresponding province or territory. Data from January 1, 2010 to December 31, 2015 were available from all provinces and territories and were extracted from the CNDSS in July 2017.

Data analysis

Descriptive analysis was performed using Microsoft Excel. National annual rates of reported cases were computed using the number of cases from the CNDSS as numerators, and Statistics Canada yearly population estimates as denominators. Sex, age group and province/territory-specific rates were also calculated. For all years, rates are given per 100,000 population. No statistical procedures were used for comparative analyses. Small numbers are more susceptible to change and so corresponding rates should be interpreted with caution. Previous reports may contain different rates for some years due to reporting delays and data updating.

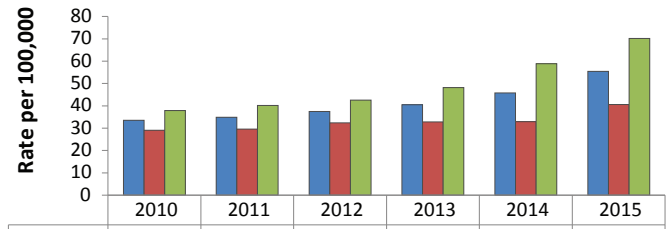
Results

Between 2010 and 2015, the number of reported gonorrhea cases increased from 11,386 to 19,845. The corresponding overall rate in 2015 was 55.4 cases per 100,000 population (versus 33.5 cases per 100,000 population in 2010) (**Figure 1**).

Sex and age

During the surveillance period of 2010–2015, the rate of gonorrhea was higher among males than among females (70.2 cases per 100,000 males compared with 40.6 per 100,000 females in 2015). In addition, the rate among males increased at a faster pace than the rate among females, 85.2% (from 37.9 to 70.2 per 100,000) compared with 39.5% (from 29.1 to 40.6 per 100,000) (**Figure 1**).

Figure 1: Overall[a] and sex-specific rates of reported laboratory-confirmed gonorrhea cases, 2010–2015, Canada



	2010	2011	2012	2013	2014	2015
Overall	33.5	34.9	37.5	40.5	45.8	55.4
Female	29.1	29.6	32.4	32.8	32.9	40.6
Male	37.9	40.2	42.6	48.2	58.8	70.2

[a] Total includes unspecified sex

Adolescents and young adults had the highest rates of gonorrhea in 2015 (205.3, 176.7 and 113.4 cases per 100,000 for people aged 20–24 years, 25–29 years and 15–19 years, respectively). The lowest rates were among those under 10 years old (0.6 cases per 100,000) and those aged 60 years and older (3.3 cases per 100,000).

From 2010 to 2015, adolescents aged 10–14 years were the only age group that showed a decrease in gonorrhea rates (−13.5%, from 4.6 to 4.0 cases per 100,000). In contrast, adults aged 30–39 years had the highest rate increase (128.7%, from 42.9 to 98.1 cases per 100,000), followed by those aged 40–59 years (100.0%, from 14.1 to 28.2 cases per 100,000).

When stratifying age-specific rates by sex, rates among females under 20 years old were consistently higher than those among males the same age (data not shown). Rates among males generally increased faster for all age groups except for the 10–14-year age group for which there was a 55.0% relative decrease for males (and a 1.0% decrease for females).

Geographic distribution

Rates and number of cases for each province and territory are presented in **Table 1**. Only Nunavut and New Brunswick showed a decrease in the reported rates of gonorrhea (56.9% and 22.0% decreases, respectively). Nunavut, along with the Northwest Territories and Yukon had the highest rates in 2015. The Atlantic provinces (Nova Scotia, New Brunswick, Prince Edward Island and Newfoundland and Labrador) had the lowest reported rates. The provinces and territories with the highest rate increase in the time period were Yukon (237.3%), Newfoundland and Labrador (212.7%), Alberta (159.8%) and British Columbia (143.7%).

Table 1: Number and rate of reported laboratory-confirmed cases of gonorrhea, by province and territory in Canada, 2010–2015

Province or territory	Laboratory-confirmed cases by year of diagnosis (rate per 100,000)					
	2010	2011	2012	2013	2014	2015
Alberta	1,182 (31.7)	1,508 (39.8)	2,103 (54.2)	2,017 (50.5)	1,908 (46.4)	3,438 (82.3)
British Columbia	1,365 (30.6)	1,649 (36.7)	1,420 (31.2)	1,841 (40.1)	2,031 (43.7)	3,495 (74.5)
Manitoba	982 (80.4)	1,055 (85.5)	1,349 (107.9)	1,217 (96.2)	1,107 (86.4)	1,085 (83.7)
New Brunswick	64 (8.5)	64 (8.5)	38 (5.0)	47 (6.2)	44 (5.8)	50 (6.6)
Newfoundland and Labrador	12 (2.3)	26 (5.0)	16 (3.0)	41 (7.8)	66 (12.5)	38 (7.2)
Northwest Territories	219 (506.0)	143 (328.7)	192 (440.4)	97 (221.5)	245 (558.2)	361 (815.9)
Nova Scotia	100 (10.6)	102 (10.8)	119 (12.6)	97 (10.3)	114 (12.1)	133 (14.1)
Nunavut	648 (1942.9)	595 (1740.0)	448 (1290.8)	466 (1316.3)	326 (905.0)	306 (837.6)

Table 1: Number and rate of reported laboratory-confirmed cases of gonorrhea, by province and territory in Canada, 2010–2015 (continued)

Province or territory	Laboratory-confirmed cases by year of diagnosis (rate per 100,000)					
	2010	2011	2012	2013	2014	2015
Ontario	3,966 (30.2)	4,205 (31.7)	4,097 (30.5)	4,540 (33.5)	5,840 (42.7)	5,932 (43.0)
Prince Edward Island	0 (0.0)	11 (7.6)	8 (5.5)	6 (4.1)	7 (4.8)	10 (6.8)
Quebec	2,054 (25.9)	1,864 (23.3)	2,219 (27.4)	2,642 (32.4)	3,312 (40.3)	3,927 (47.5)
Saskatchewan	763 (72.6)	758 (71.1)	1,018 (93.7)	1,213 (109.8)	1,240 (110.6)	957 (84.5)
Yukon	31 (89.6)	6 (16.9)	9 (25.0)	10 (27.5)	49 (132.9)	113 (302.2)
Canada	**11,386 (33.5)**	**11,986 (34.9)**	**13,036 (37.5)**	**14,234 (40.5)**	**16,289 (45.8)**	**19,845 (55.4)**

Discussion

After a sharp decrease from the early 1980s to the 1990s, gonorrhea rates rose in Canada in the late 1990s and continued to rise among both males and females in almost all age groups, from 2010 to 2015. Other countries have had similar trends. For example, the United States of America (USA) saw a rate increase of 22.2% in males and 13.8% in females from 2015 to 2016 (12,13). In line with the trend seen in 2012–2014, in 2015 Canada had the lowest reported rate of gonorrhea compared with the USA, Australia and England (55.4 cases per 100,000 versus 123.9, 79.7 and 75.3 cases per 100,000, respectively) (13-15).

Several factors may help explain the apparent increase in gonorrhea rates. The introduction of a more sensitive diagnostic tool, Nucleic Acid Amplification Test (NAAT), has significantly increased the number of cases detected (16). Moreover, Canadian and other national treatment guidelines have emphasized the importance of screening at other anatomical sites (oropharyngeal and rectal infections) in some populations, which may have increased the number of cases detected (2).

Along with improved screening and detection, antimicrobial resistance to first-line medications also contributes to the high rates of gonorrhea (17). Gonococcal infections have recently shown resistance or decreased susceptibility to all of the antibiotics commonly used for treatment in Canada, including penicillins, tetracyclines, macrolides and quinolones (8,18). Antimicrobial resistance can lead to ineffective treatment and ongoing transmission of the uncured infection. A study conducted in the USA reported higher antibiotic resistance among men who have sex with men (MSM) (19). Higher gonorrhea antimicrobial resistance may have contributed to the rate increase in Canadian men. Canadian treatment guidelines for gonorrhea have been updated frequently in the past five years to account for new information on antimicrobial resistance to *N. gonorrhoeae*. However, a recent Ontario study has shown poor adherence to gonorrhea treatment guidelines (20). Ineffective treatment affects the patient and may increase the transmission of resistant strains (17). Monitoring of resistant strains has proven more challenging due to the increased use of NAAT for screening. The NAAT is a diagnostic tool that does not allow for antimicrobial susceptibility assessment. However, new molecular testing methods using polymerase chain reaction (PCR), single nucleotide polymorphism or sequencing to identify resistance are being explored to improve the screening of resistant strains of gonorrhea (21,22).

Unlike chlamydia, most cases of gonorrhea in Canada were reported among men, like in the USA, Australia and England (13-15). However, in Canada, gonorrhea rates were higher in females aged less than 20 than in men the same age.

The rising gonorrhea rates among men can be explained partly by rapidly increasing rates of gonorrhea in the MSM population (23,24). Literature findings show that some MSM have adopted changes in their sexual behaviour, such as seroadaptation, as a harm reduction strategy for HIV infection (25). Seroadaptation includes serosorting, defined as choosing a sexual partner known to be of the same HIV serostatus to engage in unprotected sex, in order to reduce the risk of acquiring or transmitting HIV (25). However, these behaviours potentially increase their risk of contracting other STIs (25,26). Another factor that may explain the increased rates in males would be the fact that gonorrhea tends to be symptomatic more often in males than in females, which may motivate men to seek health care more often, and consequently, get diagnosed (23). High rates among females under 20 are particularly worrisome given that infertility is a potential outcome of gonorrhea infection, which may result in substantial psychosocial and economic costs.

Gonorrhea rates seem to be rising at a faster rate in older than in younger cohorts. This may be because ageing comes with natural physiological changes (vaginal drying), psychosocial changes (loss of a partner) and behavioural changes (increases in risky behaviour due to loss of fear of pregnancy), all of which can make older adults more susceptible to contracting STIs (27,28).

Strengths and limitations

This surveillance report presents national data on gonorrhea with information collected by all provinces and territories. Moreover, it describes rates over a six-year period.

Some limitations of the data should be noted. Data presented in this report likely underestimate the incidence rate of gonorrhea as some infections may be asymptomatic, unscreened, undiagnosed or unreported. Screening, laboratory testing and reporting practices are heterogeneous across provinces and territories. Therefore, direct comparisons between provinces and territories should be made with caution. Common barriers to reporting include lack of knowledge about which diseases to report, time required for notification and perception of the severity of the disease (29,30). However, as comprehensive incidence and prevalence studies are rare, the reported case rates provide valuable information on trends of disease and on minimum incidence rates.

Reinfections are common for gonorrhea, and more than one infection may have occurred and been reported for a given individual. Thus, the true number of infected people may be lower than the number of cases reported. In addition, information on risk factors is unavailable in the CNDSS, limiting

our ability to identify factors associated with higher gonorrhea rates.

The absence of statistical analysis in this surveillance report is a limitation. As rates were not age-standardized, changes in rates over the past three decades might be due partly to changes in the age structure of the provinces and territories and in Canada in general.

Conclusion

Gonorrhea rates in Canada rose by 65.4% between 2010 and 2015. Males continue to have higher rates than females. Studies indicate that more sensitive testing and antimicrobial resistance may account for a portion of the increase in cases. Ongoing monitoring of gonorrhea rates and antimicrobial resistance will help adjust current recommendations for treatment. Risk factor data would be useful in improving surveillance. Research and surveillance data are needed to better understand the current gonorrhea epidemic in order to maintain, evaluate and improve primary and secondary STI prevention activities including safer-sex awareness campaigns, screening, case finding and partner notification.

Authors' statement

YC – Conceptualization, methodology, writing – original draft
JM – Software, data collection and curation, validation, formal analysis, visualization, writing – review and editing
JS – Writing – original draft, visualization
AL – Validation, formal analysis, visualization, writing – review and editing
JA – Conceptualization, writing – original draft

Conflict of interest

None.

Contributors

Chris Archibald: Supervision, writing – review and editing, resources, project administration
Jennifer Siushansian: writing – review and editing

Acknowledgements

It would not have been possible to publish this report without the continuous and greatly appreciated contribution of all provinces and territories to STI national surveillance.

Funding

This work was supported by the Public Health Agency of Canada.

References

1. Newman L, Rowley J, Vander Hoorn S, Wijesooriya NS, Unemo M, Low N et al. Global estimates of the prevalence and incidence of four curable sexually transmitted infections in 2012 based on systematic review and global reporting. PLoS One 2015 Dec;10(12):e0143304. DOI (http://dx.doi.org/10.1371/journal.pone.0143304). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=26646541&dopt=Abstract)
2. Expert Working Group for the Canadian Guidelines on Sexually Transmitted Diseases. Gonococcal infections. In: Wong T, Latham-Carmanico C, editors. Canadian guidelines on Sexually Transmitted Infections, 2013. Ottawa: Public Health Agency of Canada; 2013. https://www.canada.ca/en/public-health/services/infectious-diseases/sexual-health-sexually-transmitted-infections/canadian-guidelines/sexually-transmitted-infections/canadian-guidelines-sexually-transmitted-infections-34.html
3. Centers for Disease Control and Prevention. Gonorrhea – CDC fact sheet (detailed version). Atlanta (GA): CDC; 2016 Oct. https://www.cdc.gov/std/gonorrhea/stdfact-gonorrhea-detailed.htm
4. Heymann DL, editor. Control of communicable diseases manual. 20th ed. Washington: American Public Health Association; 2015. 729 p.
5. Galvin SR, Cohen MS. The role of sexually transmitted diseases in HIV transmission. Nat Rev Microbiol 2004 Jan;2(1):33–42. DOI (http://dx.doi.org/10.1038/nrmicro794). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=15035007&dopt=Abstract).
6. Rebbapragada A, Kaul R. More than their sum in your parts: the mechanisms that underpin the mutually advantageous relationship between HIV and sexually transmitted infections. Drug Discov Today Dis Mech 2007;4(4):237–46. DOI (http://dx.doi.org/10.1016/j.ddmec.2007.12.003).
7. Totten S, MacLean R, Payne E. Gonorrhea in Canada: 2003-2012. Can Commun Dis Rep. 2015;41(2)26-9. http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/15vol41/dr-rm41-02/assets/pdf/15vol41_02-eng.pdf
8. Martin I, Sawatzky P, Liu G, Mulvey MR. Antimicrobial resistance to Neisseria gonorrhoeae in Canada: 2009-2013. Can Commun Dis Rep. 2015;41(2):35–41. https://www.canada.ca/en/public-health/services/reports-publications/canada-communicable-disease-report-ccdr/monthly-issue/2015-41/ccdr-volume-41-02-february-5-2015/ccdr-volume-41-02-february-5-2015-3.html
9. Public Health Agency of Canada. Canadian antimicrobial resistance surveillance system – report 2016. Ottawa (ON): PHAC; 2016 Sep. https://www.canada.ca/content/dam/phac-aspc/documents/services/publications/drugs-health-products/antibiotic-resistance-antibiotique/antibiotic-resistance-antibiotique-2016-eng.pdf
10. Public Health Agency of Canada. Canadian Notifiable Disease Surveillance System national report: 2005-2008. Ottawa (ON): PHAC; 2012. http://publications.gc.ca/collections/collection_2012/aspc-phac/HP40-75-2012-eng.pdf
11. Public Health Agency of Canada. Case definitions for communicable diseases under national surveillance; results of provincial/territorial (P/T) consultation process. Can

Commun Dis Rep 2009;35(S2):S1–123. https://www.canada.ca/content/dam/phac-aspc/migration/phac-aspc/publicat/ccdr-rmtc/09pdf/35s2-eng.pdf

12. Centers for Disease Control and Prevention. Sexually transmitted disease surveillance 2016. Atlanta (GA): US Department of Health and Human Services; 2017. https://www.cdc.gov/std/stats16/CDC_2016_STDS_Report-for508WebSep21_2017_1644.pdf
13. Centers for Disease Control and Prevention. Sexually transmitted disease surveillance 2015. Atlanta (GA): US Department of Health and Human Services; 2016. https://www.cdc.gov/std/stats15/STD-Surveillance-2015-print.pdf
14. The Kirby Institute. HIV, viral hepatitis and sexually transmissible infections in Australia: annual surveillance report 2016. Sydney (AU): University of New South Wales; 2016. https://kirby.unsw.edu.au/sites/default/files/kirby/report/SERP_Annual-Surveillance-Report-2016_UPD170627.pdf
15. Public Health England. Table 2: New diagnoses & rates by gender, sexual risk & age group, 2012-2016. London (UK): Public Health England. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/626361/2016_Table_2_Selected_STI_diagnoses___rates_by_gender__sexual_risk___age_group.pdf
16. Cornelisse VJ, Chow EP, Huffam S, Fairley CK, Bissessor M, De Petra V et al. Increased detection of pharyngeal and rectal gonorrhea in men who have sex with men after transition from culture to nucleic acid amplification testing. Sex Transm Dis 2017 Feb;44(2):114–7. DOI (http://dx.doi.org/10.1097/OLQ.0000000000000553). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=27984552&dopt=Abstract).
17. Singh AE, Gratrix J, Read R, Lovgren M, Drews SJ, Romanowski B et al. Neisseria gonorrhoeae multiantigen sequence typing is beneficial in further characterizing gonococcal populations in Alberta, Canada. Sex Transm Dis 2013 Sep;40(9):744–50. DOI (http://dx.doi.org/10.1097/01.olq.0000431356.80840.d4) PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=23945428&dopt=Abstract).
18. Public Health Agency of Canada. Treatment of N. gonorrhoeae in response to the discontinuation of spectinomycin: alternative treatment guidance statement. Ottawa (ON): PHAC; 2017. https://www.canada.ca/en/public-health/services/publications/diseases-conditions/gonorrhea-alternate-treatment.html
19. Kirkcaldy RD, Zaidi A, Hook EW 3rd, Holmes KK, Soge O, del Rio C et al. Neisseria gonorrhoeae antimicrobial resistance among men who have sex with men and men who have sex exclusively with women: the Gonococcal Isolate Surveillance Project, 2005-2010. Ann Intern Med 2013 Mar;158(5 Pt 1):321–8. DOI (http://dx.doi.org/10.7326/0003-4819-158-5-201303050-00004). PubMed (http://dx.doi.org/10.1097/01.olq.0000431356.80840.d4).
20. Dickson C, Taljaard M, Friedman DS, Metz G, Wong T, Grimshaw JM. The antibiotic management of gonorrhoea in Ontario, Canada following multiple changes in guidelines: an interrupted time-series analysis. Sex Transm Infect 2017 Dec;93(8):561–5. DOI (http://dx.doi.org/10.1136/sextrans-2017-053224). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=28844044&dopt=Abstract).
21. Peterson SW, Martin I, Demczuk W, Bharat A, Hoang L, Wylie J et al. Molecular assay for detection of genetic markers associated with decreased susceptibility to cephalosporins in Neisseria gonorrhoeae. J Clin Microbiol 2015 Jul;53(7):2042–8. DOI (http://dx.doi.org/10.1128/JCM.00493-15). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=25878350&dopt=Abstract).
22. Graham RM, Doyle CJ, Jennison AV. Epidemiological typing of Neisseria gonorrhoeae and detection of markers associated with antimicrobial resistance directly from urine samples using next generation sequencing. Sex Transm Infect 2017 Feb;93(1):65–7. DOI (http://dx.doi.org/10.1136/sextrans-2015-052422). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=26968786&dopt=Abstract).
23. Gilbert M, Rekart ML. Recent trends in chlamydia and gonorrhea in British Columbia. BCMJ 2009;51(10):435.
24. Rietmeijer CA, Patnaik JL, Judson FN, Douglas JM Jr. Increases in gonorrhea and sexual risk behaviors among men who have sex with men: a 12-year trend analysis at the Denver Metro Health Clinic. Sex Transm Dis 2003 Jul;30(7):562–7. DOI (http://dx.doi.org/10.1097/00007435-200307000-00006). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=12838084&dopt=Abstract).
25. Cassels S, Katz DA. Seroadaptation among men who have sex with men: emerging research themes. Curr HIV/AIDS Rep 2013 Dec;10(4):305–13. DOI (http://dx.doi.org/10.1007/s11904-013-0188-2). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=24234489&dopt=Abstract).
26. Mayer KH. Sexually transmitted diseases in men who have sex with men. Clin Infect Dis 2011 Dec;53 Suppl 3:S79–83. DOI (http://dx.doi.org/10.1093/cid/cir696). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=22080272&dopt=Abstract).
27. Johnson BK. Sexually transmitted infections and older adults. J Gerontol Nurs 2013 Nov;39(11):53–60. DOI (http://dx.doi.org/10.3928/00989134-20130918-01). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=24066789&dopt=Abstract).
28. Poynten IM, Grulich AE, Templeton DJ. Sexually transmitted infections in older populations. Curr Opin Infect Dis 2013 Feb;26(1):80–5. DOI (http://dx.doi.org/10.1097/QCO.0b013e32835c2173). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=23221769&dopt=Abstract).
29. Friedman SM, Sommersall LA, Gardam M, Arenovich T. Suboptimal reporting of notifiable diseases in Canadian emergency departments: a survey of emergency physician knowledge, practices, and perceived barriers. Can Commun Dis Rep 2006 Sep;32(17):187–98. PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=16989044&dopt=Abstract).
30. Doyle TJ, Glynn MK, Groseclose SL. Completeness of notifiable infectious disease reporting in the United States: an analytical literature review. Am J Epidemiol 2002 May;155(9):866–74. DOI (http://dx.doi.org/10.1093/aje/155.9.866). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=11978592&dopt=Abstract).

Appendix: Case definition of confirmed case of gonorrhea

Laboratory evidence of genital, extra-genital or perinatally acquired infections:

- detection of *Neisseria gonorrhoeae* by culture

  OR

- detection of *Neisseria gonorrhoeae* nucleic acid

Infectious and congenital syphilis in Canada, 2010–2015

Y Choudhri[1], J Miller[1], J Sandhu[1], A Leon[1], J Aho[1]*

Affiliation

[1] Centre for Communicable Diseases and Infection Control, Public Health Agency of Canada, Ottawa, ON

***Correspondence:** josephine.aho@canada.ca

Abstract

Background: Syphilis is the third most commonly reported notifiable sexually transmitted infection (STI) in Canada, following chlamydia and gonorrhea, respectively. Rates of this STI have been rising rapidly in Canada since 2001.

Objective: To summarize trends observed in syphilis rates for 2010 to 2015 in Canada.

Methods: Laboratory-confirmed cases of infectious syphilis and early congenital syphilis were reported to the Public Health Agency of Canada by all of the Canadian provinces and territories. National infectious syphilis rates were computed, as were rates per sex, age group and province/territory. Rates of congenital syphilis were also calculated.

Results: From 2010 to 2015, the rate of infectious syphilis in Canada increased by 85.6%, from 5.0 to 9.3 cases per 100,000 population. In 2015, a total of 3,321 cases of infectious syphilis were reported, mainly in males (93.7%), among whom the rate was 17.5 cases per 100,000 males versus 1.2 per 100,000 females. The rate also rose faster among males in 2010–2015, a 90.2% increase versus 27.8% among females. Individuals aged 20–39 years had the highest rates. Across the provinces and territories, the highest rates of infectious syphilis were in Nunavut, British Columbia and Manitoba.

The rate of congenital syphilis decreased from 2010 to 2014 (1.6 to 0.3 cases per 100,000 live births) before increasing to 1.5 cases per 100,000 live births in 2015, which corresponds to six reported cases.

Conclusion: Rates of syphilis continue to rise in Canada, especially among young men, and this is consistent with trends in the United States of America and European Union. Based on data from Canada and from these regions, the sexual behaviour of men who have sex with men (MSM) is thought to be a major risk factor for syphilis.

Suggested citation: Choudhri Y, Miller J, Sandhu J, Leon A, Aho J. Infectious and congenital syphilis in Canada, 2010–2015. Can Commun Dis Rep. 2018;44(2):43-8. https://doi.org/10.14745/ccdr.v44i02a02

Introduction

Syphilis, caused by the bacterium *Treponema pallidum* (1), is the third most commonly reported notifiable sexually transmitted infection (STI) in Canada, after chlamydia and gonorrhea, respectively. If left untreated, a primary syphilis infection can progress through secondary, latent and tertiary disease stages (2). Out of the four stages of syphilis, only three are infectious and therefore of public health significance: primary, secondary and early latent syphilis (1). Neurological symptoms can occur at any stage. Symptoms of infection in the earlier stages include chancres, condyloma lata and generalized lymphadenopathy. Cardiologic and musculoskeletal manifestations may occur if the infection remains untreated and reaches the tertiary stage. There is a synergy between HIV and syphilis as syphilis infection increases HIV viral load and HIV transmission (2). Moreover, for exposed individuals, HIV acquisition is two- to five-fold higher among those infected with syphilis than those without syphilis infection (2).

Congenital syphilis occurs through mother-to-child transmission, mainly in utero but also at birth. Congenital syphilis may have severe consequences for the newborn, such as cerebral palsy, hydrocephalus, sensorineural hearing loss, musculoskeletal deformity or death (3). The risk of transmission varies from 10% to more than 70% depending on the mother's stage of disease (3). Transmission may be prevented with timely diagnosis and adequate treatment.

After years of low incidence among both males and females, there has recently been a large increase in the number of syphilis cases, mainly among males (1). This rate increase coincides with the growing number of outbreaks reported in several cities and provinces across Canada among men who have sex with men (MSM), and especially among HIV-infected MSM, the heterosexual population and some Indigenous communities (1).

The objective of this article is to summarize observed trends in reported laboratory-confirmed infectious syphilis and congenital syphilis rates in Canada in the period 2010 to 2015. Rates were analyzed by sex, age and geographic distribution.

Methods

Data sources

Provincial and territorial health authorities provide non-nominal data on laboratory-confirmed cases to the Public Health Agency of Canada (PHAC) through the Canadian Notifiable Disease Surveillance System (CNDSS) (4). Confirmed case definitions of infectious syphilis and congenital syphilis are presented in the **Appendix** (5).

Variables submitted along with the diagnosis include sex, age at time of diagnosis, year of diagnosis and province/territory of diagnosis. All stages are notifiable but only infectious stages (primary, secondary and early latent) were included in this report. The received data were validated in collaboration with the corresponding province or territory. Data from January 1, 2010 to December 31, 2015 were available from all provinces and territories and were extracted from the CNDSS in July 2017.

Data analysis

Descriptive analysis was performed using Microsoft Excel. National annual reported case rates of infectious syphilis were computed per 100,000 population (or per males or females) for all years using number of cases from the CNDSS as numerators, and Statistics Canada yearly population estimates as denominators. Sex, age group and province/territory-specific rates were also calculated. For congenital syphilis, rates were computed per 100,000 live births. For 2014 and 2015, preliminary numbers of live births drawn from Statistics Canada were used, as final numbers were not yet available. No statistical procedures were used for comparative analyses. Small numbers are more susceptible to change and so corresponding rates should be interpreted with caution. Previous reports may provide different rates for some years due to reporting delays and data updating.

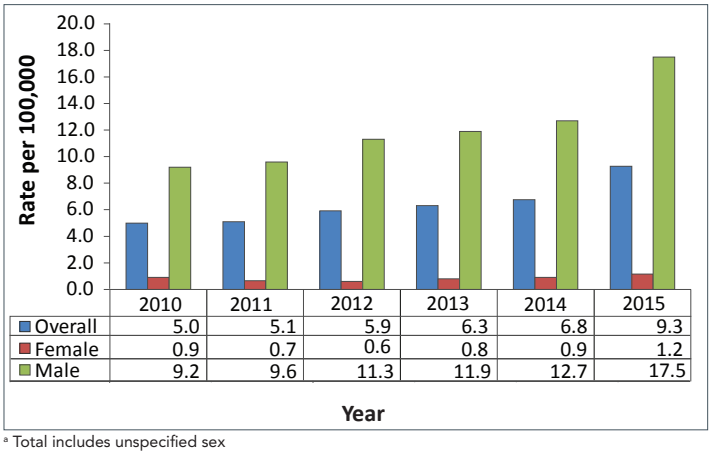
Results

From 2010 to 2015, the rate of reported laboratory-confirmed cases of infectious syphilis in Canada increased from 5.0 to 9.3 cases per 100,000 population (**Figure 1**). This represents an increase of 85.6% over this time period.

Sex and age

In 2015, a total of 3,321 cases of infectious syphilis were reported, of which 93.7% were males. This was reflected in the much higher rate of infectious syphilis among males than among females (17.5 cases per 100,000 males versus 1.2 cases per 100,000 females). The rate of infectious syphilis also increased faster among males than among females in 2010–2015 (90.2% among males versus 27.8% among females) (Figure 1).

Figure 1: Overall[a] and sex-specific rates of reported laboratory-confirmed infectious syphilis cases, 2010–2015, Canada

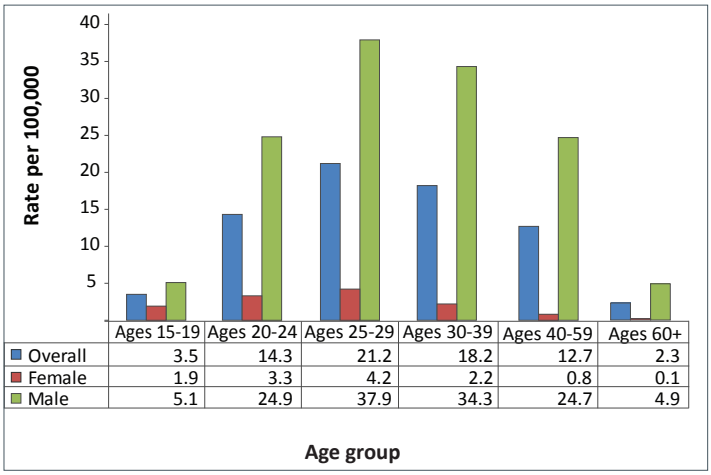


	2010	2011	2012	2013	2014	2015
Overall	5.0	5.1	5.9	6.3	6.8	9.3
Female	0.9	0.7	0.6	0.8	0.9	1.2
Male	9.2	9.6	11.3	11.9	12.7	17.5

[a] Total includes unspecified sex

From 2010 to 2015, all age cohorts had a rate increase (data not shown). The highest rates in 2015 (**Figure 2**) and highest rate increases from 2010 to 2015 were in those aged 25–29 years (a 133% increase from 2010 to 21.2 cases per 100,000 in 2015) and 30–39 years (a 109% increase from 2010 to 18.2 cases per 100,000 in 2015). For those two age groups, the increases were particularly pronounced between 2014 and 2015, accounting for more than half of the increase over 2010–2015. The increase in rate was also high during this period among those aged 60 years and above (a 91.7% increase, from 1.2 to 2.3 cases per 100,000). These three age cohorts (25–29, 30–39 and 60+) had the highest increase of all cohorts among both males and females.

Figure 2: Rates of reported laboratory-confirmed infectious syphilis by sex and age group, 2015, Canada



	Ages 15-19	Ages 20-24	Ages 25-29	Ages 30-39	Ages 40-59	Ages 60+
Overall	3.5	14.3	21.2	18.2	12.7	2.3
Female	1.9	3.3	4.2	2.2	0.8	0.1
Male	5.1	24.9	37.9	34.3	24.7	4.9

Geographic distribution

The three provinces with the highest reported rates of laboratory-confirmed syphilis in 2015 were Nunavut, British Columbia and Manitoba (**Table 1**). The greatest rate decreases were seen in the Northwest Territories, Saskatchewan and New Brunswick.

Table 1: Number and rate of reported laboratory-confirmed cases of infectious syphilis, by province and territory in Canada, 2010–2015

Province or territory	Laboratory-confirmed cases by year of diagnosis (rate per 100,000)					
	2010	2011	2012	2013	2014	2015
Alberta	173 (4.6)	94 (2.5)	129 (3.3)	124 (3.1)	157 (3.8)	369 (8.8)
British Columbia	92 (2.1)	128 (2.8)	266 (5.9)	454 (9.9)	432 (9.3)	607 (13.0)
Manitoba	17 (1.4)	16 (1.3)	25 (2.0)	59 (4.7)	118 (9.2)	205 (15.8)
New Brunswick	34 (4.5)	50 (6.6)	21 (2.8)	34 (4.5)	27 (3.6)	31 (4.1)
Newfoundland and Labrador	4 (0.8)	5 (1.0)	9 (1.7)	8 (1.5)	24 (4.5)	34 (6.4)
Northwest Territories	3 (6.9)	0 (0.0)	2 (4.6)	0 (0.0)	0 (0.0)	1 (2.3)
Nova Scotia	18 (1.9)	36 (3.8)	63 (6.7)	83 (8.8)	64 (6.8)	43 (4.6)
Nunavut	0 (0.0)	0 (0.0)	29 (83.6)	57 (161.0)	82 (227.6)	56 (153.3)
Ontario	774 (5.9)	770 (5.8)	835 (6.2)	744 (5.5)	879 (6.4)	1,052 (7.6)
Prince Edward Island	0 (0.0)	0 (0.0)	0 (0.0)	5 (3.4)	9 (6.2)	9 (6.1)
Quebec	546 (6.9)	630 (7.9)	673 (8.3)	631 (7.7)	584 (7.1)	737 (8.9)
Saskatchewan	36 (3.4)	23 (2.2)	6 (0.6)	17 (1.5)	28 (2.5)	24 (2.1)
Yukon	0 (0.0)	0 (0.0)	1 (2.8)	2 (5.5)	0 (0.0)	0 (0.0)
Canada	**1,697 (5.0)**	**1,752 (5.1)**	**2,059 (5.9)**	**2,218 (6.3)**	**2,404 (6.8)**	**3,321 (9.3)**

Congenital syphilis

The number of laboratory-confirmed cases of congenital syphilis reported in Canada varied from one to six cases per year in 2010–2015 (**Table 2**).

Table 2: Number of reported laboratory-confirmed cases and rates of congenital syphilis, 2010–2015, Canada

Indicator	Year of diagnosis					
	2010	2011	2012	2013	2014	2015
Number of cases	6	5	3	2	1	6
Rate per 100,000 live births	1.59	1.32	0.79	0.53	0.26	1.54

Discussion

In Canada, the rates of reported cases of infectious syphilis markedly increased from 2010 to 2015. The burden of syphilis seems to be disproportionately placed on men. Other high-income countries such as the United States of America (USA), Australia and the United Kingdom have reported similar increases in numbers of cases and rates (6-8).

The very high number of cases among males is thought to be mainly because of an increase in cases among MSM (1). Newfoundland and Labrador and Manitoba are among the provinces with the highest increases over 2010–2015. These provinces have reported that increased diagnoses among MSM was the main factor driving rates upwards (9,10). This is of concern as syphilis contraction increases the probability of acquiring and transmitting HIV (1). A greater increase of reported syphilis cases has been observed among MSM living with HIV than among noninfected MSM in both Western Europe and the USA (11).

The causes of the increase in the rate of syphilis among MSM are multifactorial and complex. Changing community norms and behaviours as well as new preventive interventions such as pre-exposure prophylaxis (PrEP) might explain this rise. Many MSM have adopted behaviour patterns such as serosorting (choosing to have condomless sex with partners with the same HIV status) or having condomless oral sex, with the intention of decreasing HIV transmission (12,13). However, the lowered condom use might increase the risk of contracting other STIs (13,14). In a Toronto-based study, condomless anal sex with casual partners in the previous six months was associated with syphilis infection among MSM living with HIV (15). Also of concern is the fact that Internet-based social media are increasingly being used to easily find sex partners. This may promote concurrent partnerships and rates of acquisition of new partners and decrease intervals between sex partners (16). The social mixing patterns with the use of saunas, and the consumption of recreational drugs that may impair judgment in making decisions about sexual acts are also risk factors for acquisition and transmission of syphilis and other STIs (16,17). Lastly, increased risk-taking behaviours and a rise in STI incidence have been reported among HIV-negative MSM using PrEP (18-20). In Canada, PrEP was not significantly used in 2010–2015. However, data from other countries and from research studies highlight the importance of frequent STI screening of MSM on PrEP to ensure that symptomatic and asymptomatic STIs are treated in a timely way to halt transmission, as PrEP use increases over time (21).

This finding highlights the importance of public health action to mitigate transmission of syphilis and identify new risk groups, such as MSM on PrEP.

The rate increase in women is also worrying as congenital syphilis tends to increase with rates of primary and secondary syphilis among women of childbearing age. A recent study on the epidemiology of syphilis in Winnipeg reported that one quarter

of women with syphilis were pregnant at diagnosis (22). No cases of congenital syphilis were found in the study.

This finding highlights the importance of universal screening of pregnant women in a context of syphilis resurgence in Canada, as recommended by the *Canadian Guidelines on Sexually Transmitted Infections* (1).

Strengths and limitations

This surveillance report presents a national portrait of the current infectious syphilis epidemiology and was based on data from all provinces and territories. It describes sex, age and province/territory-specific rates over a six-year period.

Some limitations of the data should be noted. First, some numbers of cases of infectious and congenital syphilis were low. This leads to less stable rates, especially for congenital syphilis for which less than 10 cases were reported annually in Canada in 2010–2015. Therefore, variations in rates over time should be interpreted with caution. Second, these figures likely underestimate the incidence rate of syphilis from 2010 to 2015 as some infections may be asymptomatic, unscreened, undiagnosed or unreported. Screening, laboratory testing and reporting practices are heterogeneous across provinces and territories, and reports to the PHAC of syphilis cases by stage vary between provinces/territories. Therefore, we were not able to calculate valid stage-specific rates or to report on the number of cases of specific conditions such as neurosyphilis. Likewise, although age structures may vary across provinces and territories, we did not perform standardization by age. Therefore, direct comparison between provinces should be made with caution.

Trend analysis on the data was not performed, which is a limitation of this report. Lastly, risk factors and clinical presentation are not available in this surveillance system, preventing identifying risk factors associated with the observed increased rates.

Conclusion

In conclusion, syphilis rates in Canada have risen markedly over time. Males make up the vast majority of syphilis cases, and based on data from Canada, USA, Australia and other countries, MSM are one of the groups at highest risk. A better understanding of transmission dynamics and social and sexual networking is needed to guide prevention efforts.

Authors' statement

YC – Conceptualization, methodology, writing – original draft
JM – Software, data collection and curation, validation, formal analysis, visualization, writing – review and editing
JS – Writing – original draft, visualization
AL – Validation, formal analysis, visualization, writing – review and editing
JA – Conceptualization, writing – original draft

Conflict of interest

None.

Contributors

Chris Archibald: Supervision, writing – review and editing, resources, project administration
Jennifer Siushansian: writing – review and editing

Acknowledgements

It would not have been possible to publish this report without the continuous and greatly appreciated contribution of all provinces and territories.

Funding

This work was supported by the Public Health Agency of Canada.

References

1. Expert Working Group for the Canadian Guidelines on Sexually Transmitted Infections. Syphilis. In: Wong T, Latham-Carmanico C, editors. Canadian Guidelines on Sexually Transmitted Infections, 2010. Ottawa (ON): Public Health Agency of Canada; 2010. https://www.canada.ca/en/public-health/services/infectious-diseases/sexual-health-sexually-transmitted-infections/canadian-guidelines/sexually-transmitted-infections/canadian-guidelines-sexually-transmitted-infections-27.html
2. Eickhoff CA, Decker CF. Syphilis. Dis Mon 2016 Aug;62(8):280–6. DOI (http://dx.doi.org/10.1016/j.disamonth.2016.03.012). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=27091635&dopt=Abstract).
3. Finelli L, Berman SM, Koumans EH, Levine WC. Congenital syphilis. Bull World Health Organ 1998;76 Suppl 2:126–8. PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=10063689&dopt=Abstract).
4. Public Health Agency of Canada. Canadian Notifiable Disease Surveillance System national report: 2005-2008. Ottawa (ON): PHAC; 2012. http://publications.gc.ca/collections/collection_2012/aspc-phac/HP40-75-2012-eng.pdf
5. Public Health Agency of Canada. Case definitions for communicable diseases under national surveillance; results of provincial/territorial (P/T) consultation process. Can Commun Dis Rep. 2009;35(S2):S1–123. https://www.canada.ca/en/public-health/services/reports-publications/canada-communicable-disease-report-ccdr/monthly-issue/2009-35/definitions-communicable-diseases-national-surveillance.html
6. Centers for Disease Control and Prevention. Sexually transmitted disease surveillance 2015. Atlanta (GA): US

Department of Health and Human Services; 2016. https://www.cdc.gov/std/stats15/STD-Surveillance-2015-print.pdf

7. The Kirby Institute. HIV, viral hepatitis and sexually transmissible infections in Australia: annual surveillance report 2016. Sydney (AU): University of New South Wales; 2016. https://kirby.unsw.edu.au/sites/default/files/kirby/report/SERP_Annual-Surveillance-Report-2016_UPD170627.pdf
8. Public Health England. Table 2: New diagnoses & rates by gender, sexual risk & age group, 2012-2016. London (UK): Public Health England. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/626361/2016_Table_2_Selected_STI_diagnoses___rates_by_gender__sexual_risk___age_group.pdf
9. Manitoba Health. Update on infectious syphilis in Manitoba. 2015 Dec. Winnipeg (MB): Manitoba Health. http://www.gov.mb.ca/health/publichealth/factsheets/syph_update.pdf
10. Health and Community Services. Syphilis clinical management, 2015. St John's (NL): Government of Newfoundland and Labrador; 2015 Jul 10. http://www.health.gov.nl.ca/health/publichealth/cdc/Syphilis_Clinical_Mgnt.pdf
11. Abara WE, Hess KL, Neblett Fanfair R, Bernstein KT, Paz-Bailey G. Syphilis trends among men who have sex with men in the United States and Western Europe: a systematic review of trend studies published between 2004 and 2015. PLoS One 2016 Jul;11(7):e0159309. DOI (http://dx.doi.org/10.1371/journal.pone.0159309). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=27447943&dopt=Abstract).
12. Cassels S, Katz DA. Seroadaptation among men who have sex with men: emerging research themes. Curr HIV/AIDS Rep 2013 Dec;10(4):305–13. DOI (http://dx.doi.org/10.1007/s11904-013-0188-2). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=24234489&dopt=Abstract).
13. Marcus U, Schmidt AJ, Hamouda O. HIV serosorting among HIV-positive men who have sex with men is associated with increased self-reported incidence of bacterial sexually transmissible infections. Sex Health 2011 Jun;8(2):184–93. DOI (http://dx.doi.org/10.1071/SH10053). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=21592432&dopt=Abstract).
14. Truong HM, Kellogg T, Klausner JD, Katz MH, Dilley J, Knapper K et al. Increases in sexually transmitted infections and sexual risk behaviour without a concurrent increase in HIV incidence among men who have sex with men in San Francisco: a suggestion of HIV serosorting? Sex Transm Infect 2006 Dec;82(6):461–6. DOI (http://dx.doi.org/10.1136/sti.2006.019950). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=17151031&dopt=Abstract).
15. Remis RS, Liu J, Loutfy MR, Tharao W, Rebbapragada A, Huibner S et al. Prevalence of sexually transmitted viral and bacterial infections in HIV-positive and HIV-negative men who have sex with men in Toronto. PLoS One 2016 Jul;11(7):e0158090. DOI (http://dx.doi.org/10.1371/journal.pone.0158090). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=27391265&dopt=Abstract).
16. Fenton KA, Breban R, Vardavas R, Okano JT, Martin T, Aral S et al. Infectious syphilis in high-income settings in the 21st century. Lancet Infect Dis 2008 Apr;8(4):244–53. DOI (http://dx.doi.org/10.1016/S1473-3099(08)70065-3). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=18353265&dopt=Abstract).
17. Grov C, Breslow AS, Newcomb ME, Rosenberger JG, Bauermeister JA. Gay and bisexual men's use of the Internet: research from the 1990s through 2013. J Sex Res 2014;51(4):390–409. DOI (http://dx.doi.org/10.1080/00224499.2013.871626). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=24754360&dopt=Abstract).
18. Lal L, Audsley J, Murphy DA, Fairley CK, Stoove M, Roth N et al.; VicPrEP Study Team. Medication adherence, condom use and sexually transmitted infections in Australian preexposure prophylaxis users. AIDS 2017 Jul;31(12):1709–14. DOI (http://dx.doi.org/10.1097/QAD.0000000000001519) PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=28700394&dopt=Abstract).
19. Kojima N, Davey DJ, Klausner JD. Pre-exposure prophylaxis for HIV infection and new sexually transmitted infections among men who have sex with men. AIDS 2016 Sep;30(14):2251–2. DOI (http://dx.doi.org/10.1097/QAD.0000000000001185). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=27314179&dopt=Abstract).
20. Scott HM, Klausner JD. Sexually transmitted infections and pre-exposure prophylaxis: challenges and opportunities among men who have sex with men in the US. AIDS Res Ther 2016 Jan;13:5. DOI (http://dx.doi.org/10.1186/s12981-016-0089-8). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=26793265&dopt=Abstract).
21. Jenness SM, Weiss KM, Goodreau SM, Gift T, Chesson H, Hoover KW et al. Incidence of Gonorrhea and Chlamydia Following Human Immunodeficiency Virus Preexposure Prophylaxis Among Men Who Have Sex With Men: A Modeling Study. Clin Infect Dis 2017;65(5):712–8. DOI (http://dx.doi.org/10.1093/cid/cix439). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=28505240&dopt=Abstract).
22. Shaw SY, Ross C, Nowicki DL, Marshall S, Stephen S, Davies C et al. Infectious syphilis in women: what's old is new again? Int J STD AIDS 2017 Jan;28(1):77–87. DOI (http://dx.doi.org/10.1177/0956462415627397). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=26769755&dopt=Abstract).

Appendix: Case definitions of confirmed cases of infectious and congenital syphilis[a]

Laboratory confirmation of early congenital syphilis infection (within two years of birth):

- Identification of *Treponema pallidum* by dark-field microscopy, fluorescent antibody or equivalent examination of material from nasal discharges, skin lesions, placenta, umbilical cord or autopsy material of a neonate (up to four weeks of age)
  OR
- Reactive serology (non-treponemal and treponemal) from venous blood (not cord blood) in an infant/child with clinical, laboratory or radiographic evidence of congenital syphilis whose mother is without documented evidence of adequate treatment
  OR
- Detection of *T. pallidum* DNA in an appropriate clinical specimen

Laboratory confirmation of primary syphilis infection:

- Identification of *T. pallidum* by dark-field microscopy, fluorescent antibody, nucleic acid testing or equivalent examination of material from a chancre or a regional lymph node
  OR
- Presence of one or more typical lesions (chancres) and reactive treponemal serology, regardless of non-treponemal test reactivity, in individuals with no previous history of syphilis
  OR
- Presence of one or more typical lesions (chancres) and a fourfold or greater increase in the titre over the last known non-treponemal test in individuals with a past history of syphilis treatment

Laboratory evidence of infection for secondary syphilis:

- Identification of *T. pallidum* by dark-field microscopy, fluorescent antibody, nucleic acid testing or equivalent examination of mucocutaneous lesions, condylomata lata and reactive serology (non-treponemal and treponemal)
  OR
- Presence of typical signs or symptoms of secondary syphilis (e.g. mucocutaneous lesions, alopecia, loss of eyelashes and lateral third of eyebrows, iritis, generalized lymphadenopathy, fever, malaise or splenomegaly) AND either a reactive serology (non-treponemal and treponemal) OR a fourfold or greater increase in titre over the previous known non-treponemal test

Laboratory confirmation of early latent syphilis infection (<1 year after infection):

An asymptomatic patient with reactive serology (treponemal and/or non-treponemal) who, within the previous 12 months, had one of the following:

- nonreactive serology
- symptoms suggestive of primary or secondary syphilis
- exposure to a sexual partner with primary, secondary or early latent syphilis

[a] Quebec's definition requires the use of two tests including a treponemal one for a diagnostic of primary, secondary or early latent syphilis

Chlamydia in Canada, 2010–2015

Y Choudhri[1], J Miller[1], J Sandhu[1], A Leon[1], J Aho[1]*

Affiliation

[1] Centre for Communicable Diseases and Infection Control, Public Health Agency of Canada, Ottawa, ON

***Correspondence:** josephine.aho@canada.ca

Abstract

Background: Chlamydia is the most commonly reported notifiable sexually transmitted infection in Canada. Rates have been steadily increasing since 1997.

Objective: To summarize trends in chlamydia rates for the period 2010–2015 in Canada.

Methods: Laboratory-confirmed cases of chlamydia were reported to the Public Health Agency of Canada by all the Canadian provinces and territories. The overall national rate was computed, as were rates per sex, age group and province/territory.

Results: In 2015, a total of 116,499 cases of chlamydia were reported in Canada, corresponding to a rate of 325 cases per 100,000 population. Females accounted for the majority (two-thirds) of chlamydia infections from 2010 to 2015. However, rates among males rose faster during this time period. Youth and young adults aged 15–29 years had the highest rates in 2015. While increased rates were observed over time for most age groups, adults aged 40 years and older had the greatest increase (51%) between 2010 and 2015. Chlamydia rates increased in most provinces during this period, with the highest rates being reported by the Northwest Territories and Nunavut in 2015.

Conclusion: Between 2010 and 2015, chlamydia rates increased by 16.7% and were highest among females and young adults. Although a number of factors may account for this rising trend, the possibility of a true increase in incidence cannot be ruled out. Ongoing monitoring of chlamydia and research into the reasons for the observed changes will help guide sexually transmitted infection (STI) prevention and control activities.

Suggested citation: Choudhri Y, Miller J, Sandhu J, Leon A, Aho J. Chlamydia in Canada, 2010–2015. Can Commun Dis Rep. 2018;44(2):49-54. https://doi.org/10.14745/ccdr.v44i02a03

Introduction

Chlamydia, caused by the bacterium *Chlamydia trachomatis*, is the most commonly reported sexually transmitted infection (STI) in Canada. In 2012, there were an estimated 131 million new cases of chlamydia globally, making it one of the most common STIs (1). If left untreated, chlamydia can lead to reactive arthritis in both sexes, as well as infertility, pelvic inflammatory disease, chronic pelvic pain and ectopic pregnancy in females and epididymo-orchitis in males (2). Mother-to-child transmission can occur at birth, resulting in pneumonia or conjunctivitis in newborns (2). In addition, chlamydia increases the infectiousness of and susceptibility to HIV by increasing the number of HIV target cells in the genital tract and amplifying HIV shedding (an infected cell releases viral particles, which in turn can infect new cells) (3,4).

The number of cases of chlamydia has risen steadily since 1997 in most jurisdictions (2,5). Aside from the use of more sensitive detection methods, this increase in the number of reported cases may be due to a real increase in incidence due to active transmission (2). In fact, many infected individuals are unaware of their status because of the asymptomatic nature of chlamydia. This can leave infections undiagnosed and untreated, helping to spread chlamydia among sexually active individuals. According to the 2009–2011 Canadian Health Measures Survey, the overall prevalence of chlamydial infection in the urine of Canadians aged 14–59 years was 0.7% (6). However, none of the respondents who tested positive for chlamydia reported being diagnosed with an STI.

The prevalence of chlamydia can be much higher in certain populations. A prevalence of chlamydia of 11.6% was reported in an Indigenous community in Nunavut (7) whereas it was 8.6% among urban Canadian street youth (8). Traditional approaches such as case-by-case partner notification seem to have produced mixed results in this largely asymptomatic disease, failing to curb the incidence of the infection.

The objective of this article is to summarize observed trends in chlamydia rates across Canada in the period 2010–2015.

Methods

Data sources

Chlamydia has been nationally notifiable since 1991. Provincial and territorial health authorities provide non-nominal data on laboratory-confirmed cases to the Public Health Agency

of Canada (PHAC) through the Canadian Notifiable Disease Surveillance System (CNDSS) (9). Confirmed case definitions include lymphogranuloma venereum serovars, and are shown in the **Appendix** (10).

Variables submitted along with the diagnosis include age at time of diagnosis, year of diagnosis, province/territory of diagnosis and sex. The received data are validated in collaboration with the corresponding province or territory. Data from January 1, 2010 to December 31, 2015 were available from all provinces and territories and were extracted from the CNDSS in July 2017.

Data analysis

Descriptive analysis was performed using Microsoft Excel. National annual rates of reported cases were computed using the number of cases from the CNDSS as numerators, and Statistics Canada yearly population estimates as denominators. Age group, sex and province/territory-specific rates were also calculated. For all years, rates were given per 100,000 population. No statistical procedures were used for comparative analyses. Small numbers are more susceptible to change so corresponding rates should be interpreted with caution. Previous reports may present different rates for some years due to reporting delays and data updating from provinces and territories.

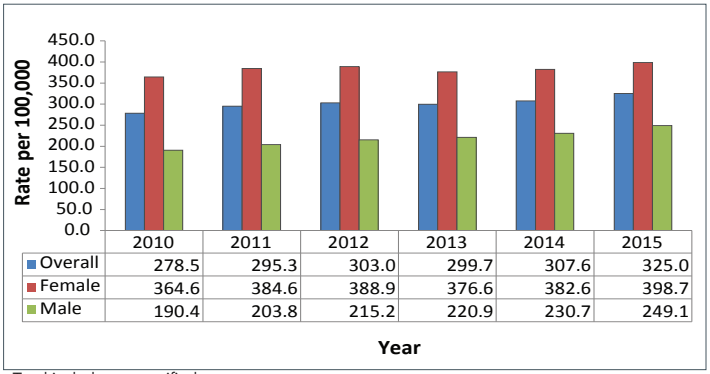
Results

Between 2010 and 2015, the number of reported chlamydia cases increased steadily, from 94,719 to 116,499. The corresponding overall rate in 2015 was 325.0 cases per 100,000 population, an increase of 16.7% from 2010.

Sex and age

Although the rate among females was consistently higher than the rate among males during the surveillance period, the rate among males rose at a faster pace. From 2010 to 2015, the rate of chlamydia infection among males increased 30.8% (from 190.4 to 249.1 cases per 100,000) and 9.3% among females (from 364.6 to 398.6 per 100,000) (**Figure 1).**

Figure 1: Overall[a] and sex-specific rates of reported laboratory-confirmed chlamydia cases, 2010–2015, Canada



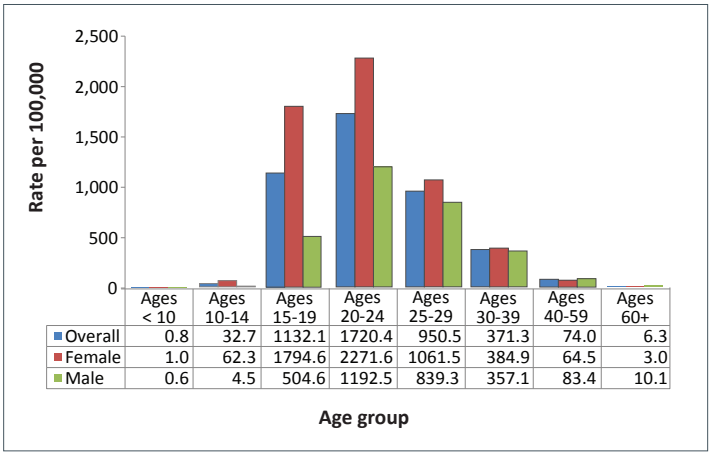
	2010	2011	2012	2013	2014	2015
Overall	278.5	295.3	303.0	299.7	307.6	325.0
Female	364.6	384.6	388.9	376.6	382.6	398.7
Male	190.4	203.8	215.2	220.9	230.7	249.1

[a] Total includes unspecified sex

From 2010 to 2015, the only decrease in the reported rate of chlamydia was among children aged 10 years or younger, from 1.01 to 0.77 per 100,000 (−23.7%). In contrast, adults 60 years and older had the highest increase in rates, at 51.9% (from 4.2 to 6.3 cases per 100,000) and those aged 40–59 years and 30–39 years were the next highest, at 51.0% and 40.9% (from 49.0 to 74.0 cases per 100,000 and from 263.6 to 371.3 cases per 100,000, respectively). Although the increases in rates were greatest in the oldest cohorts, those aged 60 plus years had one of lowest absolute infection rates (6.3 per 100,000) in 2015.

In 2015, the 20–24 year age cohort had the highest chlamydia infection rate at 1,720.4 per 100,000; both men and woman showed a peak in this age group (**Figure 2**). The next highest rate was in the 15–19 and 25–29 year age cohorts (1,132.1 per 100,000 and 950.5 per 100,000, respectively). Youth and young adults aged 15–24 years represented 56.8% of all reported chlamydia cases in 2015 although they accounted for only 12.6% of the overall population.

Figure 2: Rates of reported laboratory-confirmed chlamydia by sex and by age group, 2015, Canada



	Ages < 10	Ages 10-14	Ages 15-19	Ages 20-24	Ages 25-29	Ages 30-39	Ages 40-59	Ages 60+
Overall	0.8	32.7	1132.1	1720.4	950.5	371.3	74.0	6.3
Female	1.0	62.3	1794.6	2271.6	1061.5	384.9	64.5	3.0
Male	0.6	4.5	504.6	1192.5	839.3	357.1	83.4	10.1

Men and women aged 20 years and older showed increasing infection rates over time for all age groups, and the relative increases were higher for men (data not shown). Among adolescents aged 10–14 years in the period from 2010 to 2015, there was a 20.7% decrease in chlamydia rates among boys and a 9.6% increase among girls. The trend was reversed for the 15–19 year age group, with rates decreasing by 0.5% for girls between 2010 and 2015 and increasing by 19.5% among boys.

Geographic distribution

The majority of provinces and territories showed an increase in the number of chlamydia cases and rates over the 2010 to 2015 period (**Table 1**). However, the two jurisdictions with the highest rates (Northwest Territories and Nunavut) both showed slightly decreasing trends over this period.

Table 1: Number and rate of reported laboratory-confirmed cases of chlamydia by province and territory in Canada, 2010–2015

Province or territory	Laboratory-confirmed cases by year of diagnosis (rate per 100,000)					
	2010	2011	2012	2013	2014	2015
Alberta	13,112 (351.3)	14,142 (373.1)	15,704 (404.7)	16,081 (402.4)	16,622 (404.6)	17,548 (419.8)
British Columbia	11,874 (265.9)	11,765 (261.5)	12,416 (273.1)	12,244 (266.8)	13,452 (289.6)	14,379 (306.4)
Manitoba	6,370 (521.7)	6,722 (544.8)	6,589 (527.0)	6,420 (507.3)	6,294 (491.4)	6,539 (504.6)
New Brunswick	1,875 (249.0)	1,931 (255.6)	1,932 (255.3)	1,770 (234.2)	1,746 (231.3)	1,891 (250.7)
Newfoundland and Labrador	644 (123.4)	689 (131.2)	864 (164.1)	801 (151.9)	871 (164.9)	963 (182.2)
Northwest Territories	909 (2,100.4)	825 (1,896.5)	956 (2,193.0)	870 (1,986.9)	826 (1,882.0)	886 (2,002.5)
Nova Scotia	2,236 (237.3)	2,464 (260.9)	2,613 (276.5)	2,464 (261.1)	2,628 (278.6)	2,835 (300.5)
Nunavut	1,396 (4,185.5)	1,320 (3,860.1)	1,356 (3,907.0)	1,475 (4,166.6)	1,284 (3,564.4)	1,385 (3,791.2)
Ontario	33,478 (254.9)	36,418 (274.6)	36,558 (272.5)	34,683 (255.9)	35,985 (263.0)	39,024 (282.8)
Prince Edward Island	213 (150.3)	220 (152.7)	257 (177.1)	242 (166.7)	254 (174.2)	227 (154.7)
Quebec	17,324 (218.5)	19,147 (239.1)	20,159 (249.3)	22,287 (273.3)	23,340 (284.1)	24,448 (296.0)
Saskatchewan	5,059 (481.2)	5,554 (520.8)	5,721 (526.8)	5,771 (522.3)	5,807 (517.9)	6,091 (538.0)
Yukon	229 (661.9)	209 (590.4)	176 (488.1)	239 (658.1)	210 (569.5)	283 (756.8)
Canada	**94,719 (278.5)**	**101,406 (295.3)**	**105,301 (303.0)**	**105,347 (299.7)**	**109,319 (307.6)**	**116,499 (325.0)**

Discussion

From 2010 to 2015, rates of reported cases of chlamydia increased across Canada, a picture similar to that in the United States of America (USA) (11). Several factors may help to explain these increasing rates. In addition to a possible true increase in incidence, the popularity of a highly sensitive diagnostic tool (nucleic acid amplification testing or NAAT) as well as more effective screening and case-finding may have led to increased diagnoses of chlamydia (12-14). Quebec, which had one of the highest rate increases, has indicated that their increasing rates are partly due to increased testing in the province and increased use of NAAT (15).

From 2010 to 2015, females had consistently higher rates of reported chlamydia than did men, and rates are continuing to rise. Chlamydia rates are also higher among females than among males in the USA, England and Australia (11,16-17). Several studies have indicated that females may be more biologically susceptible to chlamydia than males (18,19). Furthermore, they are also more likely to seek health care (19,20). Infections in females are frequently asymptomatic, and untreated infections can lead to serious complications and morbidity such as pelvic inflammation, ectopic pregnancies and infertility (21,22). This may explain why chlamydia screening programs and physician practices have traditionally targeted females (23). A higher rate of ascertainment could partly explain the higher rates of chlamydia infection among females.

Although absolute rates were lower among males than among females, rates among men were also increasing and at a rate much higher than that of females. This increase may also be partly due to the increased uptake of sensitive testing since males are considered a hidden reservoir of chlamydia (2,24). Also, the increased use of NAAT to detect extra-genital infections (especially rectal infections among men who have sex with men) and increased availability of urine-based NAAT tests may explain the observed rise in chlamydia rates among men (15).

Adolescents and young adults aged 15–29 years continue to have high rates of infection, a situation observed in several high-income countries. For example, in the USA, lack of access to health care services, insufficient screening, confidentiality concerns around disclosing risky behaviours and having multiple sexual partners have been reported as the constellation of factors that put youth at risk of STIs (25). Suboptimal risk awareness and poor knowledge of risk-reduction behaviours may also explain these levels of STI risk (26).

An increasing trend in rates has also been observed among older cohorts. Recently, Canadian demographics have shifted towards an older population. Although absolute rates are low among those aged 60 years and over, chlamydia rates increased notably in this age group over time. This is likely due to a combination of factors, including increases in risky sexual behaviour, psychosocial changes such as the loss of a spouse, evolving societal norms and natural physiological changes, such as decreased vaginal lubrication, which can cause the mucosal tissue to be more fragile and more susceptible to infection (27,28).

Strengths and limitations

This surveillance report presents national data on chlamydia based on cases reported by all provinces and territories in Canada; it describes rates over a six-year period.

Some limitations of these data should be noted. Data presented in this report likely underestimate the true incidence rate of chlamydia from 2010–2015 as many infections are asymptomatic, undiagnosed or unreported. Reporting might vary and common barriers include lack of knowledge about which diseases to report, time required for notification, and perceived severity of the disease to be reported (29,30). However, as comprehensive incidence and prevalence studies are rare, the reported case rates provide valuable information on disease trends and on minimum incidence rates.

Chlamydia reinfections are common and more than one infection may have occurred and been reported for a given individual, so the true number of people infected may be lower than the number of cases reported. In addition, information on risk factors is unavailable in the CNDSS, limiting our ability to identify factors associated with higher chlamydia rates.

The absence of statistical analysis in this surveillance report is also a limitation. As rates were not age-standardized, changes in rates over the past three decades might be due partly to

changes in the age structure of provinces and territories and in Canada in general.

Finally, screening, testing and reporting practices can differ significantly between provinces and territories and might have changed over time, resulting in an uneven ability to capture all cases across jurisdictions. Therefore, direct comparisons between provinces and territories should be made with caution.

Conclusion

Chlamydia rates increased by 16.7% between 2010 and 2015, and females consistently have higher rates than males. Although a number of factors may account for these trends, the possibility of a true increase in incidence cannot be ruled out. Ongoing monitoring of chlamydia, evaluation of traditional approaches and interventions and research into the reasons for the observed changes will help guide chlamydia prevention and control activities.

Authors' statement

YC – Conceptualization, methodology, writing – original draft
JM – Software, data collection and curation, validation, formal analysis, visualization, writing – review and editing
JS – Writing – original draft, visualization
AL – Validation, formal analysis, visualization, writing – review and editing
JA – Conceptualization, writing – original draft

Conflict of interest

None.

Contributors

Chris Archibald – Supervision, writing – review and editing, resources, project administration
Jennifer Siushansian – Writing – review and editing

Acknowledgements

It would not have been possible to publish this report without the continuous and greatly appreciated contribution of all provinces and territories to STI national surveillance.

Funding

This work was supported by the Public Health Agency of Canada.

References

1. Newman L, Rowley J, Vander Hoorn S, Wijesooriya NS, Unemo M, Low N et al. Global estimates of the prevalence and incidence of four curable sexually transmitted infections in 2012 based on systematic review and global reporting. PLoS One 2015 Dec;10(12):e0143304. DOI (http://dx.doi.org/10.1371/journal.pone.0143304). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=26646541&dopt=Abstract).
2. Expert Working Group for the Canadian Guidelines on Sexually Transmitted Infections. Chlamydial infections. In: Wong T, Latham-Carmanico C, editors. Canadian Guidelines on Sexually Transmitted Infections, 2010. Ottawa (ON): Public Health Agency of Canada; 2010. https://www.canada.ca/en/public-health/services/infectious-diseases/sexual-health-sexually-transmitted-infections/canadian-guidelines/sexually-transmitted-infections/canadian-guidelines-sexually-transmitted-infections-30.html
3. Galvin SR, Cohen MS. The role of sexually transmitted diseases in HIV transmission. Nat Rev Microbiol 2004 Jan;2(1):33–42. DOI (http://dx.doi.org/10.1038/nrmicro794). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=15035007&dopt=Abstract).
4. Rebbapragada A, Kaul R. More than their sum in your parts: the mechanisms that underpin the mutually advantageous relationship between HIV and sexually transmitted infections. Drug Discov Today Dis Mech 2007;4(4):237–46. DOI (http://dx.doi.org/10.1016/j.ddmec.2007.12.003).
5. Totten S, MacLean R, Payne E, Severini A. Chlamydia and lymphogranuloma venereum in Canada: 2003-2012..Summary Report. Can Commun Dis Rep 2015;41(2):20–5. https://www.canada.ca/en/public-health/services/reports-publications/canada-communicable-disease-report-ccdr/monthly-issue/2015-41/ccdr-volume-41-02-february-5-2015/ccdr-volume-41-02-february-5-2015.html
6. Rotermann M, Langlois KA, Severini A, Totten S. Prevalence of Chlamydia trachomatis and herpes simplex virus type 2: Results from the 2009 to 2011 Canadian Health Measures Survey. Health Rep 2013 Apr;24(4):10–5. https://www.statcan.gc.ca/pub/82-003-x/2013004/article/11777-eng.pdf
7. Steenbeek A, Tyndall M, Sheps S, Rothenberg R. An epidemiological survey of chlamydial and gonococcal infections in a Canadian arctic community. Sex Transm Dis 2009 Feb;36(2):79–83. DOI (http://dx.doi.org/10.1097/OLQ.0b013e3181898e4d). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=19125145&dopt=Abstract).
8. Shields SA, Wong T, Mann J, Jolly AM, Haase D, Mahaffey S et al. Prevalence and correlates of Chlamydia infection in Canadian street youth. J Adolesc Health 2004 May;34(5):384–90. DOI (http://dx.doi.org/10.1016/S1054-139X(03)00332-X). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=15093792&dopt=Abstract).
9. Public Health Agency of Canada. Canadian Notifiable Disease Surveillance System national report: 2005-2008. Ottawa (ON): PHAC; 2012. http://publications.gc.ca/collections/collection_2012/aspc-phac/HP40-75-2012-eng.pdf
10. Public Health Agency of Canada. Case definitions for communicable diseases under national surveillance; results of provincial/territorial (P/T) consultation process. Can Commun Dis Rep. 2009;35(S2):S1–123. https://www.canada.ca/en/public-health/services/reports-publications/canada-communicable-disease-report-ccdr/monthly-issue/2009-35/definitions-communicable-diseases-national-surveillance.html
11. Centers for Disease Control and Prevention. Sexually transmitted disease surveillance 2015. Atlanta (GA): US Department of Health and Human Services; 2016. https://www.cdc.gov/std/stats15/STD-Surveillance-2015-print.pdf
12. McKay A, Barrett M. Rising reported rates of chlamydia among young women in Canada: what do they tell us about trends

in the actual prevalence of the infection? Can J Hum Sex 2008;17(1-2):61–9.

13. Rekart ML, Brunham RC. Epidemiology of chlamydial infection: are we losing ground? Sex Transm Infect 2008 Apr;84(2):87–91. DOI (http://dx.doi.org/10.1136/sti.2007.027938). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=18216155&dopt=Abstract).
14. Tuite AR, Jayaraman GC, Allen VG, Fisman DN. Estimation of the burden of disease and costs of genital Chlamydia trachomatis infection in Canada. Sex Transm Dis 2012 Apr;39(4):260–7. DOI (http://dx.doi.org/10.1097/OLQ.0b013e31824717ae). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=22421691&dopt=Abstract).
15. Blouin K, Venne S, Lambert G. Portrait des infections transmissibles sexuellement et par le sang (ITSS) au Québec: année 2015 (et projections 2016). Québec (QC): INSPQ; 2016. https://www.inspq.qc.ca/en/node/6914
16. The Kirby Institute. HIV, viral hepatitis and sexually transmissible infections in Australia: annual surveillance report 2016. Sydney (AU): University of New South Wales; 2016. https://kirby.unsw.edu.au/sites/default/files/kirby/report/SERP_Annual-Surveillance-Report-2016_UPD170627.pdf
17. Public Health England. Table 2: New diagnoses & rates by gender, sexual risk & age group, 2012-2016. London (UK): Public Health England. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/626361/2016_Table_2_Selected_STI_diagnoses___rates_by_gender__sexual_risk___age_group.pdf
18. Lee V, Tobin JM, Foley E. Relationship of cervical ectopy to chlamydia infection in young women. J Fam Plann Reprod Health Care 2006 Apr;32(2):104–6. DOI (http://dx.doi.org/10.1783/147118906776276440). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=16824301&dopt=Abstract).
19. Wong T, Singh A, Mann J, Hansen L, McMahon S. Gender differences in bacterial STIs in Canada. BMC Womens Health 2004 Aug;4 Suppl 1:S26. DOI (http://dx.doi.org/10.1186/1472-6874-4-S1-S26). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=15345089&dopt=Abstract).
20. Thompson AE, Anisimowicz Y, Miedema B, Hogg W, Wodchis WP, Aubrey-Bassler K. The influence of gender and other patient characteristics on health care-seeking behaviour: a QUALICOPC study. BMC Fam Pract 2016 Mar;17:38. DOI (http://dx.doi.org/10.1186/s12875-016-0440). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=27036116&dopt=Abstract)
21. Moreno MA, Furtner F, Rivara FP. Advice for patients. Chlamydia screening: a routine test. Arch Pediatr Adolesc Med 2009 Jun;163(6):592 DOI (http://doi.org/10.1001/archpediatrics.2009.99). PubMed (https://www.ncbi.nlm.nih.gov/pubmed/19487620).
22. Wiesenfeld HC, Solomon CG. Screening for Chlamydia trachomatis infections in women. N Engl J Med 2017 Mar. DOI (http://www.nejm.org/doi/citedby/10.1056/NEJMcp1412935#t=article). PubMed (https://www.ncbi.nlm.nih.gov/pubmed/28225683).
23. Machalek K, Hanley BE, Kajiwara JN, Pasquali PE, Stannard CJ. Chlamydia screening practices among physicians and community nurses in Yukon, Canada. Int J Circumpolar Health 2013 Aug;72(1):22447. DOI (http://dx.doi.org/10.3402/ijch.v72i0.21607). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=23984299&dopt=Abstract).
24. Barbee LA, Dombrowski JC, Kerani R, Golden MR. Effect of nucleic acid amplification testing on detection of extragenital gonorrhea and chlamydial infections in men who have sex with men sexually transmitted disease clinic patients. Sex Transm Dis 2014 Mar;41(3):168–72. DOI (http://dx.doi.org/10.1097/OLQ.0000000000000093). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=24521722&dopt=Abstract).
25. Centers for Disease Prevention and Control. Sexually transmitted infections among young Americans. Atlanta (GA): US Department of Health and Human Services; 2013. https://www.cdc.gov/std/products/youth-sti-infographic.pdf
26. Council of Ministers of Education. Canada. Canadian Youth, Sexual Health and HIV/AIDS Study: factors influencing knowledge, attitudes and behaviours. Toronto (ON): Council of Ministers of Education Canada; 2003. http://educ.queensu.ca/sites/webpublish.queensu.ca.educwww/files/files/Research/SPEG/SPEG%20Canadian%20Youth%2C%20Sexual%20Health%20and%20HIV.pdf
27. Johnson BK. Sexually transmitted infections and older adults. J Gerontol Nurs 2013 Nov;39(11):53–60. DOI (http://dx.doi.org/10.3928/00989134-20130918-01). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=24066789&dopt=Abstract).
28. Poynten IM, Grulich AE, Templeton DJ. Sexually transmitted infections in older populations. Curr Opin Infect Dis 2013 Feb;26(1):80–5. DOI (http://dx.doi.org/10.1097/QCO.0b013e32835c2173). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=23221769&dopt=Abstract).
29. Friedman SM, Sommersall LA, Gardam M, Arenovich T. Suboptimal reporting of notifiable diseases in Canadian emergency departments: a survey of emergency physician knowledge, practices, and perceived barriers. Can Commun Dis Rep. 2006 Sep;32(17):187–98. https://www.canada.ca/content/dam/phac-aspc/migration/phac-aspc/publicat/ccdr-rmtc/06pdf/cdr3217.pdf
30. Doyle TJ, Glynn MK, Groseclose SL. Completeness of notifiable infectious disease reporting in the United States: an analytical literature review. Am J Epidemiol 2002 May;155(9):866–74. DOI (http://dx.doi.org/10.1093/aje/155.9.866). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=11978592&dopt=Abstract).

Appendix: Case definition of confirmed case of chlamydia

Laboratory evidence of infection in genitourinary or extra-genital infections

- Detection of *Chlamydia trachomatis* by culture
  OR
- Detection of *C. trachomatis* nucleic aci
  OR
- Detection of *C. trachomatis* antigen

Laboratory evidence of perinatal infection

Detection and confirmation of *C. trachomatis* in nasopharyngeal or other respiratory tract specimens from an infant in whom pneumonia developed in the first six months of life or in conjunctival specimens from an infant who developed conjunctivitis in the first month of life:

- Detection of *C. trachomatis* by culture
  OR
- Detection of *C. trachomatis* nucleic acid
  OR
- Detection of *C. trachomatis* antigen

Lymphogranuloma venereum in Quebec: Re-emergence among men who have sex with men

CA Boutin[1], S Venne[2], M Fiset[2], C Fortin[1,3], D Murphy[3], A Severini[4], C Martineau[1,3], J Longtin[3], AC Labbé[1,3]*

Abstract

Background: Lymphogranuloma venereum (LGV) is a sexually transmitted infection (STI) caused by *Chlamydia trachomatis* genotypes L_1, L_2 and L_3. This LGV is associated with significant morbidity and increased risk of HIV transmission. While fewer than two cases per year were reported in Quebec before 2005, LGV emerged in 2005–2006 with 69 cases, followed by a period of low incidence (2007–2012), and subsequent re-emergence since 2013.

Objectives: To describe the incidence of LGV in Quebec and the characteristics of the affected population, including demographics and risk factors, clinical manifestations, laboratory tests, treatments and reinfection rates.

Methods: Descriptive data were collected from the notifiable diseases records through the Institut national de santé publique du Québec (INSPQ) infocentre portal. Questionnaires were obtained through the enhanced surveillance system and transmitted anonymously to the Quebec Ministry of Health. In-depth analysis was performed on cases from 2013 to 2016.

Results: There were 338 cases of LGV over the four-year period in Quebec. All cases were male, excluding one transsexual. Mean age was 41 years. Most lived in Montréal (81%) and were men who have sex with men (MSM; 99%). The majority (83%) reported four sexual partners or more in the last year, met mostly through the Internet (77%) and in saunas (73%). Frequency of sexual intercourse with out-of-province residents decreased in 2013–2016 (27%) compared with 2005–2012 (38%). History of STIs was frequent: 83% were HIV-infected, 81% reported previous syphilis and 78% previous gonorrhea. Recreational drug use was frequent (57%), reaching 71% in 2016. Most cases were symptomatic, a proportion which decreased in 2016 (68%) compared with 2013–2015 (82%; p=0.006). Clinical presentations included proctitis (86%), lymphadenopathy (13%) and ulcer/papule (12%). Reinfections, mostly within two years of first infection, occurred in 35 individuals (10%).

Conclusion: The re-emergence of LGV in Quebec involves an urban subpopulation composed almost exclusively of MSM with STIs, who have a high number of partners and often use drugs.

Affiliations

[1] Département de microbiologie, infectiologie et immunologie, Université de Montréal, Montréal, QC

[2] Ministère de la santé et des services sociaux du Québec, Montréal, QC

[3] Institut national de santé publique du Québec, Montréal, QC

[4] National Microbiology Laboratory, Public Health Agency of Canada, Winnipeg, MB

***Correspondence:** ac.labbe@umontreal.ca

Suggested citation: Boutin CA, Venne S, Fiset M, Fortin C, Murphy D, Severini A, Martineau C, Longtin J, Labbé AC. Lymphogranuloma venereum in Quebec: Re-emergence among men who have sex with men. Can Commun Dis Rep. 2018;44(2):55-61. https://doi.org/10.14745/ccdr.v44i02a04

Introduction

Lymphogranuloma venereum (LGV) is a sexually transmitted infection (STI) caused by *Chlamydia trachomatis* genotypes L_1, L_2 and L_3 (L_{1-3}). It is associated with anogenital fistula, stenosis formation and lymphatic obstruction, among others (1) and increased risk of HIV transmission (1-3). This information was rarely reported in industrialized countries until the early 2000s, but it has since been described in urban settings, mainly among men who have sex with men (MSM). Recent outbreaks occurred in Belgium, France, the Netherlands, the United Kingdom and the United States of America (2). Over the last decade, LGV emerged in Canada, with sporadic outbreaks mainly in major urban centres (3-5).

In Quebec, fewer than two cases per year were reported before a significant rise was noted in 2005 and 2006 with a total of 69 cases. A period of low incidence followed from 2007 to 2012, with a mean of nine cases per year. In 2013, an evolving outbreak started in Montréal.

The classical presentation of LGV is an inguinogenital disease, with an ulcer or papule at the site of inoculation and frequently a unilateral inguinal or femoral lymphadenopathy (1). Many young patients are now presenting with proctitis or proctocolitis, often mimicking the first manifestations of inflammatory bowel disease (2). Prevalence studies have recently found a higher proportion of asymptomatic cases, representing up to 25–27% of cases in MSM (6,7).

In 2014, the Public Health Agency of Canada (PHAC) revised its recommendations to encourage LGV genotyping on positive *C. trachomatis* specimens among asymptomatic MSM with risk factors, regardless of sampled site; this was further updated in 2017 to focus on rectal specimens only (3). Following expert advice from the Institut national de santé publique du Québec (INSPQ) (8), systematic genotyping of all positive rectal specimens for *C. trachomatis* (regardless of symptomatology) was implemented in June 2016 (the value of this strategy will be assessed after two years). The INSPQ also provides guidelines on treatment of cases and partners (8).

Given the growing epidemic, enhanced surveillance of LGV cases was pursued in Quebec with the goal of implementing targeted public health interventions.

The objective of this article is to describe the Quebec 2013–2016 LGV epidemic and present epidemiologic data including demographic details, risk factors, clinical manifestations, laboratory tests, treatment and reinfection.

Methods

Until 2005, LGV was part of routine surveillance and notifiable to public health authorities. In 2005, PHAC (9) and the Quebec Ministry of Health initiated an enhanced surveillance system for LGV, whereby when a case is notified, key epidemiologic and clinical information are collected by public health nurses who contact the attending physicians or the patients directly. The nurses administer an epidemiologic questionnaire to collect information about patient demographics (age, sex, area of residence), risk factors (number, sex and meeting context of partners; history of sexually transmitted or blood-borne infections [STBBIs]; drug use), clinical presentation, laboratory tests performed and treatment information. In an attempt to prevent missing any data, epidemiologic questionnaires were revised over the surveillance period and medical teams were contacted, if necessary.

For this present surveillance report, descriptive data for all LGV cases in Quebec from 2013 to 2016 were collected from the notifiable diseases database through the INSPQ infocentre portal and enhanced surveillance questionnaires were transmitted anonymously to the provincial Ministry of Health for compilation and analysis. Surveillance definitions changed over time. In 2013–2014, confirmed cases included:

- Patients with proctitis, inguinal/femoral lymphadenopathy or contact with a confirmed LGV case
- Isolation of *C. trachomatis* or detection by nucleic acid amplification testing (NAAT) from an appropriate clinical specimen and $L_{1–3}$ genotype documented through DNA sequencing

In 2015, genotyping alone became sufficient to consider a case confirmed and clinical manifestation or contact with a case were no longer required. Probable cases included patients who presented with proctitis or inguinal/femoral lymphadenopathy or had a contact with a confirmed LGV case and had a positive test for *C. trachomatis* from an appropriate clinical specimen (10).

Until February 2016, all genotyping was performed at the National Microbiology Laboratory, in Winnipeg, Manitoba. In March 2016, a multiplex polymerase chain reaction (PCR) assay that distinguishes LGV from non-LGV *C. trachomatis* infections (11) became available at Laboratoire de santé publique du Québec, Sainte-Anne-de-Bellevue, Quebec. Thereafter, only positive LGV samples were sent to the National Microbiology Laboratory for genotype identification by DNA sequencing.

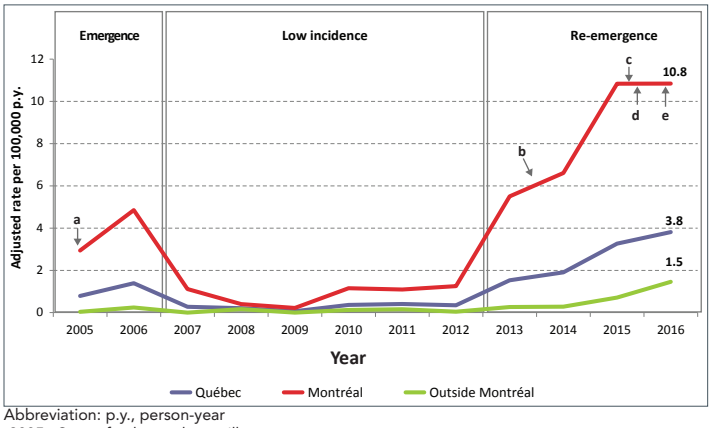
All cases notified in 2013–2016 were investigated to identify any previous episodes since January 1, 2005. A reinfection was defined as a second infection in the same individual occurring at least 90 days after the first episode (12).

Data were analyzed for all 338 cases (or cases for which information was available for a specific variable) notified between 2013 and 2016, excluding one transsexual case (man to woman). Data were analyzed with statistical software Epi Info version 7.2.0.1 and Stata 64 (version 10.1). Proportions were compared using the x^2 test. The epidemiologic portrait presented here focuses on the 2013–2016 outbreak in Quebec, with parallels to preceding years (i.e. 2005–2012) only where appropriate.

Results

From January 1, 2013, to December 31, 2016, 338 cases (328 confirmed and 10 probable) were reported: 49 in 2013, 61 in 2014, 105 in 2015 and 123 in 2016 (**Figure 1).**

Figure 1: Lymphogranuloma venereum among men: annual adjusted rate per 100,000 person years in Quebec, Montréal and outside Montréal, 2005–2016



Abbreviation: p.y., person-year
[a]2005 : Start of enhanced surveillance
[b]Septembre 2014 : Asymptomatic cases inclusion
[c]February 2016 : Provincial genotyping
[d]June 2016 : Systematic genotyping of *C. Trachomatis* specimens
[e]November 2016: Serology and micro-IF removed

Demographic and risk factors

The majority of cases were in the 25–54 year age group (83%) and in Montréal (81%) (**Table 1**). Most patients were MSM (99%), with 3% (n=7) also having female partners. Half of the patients reported more than 10 sexual partners over the last 12 months (101/205; 49%). Almost all (96%) had a new partner and 84% had anonymous sexual partners. The proportion of cases with more than 20 sexual partners in the last year was higher in Montréal than in the rest of the province (27% vs 3%; $p<0.001$). Saunas and Internet (including smartphone networking applications) were two important means of meeting partners. Although not statistically significant ($p=0.07$), fewer patients (27%) had encounters with partners from outside the province in the last year in contrast to preceding years (2005-2012; n=31/81; 38%). Among cases living outside of Montréal, 16/42 (38%) reported partners from Montréal or out of the province.

Table 1: Characteristics of male lymphogranuloma venereum cases, Quebec, 2013–2016[a]

Characteristic	2013–2016	
	n	%
Age (n=338)		
15–24	23	7
25–34	98	29
35–44	92	27
45–54	83	25
>55	42	12
Demographics (n=338)		
Montréal	273	81
Outside of Montréal	65	19
Sex of partners (n=287)		
Men only	279	97
Men and women	7	2
Women only	1	0.3
History of STBBIs[b]		
At least one	286/295	97
HIV	210/252	83
Syphilis	183/226	81
Gonorrhea	165/211	78
HBV	11/102	11
HCV	11/106	10
Number of partners (n=205) in last 12 months		
1–3	34	17
4–10	70	34
11–20	55	27
>20	46	22
Meeting context[b]		
New partner	114/119	96
Anonymous partners	82/98	84
Sex worker client	8/191	4
Sex worker	10/196	5
Sauna	136/186	73
Internet/Applications	136/177	77
Club/bar	40/115	35
Drug use (n=241)		
At least one	138	57
Crystal meth	50	21
Cannabis	48	20
Ecstasy	43	18
Cocaine	28	12
Poppers	27	11
Speed	23	10
GHB	12	5
Ketamine	10	4
Crack	5	2
Heroine	1	0
IV drug	10	4
Not reported	13	5
Encounter with out-of-province resident (n=208)		
At least one	56	27

Abbreviations: GHB, gamma-hydroxybutyric acid; HBV, hepatitis B virus; HCV, hepatitis C virus; HIV, human immunodeficiency virus; IV, intravenous; n, number; STBBI, sexually transmitted or blood-borne infection

[a] Repeaters were included twice (n=35)

[b] Proportion for whom information is available differs for each variable

A high proportion of patients (210/252; 83%) were HIV-seropositive (a considerable augmentation from 2005–2012: 48/82; 59%; $p<0.001$). Past histories of syphilis (183/226; 81%) and gonococcal (165/211; 78%) infections were also frequently reported. Data on hepatitis B virus (HBV) and hepatitis C virus (HCV) infection were available for only one-third of cases, of which 11% and 10% had a history of past or current infection. The proportion of cases with a history of at least one STBBI was significantly higher in 2013–2016 (286/295; 97%) than in 2005–2012 (95/112; 85%; $p<0.001$).

Information on drug consumption was available for 241/338 cases, of whom 138 (57%) reported drug use during the past year. Crystal meth (21%), marijuana (20%) and ecstasy (18%) were the most frequently used drugs. A significant rise in crystal meth consumption was observed: 8% (3/38) in 2013, 12% (6/49) in 2014, 25% (19/77) in 2015 and 29% (22/76) in 2016 (test for trend, $p=0.008$).

Clinical manifestations

Details about symptoms were available for 303/338 cases. The majority of patients had symptoms at the time of testing (n=237; 78%) (**Table 2**). The proportion of asymptomatic cases increased from 18% (37/203) in 2013–2015 to 32% (32/100) in 2016 ($p=0.01$). A minority of patients presenting with symptoms

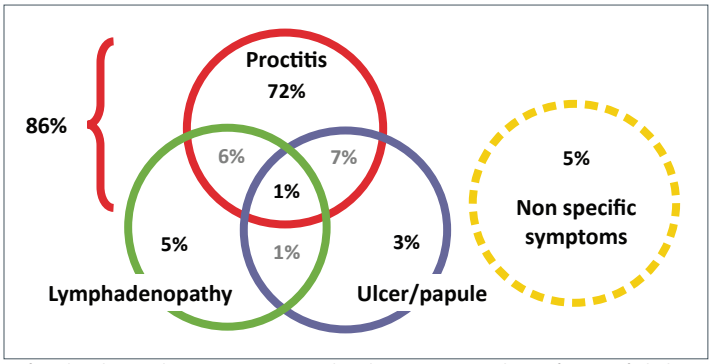
Table 2: Clinical presentation of lymphogranuloma venereum cases, Quebec, 2013–2016

Clinical presentation	2013–2016 (Total) n=303[a]		2013–2015 n=203[a]		2016 n=100[a]		*p* value
	n	%	n	%	n	%	
Asymptomatic	69	23	37	18	32	32	0.006
Nonspecific symptoms[b] only	12	4	6	3	6	6	NS
Specific symptom(s)[c]	222	73	160	79	62	62	0.002
Proctitis	201	66	141	69	60	60	NS
Lymphadenopathy	30	10	23	11	7	7	NS
Ulcer/papule	29	10	25	12	4	4	NS

Abbreviation: NS, not significant; n, number
[a] Information was missing for 35/338 cases (12 in 2013–2015 and 23 in 2016)
[b] Nonspecific symptoms or signs included malaise/asthenia, urethral discharge, dysuria, arthralgia, anal fistula and epidymitis
[c] Some patients presented with more than one specific symptom (n=35)

had only unspecific complaints (12/235; 5%). As shown in **Figure 2**, more than one symptom could occur at the same time. Symptoms included proctitis (86%), ulcer or papule (12%) and lymphadenopathy (13%). Complaints associated with proctitis included bloody stools (69/201; 35%), anal pain (70/201; 34%) and rectal discharge (52/201; 26%).

Figure 2: Distribution of clinical manifestations among symptomatic lymphogranuloma venereum cases, Quebec, 2013–2016 (n=234)[a]



[a] Of 338 lymphogranuloma venereum cases, clinical presentation was known for 303, of which 69 cases were asymptomatic

Laboratory tests and treatment

The number of LGV genotyping tests performed on positive *C. trachomatis* samples (males and females, all sampling sites, regardless of symptoms) at the Laboratoire de santé publique du Québec are shown in **Table 3**. Overall, 13% of *C. trachomatis* samples typable by multiplex PCR assay were genotypes L_{1-3}. Some patients had more than one positive sample for a single episode. An important increase in the number of requests was noted in 2016 as a result of the recommendation to systematically genotype all rectal samples positive for *C. trachomatis*.

The reason for requesting testing was known for 302 of the 338 reported cases. The reasons included presence of symptoms

Table 3: Clinical samples received at the Laboratoire de santé publique du Québec for lymphogranuloma venereum genotyping, 2013–2016[a]

Year	*C. trachomatis* positive samples, n	Typable by multiplex PCR assay, n	Non-LGV genotypes, n (%)	LGV genotypes, n (%)	Specific genotype identified by sequencing		
					L_{2b}	L_2	N/A
2013	424	414	363 (88%)	51 (12%)	49	2	0
2014	540	534	475 (89%)	59 (11%)	55	4	0
2015	670	656	536 (82%)	120 (18%)	107	4	9
2016	1,249	1,199	1,070 (89%)	129 (11%)	124	0	5
Total	2,883	2,803	2,444 (87%)	359 (13%)	335	10	14

Abbreviations: *C. Trachomatis*, *Chlamydia trachomatis*; LGV, lymphogranuloma venereum; PCR, polymerase chain reaction
[a] Includes males and females, from any sampled site
Notes: Some LGV cases were reported on the basis of serology before November 2016. Some patients had more than one positive sample for a single episode

(n=221; 73%); screening based on risk factors (n=68; 23%); and contact with a confirmed LGV case (n=12; 4%). DNA sequencing was conducted for 93% (n=314) of cases: 304 were L_{2b}, whereas 10 typed as L_2, due to a single nucleotide mutation in the genotyping target of the *ompA* gene. Retrospective sequencing of the *pmpH* gene suggests that these cases were due to a variant of the L_{2b} genotype.

Prescribed treatment was in line with guidelines (doxycycline for 21 days) (3,8) for 77% of cases (221/288), and appropriate treatment was more often initially prescribed in 2016 than in 2013–2015 (74% vs 61%; *p*=0.03) (**Table 4**).

Table 4: Treatment of lymphogranuloma venereum cases, Quebec, 2013–2016

Treatment	2013–2016 (Total) n=288[a]		2013–2015 n=194[a]		2016 n=94[a]		*p* value
	n	%	n	%	n	%	
Appropriate treatment[b]	221	77	144	74	77	82	NS
At first prescription	189	66	119	61	70	74	0.03
At second prescription	32	11	25	13	7	7	NS
Inappropriate treatment	67	23	50	26	17	18	NS

Abbreviation: n, number; NS, nonsignificant
[a] Information was missing for 50/338 cases (21/215 in 2013–2015 and 29/123 in 2016)
[b] Appropriate treatment: Doxycycline for 21 days (3)

Reinfections

Of the 35 individuals who were repeaters (338 cases occurred in 303 individuals), that is, were reinfected more than 90 days after an episode, 10 (29%) had had at least one previous documented episode before 2013, whereas 25 had had their first episode in 2013–2016 (12). Most reinfections (75%) occurred within two years of first infection (from 108 days to 10.5 years). The LGV repeaters were more likely than those who had had only one episode to be living in Montréal (31/35 [89%] vs 210/268 [78%];

p=0.13). Compared with individuals who had a single episode, repeaters were also more likely to be HIV-infected (29/30 [97%] vs 155/193 [80%]; *p*=0.03); to report a past history of syphilis (27/27 [100%] vs 132/173 [76%]; *p*=0.004); and to have used recreational drugs during the past 12 months (17/22 [77%] vs 106/194 [55%]; *p*=0.04).

Discussion

Incidence of LGV, which occurs within a core group of MSM living in an urban setting, has been increasing in Quebec over the last four years. The MSM population is characterized by a significant past history of STBBIs, especially HIV, a high number of sexual partners and frequent drug use. Our data show a high prevalence of proctitis as the presenting symptom, with very few classical inguinogenital diseases. The majority of the cases were diagnosed as L_{2b} genotypes, a variant isolated as far back as the 1980s in San Francisco (13). A number of studies of LGV outbreaks across Europe reported a population of high-risk MSM similar to what we found in the current Quebec outbreak (2). A large percentage of men are HIV and/or hepatitis C positive and very few cases, if any, are detected in heterosexual men or women. Asymptomatic cases have been detected, but the vast majority of cases present with symptoms of rectal infection (14-19).

The LGV rate remains relatively low in comparison with other common STIs including non-LGV *C. trachomatis* infections. In 2015, among males aged 15–75 years in Quebec, the annual incidence rates of infectious syphilis (17.2/100,000 person-year) and gonococcal infection (69.4/100,000 person-year) were significantly higher than those of LGV (2.6/100,000 person-year) (20). As LGV is thought to be more often symptomatic than syphilis or gonococcal infection, it could be speculated that those who become infected are more likely to seek medical attention and get treatment, restricting transmission. For now, LGV is also confined to a smaller subgroup of MSM, while gonococcal and non-LGV *C. trachomatis* infections also involve the heterosexual population. However, the incidence prior to 2014 was likely underestimated given the exclusion of asymptomatic patients in previous case definitions. The higher proportion of asymptomatic cases in 2016 can also be partly explained by the systematic genotyping of all positive *C. trachomatis* rectal specimens, which started in June 2016 in Quebec.

The presented clinical manifestations are in line with recent literature reporting proctitis and proctocolitis as the most common presentation (2,21). Although systematic genotyping for LGV is currently performed in Quebec only for rectal specimens, there is some evidence suggesting that extrarectal LGV (pharyngeal and urethral infections) could be a potential contributor to the ongoing outbreak. In 2014, van Rooijen et al. (22) collected pharyngeal swabs from MSM and found that 1% were *C. trachomatis* positive; of these, 53% did not have concomitant anogenital infection. The implication of pharyngeal as well as urethral LGV in transmission of the epidemic strain remains unclear. Rectal infections have been shown to be far more common in various LGV prevalence studies (23-26). It is thus arguable that extrarectal screening would not be a cost-effective measure.

A significant improvement in adequate first prescribed treatment has been noted in 2016, possibly following educational efforts towards physicians (3,8). The province-wide genotyping of positive rectal *C. trachomatis* specimens implemented in 2016 could have contributed to improvements in case management by shortening diagnostic delays, from a mean of 30 days in 2014 (9), to 12 days in 2016 (data not shown).

A specific subpopulation seems to be at greater risk of reinfection with higher rates of HIV infection, in line with potentially riskier sexual behaviours as shown in other reports (27,28). In an attempt to describe this specific subpopulation, Rönn et al. (12) found repeaters to be more likely to be infected by HIV and HCV, and to have a concomitant gonococcal infection compared with patients with a single episode of LGV. It remains unclear if serosorting, the strategy by which MSM have unprotected sexual encounters with seroconcordant partners, has a role to play in nurturing the present outbreak, as hypothesized for other STIs with higher incidence within this specific group (29,30).

The national enhanced LGV surveillance, conducted between 2004 and 2012, received 170 case reports from provincial and territorial health authorities (including 104 confirmed and 66 probable cases) (5). Confirmed cases were reported from Quebec, Ontario, Alberta and British Columbia; probable cases were reported from these provinces as well as one from Nova Scotia (5).

Strengths and limitations

This study provides recent surveillance data on LGV in Quebec with a high number of cases. Description of risk factors contributes to understanding the current outbreak and its sexual network. Limitations include the descriptive nature and lack of standardization of the questionnaires, both over time and across the different administrative regions, as well as some missing information. Data collecting forms have since been revised and medical teams contacted to allow better standardization. Information regarding HIV follow-up (i.e. treatment, viral load, CD4, etc.) were unfortunately not available.

Conclusion

The re-emergence of LGV in Quebec involves a core group of MSM with history of STIs, most being HIV-seropositive, with multiple partners and substantial drug use. Sporadic transmission outside of Montréal and relatively frequent reinfections highlight the potential for a further spread; this is of particular significance given the associated morbidity. The transmission among HIV-infected patients is of concern given the implication of unprotected sexual encounters within the LGV-affected population as well as the increased risk of HIV transmission associated with inflammation of rectal mucosa seen in LGV proctitis (1-3). Enhanced surveillance helps monitor and better describe this subgroup in order to tailor public health actions to reduce the risk of LGV transmission. A clinical tool for LGV was released in October 2017 to assist medical teams with LGV screening, diagnosis, treatment, follow-up and partners' medical care (31). The systematic genotyping of rectal specimen positive for *C. trachomatis* proved useful at identifying asymptomatic patients. An analysis of the cost effectiveness of such a strategy would inform future public health actions.

Author's statements

CAB – Writing – original draft, review and editing, visualization

SV – Conceptualization, methodology, validation, formal analysis, investigation, writing – review and editing, project administration
MF – Conceptualization, methodology, software, validation, formal analysis, data collection and curation, investigation, writing – review and editing, project administration
DM – Methodology, investigation, data collection and curation, writing – review and editing
CM – Methodology, writing – review and editing
AS – Genotyping by direct sequencing, writing – review and editing
JL – Resources, writing – review and editing, supervision
CF – Writing – review and editing
ACL – Conceptualization, formal analysis, validation, writing – review and editing, visualization, supervision

Conflict of interest

None.

Acknowledgements

The authors thank all public health nurses, collaborating physicians, regional public health directorates, the Ministère de la santé et des services sociaux du Québec, Bureau de Vigie sanitaire and the Direction de la lutte contre les ITSS (SLITSS) for the collection and processing of clinical data. We would also like to thank Suzanne Gibbons and Vanessa Zubach at the Viral Exanthemata and STDs laboratory (National Microbiology Laboratory) as well as Martine Morin and Lyne Desautels for the implementation of the multiplex PCR assay at the Laboratoire de santé publique du Québec and laboratory testing of specimens.

Funding

This epidemiologic study was supported by the provincial public health organizations that participated in data collection and analysis.

References

1. Ministère de la santé et des services sociaux du Québec. Guide québécois de dépistage de ITSS, Fiche clinique. Lymphogranulomatose vénérienne – MSSS. Québec (QC): MSSS; 2017. http://publications.msss.gouv.qc.ca/msss/document-000090/
2. Stoner BP, Cohen SE. Lymphogranuloma venereum 2015: clinical presentation, diagnosis, and treatment. Clin Infect Dis 2015 Dec;61 Suppl 8:S865–73. DOI (http://dx.doi.org/10.1093/cid/civ756). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=26602624&dopt=Abstract).
3. Public Health Agency of Canada. Canadian Guidelines on Sexually Transmitted Infections. Ottawa (ON): PHAC; 2017. https://www.canada.ca/en/public-health/services/infectious-diseases/sexual-health-sexually-transmitted-infections/canadian-guidelines/sexually-transmitted-infections.html
4. Kropp RY, Wong T; Canadian LGV Working Group. Emergence of lymphogranuloma venereum in Canada. CMAJ 2005 Jun;172(13):1674–6. DOI (http://dx.doi.org/10.1503/cmaj.050621. PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=15928239&dopt=Abstract).
5. Public Health Agency of Canada. Section 1: Report on sexually transmitted infections in Canada: 2012 – Chlamydia (Chlamydia trachomatis). Ottawa (ON): PHAC; 2017. https://www.canada.ca/en/public-health/services/infectious-diseases/surveillance-epidemiology-sexually-transmitted-infections-hep-b-c/report-2012/report-on-sexually-transmitted-infections-canada-2012-5.html
6. Saxon C, Hughes G, Ison C; UK LGV Case-Finding Group. Asymptomatic lymphogranuloma venereum in men who have sex with men, United Kingdom. Emerg Infect Dis 2016 Jan;22(1):112–6. DOI (http://dx.doi.org/10.3201/EID2201.141867). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=26691688&dopt=Abstract).
7. de Vrieze NH, de Vries HJ. Lymphogranuloma venereum among men who have sex with men. An epidemiological and clinical review. Expert Rev Anti Infect Ther 2014 Jun;12(6):697–704. DOI (http://dx.doi.org/10.1586/14787210.2014.901169). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=24655220&dopt=Abstract).
8. Comité sur les analyses de laboratoire en lien avec les ITSS (CALI). Lymphogranulomatose vénérienne: avis sur le dépistage, la prise en charge clinique et la surveillance au Québec. Québec (QC): INSPQ; 2016. https://www.inspq.qc.ca/publications/2130
9. Public Health Agency of Canada. Protocol for LGV enhanced surveillance: lymphogranuloma venereum (LGV) in Canada: recommendations for diagnosis and treatment and protocol for national enhanced surveillance. Ottawa (ON): PHAC; 2017. http://www.phac-aspc.gc.ca/publicat/lgv/lgv-rdt2-eng.php
10. Ministère de la Santé et des Services Sociaux du Québec (MSSS). Surveillance des maladies à déclaration obligatoire au Québec - Définitions nosologiques. msss.gouv.qc.ca. 2016. http://publications.msss.gouv.qc.ca/msss/fichiers/2016/16-268-03W.pdf
11. Chen CY, Chi KH, Alexander S, Ison CA, Ballard RC. A real-time quadriplex PCR assay for the diagnosis of rectal lymphogranuloma venereum and non-lymphogranuloma venereum Chlamydia trachomatis infections. Sex Transm Infect 2008 Aug;84(4):273–6. DOI (http://dx.doi.org/10.1136/sti.2007.029058). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=18283094&dopt=Abstract).
12. Rönn M, Hughes G, White P, Simms I, Ison C, Ward H. Characteristics of LGV repeaters: analysis of LGV surveillance data. Sex Transm Infect 2014 Jun;90(4):275–8. DOI (http://dx.doi.org/10.1136/sextrans-2013-051386). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=24431182&dopt=Abstract).
13. Spaargaren J, Schachter J, Moncada J, de Vries HJ, Fennema HS, Peña AS et al. Slow epidemic of lymphogranuloma venereum L2b strain. Emerg Infect Dis 2005 Nov;11(11):1787–8. DOI (http://dx.doi.org/10.3201/eid1111.050821). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=16318741&dopt=Abstract).
14. Haar K, Dudareva-Vizule S, Wisplinghoff H, Wisplinghoff F, Sailer A, Jansen K et al. Lymphogranuloma venereum in men screened for pharyngeal and rectal infection, Germany. Emerg Infect Dis 2013 Mar;19(3):488–92. DOI (http://dx.doi.org/10.3201/eid1903.121028). PubMed (https://www.ncbi.

nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=23621949&dopt=Abstract).

15. Spaargaren J, Fennema HS, Morré SA, de Vries HJ, Coutinho RA. New lymphogranuloma venereum Chlamydia trachomatis variant, Amsterdam. Emerg Infect Dis 2005 Jul;11(7):1090–2. PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=16022786&dopt=Abstract)
16. Rönn MM, Ward H. The association between lymphogranuloma venereum and HIV among men who have sex with men: systematic review and meta-analysis. BMC Infect Dis 2011 Mar;11:70. DOI (http://dx.doi.org/10.1186/1471-2334-11-70). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=21418569&dopt=Abstract).
17. de Vrieze NH, van Rooijen M, Schim van der Loeff MF, de Vries HJ. Anorectal and inguinal lymphogranuloma venereum among men who have sex with men in Amsterdam, The Netherlands: trends over time, symptomatology and concurrent infections. Sex Transm Infect 2013 Nov;89(7):548–52. DOI (http://dx.doi.org/10.1136/sextrans-2012-050915). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=23427272&dopt=Abstract).
18. Parra-Sánchez M, García-Rey S, Pueyo Rodríguez I, Viciana Fernández P, Torres Sánchez MJ, Palomares Folía JC. Clinical and epidemiological characterisation of lymphogranuloma venereum in southwest Spain, 2013-2015. Sex Transm Infect 2016 Dec;92(8):629–31. DOI (http://dx.doi.org/10.1136/sextrans-2015-052453). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=27288416&dopt=Abstract).
19. Childs T, Simms I, Alexander S, Eastick K, Hughes G, Field N. Rapid increase in lymphogranuloma venereum in men who have sex with men, United Kingdom, 2003 to September 2015. Euro Surveill 2015;20(48):30076. DOI (http://dx.doi.org/10.2807/1560-7917.ES.2015.20.48.30076). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=26675210&dopt=Abstract).
20. Blouin K, Venne S, Lambert G. Portrait des infections transmissibles sexuellement et par le sang (ITSS) au Québec: année 2015 (et projections 2016). Québec (QC): INSPQ; 2017. https://www.inspq.qc.ca/publications/2201
21. de Vrieze NH, Versteeg B, Bruisten SM, van Rooijen MS, van der Helm JJ, de Vries HJ. Low prevalence of urethral lymphogranuloma venereum infections among men who have sex with men: a prospective observational study, sexually transmitted infection clinic in Amsterdam, the Netherlands. Sex Transm Dis 2017 Sep;44(9):547–50. DOI (http://dx.doi.org/10.1097/OLQ.0000000000000657). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=28809772&dopt=Abstract).
22. 22. van Rooijen MS, van der Loeff MF, Morré SA, van Dam AP, Speksnijder AG, de Vries HJ. Spontaneous pharyngeal Chlamydia trachomatis RNA clearance. A cross-sectional study followed by a cohort study of untreated STI clinic patients in Amsterdam, The Netherlands. Sex Transm Infect 2015 May;91(3):157–64. DOI (http://dx.doi.org/10.1136/sextrans-2014-051633). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=25237127&dopt=Abstract).
23. Annan NT, Sullivan AK, Nori A, Naydenova P, Alexander S, McKenna A et al. Rectal chlamydia--a reservoir of undiagnosed infection in men who have sex with men. Sex Transm Infect 2009 Jun;85(3):176–9. DOI (http://dx.doi.org/10.1136/sti.2008.031773). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=19176570&dopt=Abstract).
24. Rodríguez-Domínguez M, Puerta T, Menéndez B, González-Alba JM, Rodríguez C, Hellín T et al. Clinical and epidemiological characterization of a lymphogranuloma venereum outbreak in Madrid, Spain: co-circulation of two variants. Clin Microbiol Infect 2014 Mar;20(3):219–25. DOI (http://dx.doi.org/10.1111/1469-0691.12256). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=23730727&dopt=Abstract).
25. Ward H, Alexander S, Carder C, Dean G, French P, Ivens D et al. The prevalence of lymphogranuloma venereum infection in men who have sex with men: results of a multicentre case finding study. Sex Transm Infect 2009 Jun;85(3):173–5. DOI (http://dx.doi.org/10.1136/sti.2008.035311). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=19221105&dopt=Abstract).
26. de Vrieze NH, van Rooijen M, Speksnijder AG, de Vries HJ. Urethral lymphogranuloma venereum infections in men with anorectal lymphogranuloma venereum and their partners: the missing link in the current epidemic? Sex Transm Dis 2013 Aug;40(8):607–8. DOI (http://dx.doi.org/10.1097/01.OLQ.0000431359.26583.13). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=23859905&dopt=Abstract).
27. Macdonald N, Sullivan AK, French P, White JA, Dean G, Smith A et al. Risk factors for rectal lymphogranuloma venereum in gay men: results of a multicentre case-control study in the U.K. Sex Transm Infect 2014 Jun;90(4):262–8. DOI (http://dx.doi.org/10.1136/sextrans-2013-051404). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=24493859&dopt=Abstract).
28. de Vries HJ, van der Bij AK, Fennema JS, Smit C, de Wolf F, Prins M et al. Lymphogranuloma venereum proctitis in men who have sex with men is associated with anal enema use and high-risk behavior. Sex Transm Dis 2008 Feb;35(2):203–8. DOI (http://dx.doi.org/10.1097/OLQ.0b013e31815abb08). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=18091565&dopt=Abstract).
29. Marcus U, Schmidt AJ, Hamouda O. HIV serosorting among HIV-positive men who have sex with men is associated with increased self-reported incidence of bacterial sexually transmissible infections. Sex Health 2011 Jun;8(2):184–93. DOI (http://dx.doi.org/10.1071/SH10053). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=21592432&dopt=Abstract).
30. Jin F, Prestage GP, Templeton DJ, Poynten IM, Donovan B, Zablotska I et al. The impact of HIV seroadaptive behaviors on sexually transmissible infections in HIV-negative homosexual men in Sydney, Australia. Sex Transm Dis 2012 Mar;39(3):191–4. DOI (http://dx.doi.org/10.1097/OLQ.0b013e3182401a2f). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=22337105&dopt=Abstract).
31. Ministère de la santé et des services sociaux du Québec (MSSS). Recrudescence de la lymphogranulomatose vénérienne au Québec: détection et traitement. Québec (QC): Gouvernement du Québec; 2017. http://publications.msss.gouv.qc.ca/msss/document-001956/

Resources to address stigma related to sexuality, substance use and sexually transmitted and blood-borne infections

R MacLean[1]*

Afilliation

[1] Canadian Public Health Association, Ottawa, ON

***Correspondence:** rmaclean@cpha.ca

Abstract

Background: Stigma is widely recognized as a significant barrier to the prevention, management and treatment of sexually transmitted and blood-borne infections (STBBIs) in Canada. Despite major advances in STBBI prevention and treatment, and global efforts to reduce stigma, people living with or affected by STBBIs continue to experience stigma within health and social service settings in Canada.

Objective: To describe the development, content and evaluation of knowledge translation resources and training workshops designed to equip health and social service professionals with the knowledge and skills needed to provide more respectful and inclusive sexual health, harm reduction and STBBI services.

Methods: After conducting a literature review, environmental scan and key informant interviews, and developing a conceptual framework, the Canadian Public Health Association (CPHA) developed four knowledge translation resources and three training workshops in partnership with a number of community-based organizations and experts. The resources were drafted and reviewed by both service providers and individuals affected by STBBIs. The workshops were developed, piloted and then evaluated using post-workshop questionnaires.

Results: The four resources developed were a self-assessment tool related to STBBIs and stigma; a service provider discussion guide to facilitate respectful and inclusive discussions on issues related to sexuality, substance use and STBBIs; a toolkit focused on stigma reduction, privacy, confidentiality and the criminalization of HIV non-disclosure; and an organizational assessment tool related to STBBIs and stigma for health and social service settings. These knowledge translation resources were subsequently integrated into the content of three face-to-face trainings that were piloted and evaluated across the country. Post-workshop evaluation had an overall 85% response rate; 88% of participants noted increased awareness of various forms of stigma, 87% noted increased comfort discussing sexuality, substance use and harm reduction with their clients/patients, 90% reported increased awareness of organizational strategies to reduce stigma, and 93% reported being able to integrate workshop learnings into practice. In addition, there was strong support for professional development on issues related to STBBI stigma reduction.

Conclusion: These knowledge translation resources and training workshops represent a comprehensive set of tools developed in Canada that service providers can use to help reduce stigma when caring for clients/patients with STBBIs and related conditions. Evaluation indicates there is a strong willingness among health and social service providers to engage in educational opportunities in this area and that participation in the training workshops led to increased awareness and a willingness to adopt best practices.

Suggested citation: MacLean R. Resources to address stigma related to sexuality, substance use and sexually transmitted and blood-borne infections. Can Commun Dis Rep. 2018;44(2):62-7. https://doi.org/10.14745/ccdr.v44i02a05

Introduction

Stigma, defined as a dynamic process of devaluation that significantly discredits an individual in the eyes of others, is widely recognized as a barrier to the prevention, management and treatment of sexually transmitted and blood-borne infections (STBBIs), such as HIV, hepatitis B and C, human papillomavirus, genital herpes and syphilis (1). For individuals affected by STBBIs, stigma can lead to poor health and well-being, including mental health problems, social withdrawal, fear of disclosure of STBBIs and reduced sexual well-being (2-5). Despite major advances in STBBI prevention and treatment, and global efforts to reduce stigma, numerous Canadian studies have identified health and social service settings as significant sources of stigma for

people affected by STBBIs and, in particular, people living with HIV (3,6-8). Stigma experienced within health and social service settings can affect an individual's access to and usage of STBBI prevention, treatment and support services as well as adoption of preventative behaviours, including adherence to antiretroviral treatment for HIV (2).

A number of factors may contribute to stigma within service settings, all of which overlap to produce the complex and layered nature of STBBI stigma. These include providers' discomfort in discussing sexuality and/or substance use; social norms stipulating that individuals affected by STBBIs are to blame due to participation in activities deemed morally disreputable, such as sexual promiscuity or substance use; and organizational policies and procedures that inadvertently contribute to stigma. For example, within health and social service settings, intake forms do not always use inclusive language; there are often penalties for missed appointments; and staff sometimes lack training on issues related to cultural safety (practices designed to make the client/patient feel comfortable) and stigma reduction (3,9-13). Moreover, STBBI stigma does not occur in isolation and can compound other forms of stigma and oppression, including stigma against injection drug use, stigma against sex work, racism, sexism and homophobia (5), ultimately resulting in experiences of layered stigma for individuals with more than one stigmatized identity.

Between April 2014 and March 2017, the Canadian Public Health Association (CPHA), in partnership with many professionals and organizations, developed knowledge translation (KT) resources and training workshops to assist health and social service providers in offering safer and more inclusive sexual health, harm reduction and STBBI services. The objective of this paper is to describe the development, content and evaluation of these resources and workshops.

Methods

Scoping activities

Prior to developing project resources, CPHA undertook numerous scoping activities, including:

- A literature review to identify the various forms of stigma and the factors that contribute to stigma
- An environmental scan to identify the continuing education resources available to health and social service providers in Canada
- Twenty interviews with key informants from various disciplines, including education and advocacy, research, health promotion and harm reduction program planning, community outreach, medicine, social work, law, nursing and pharmacy. Key informants worked in both rural and urban settings across the country (Ontario: n=8; Manitoba: n=3; Alberta: n=2; British Columbia: n=2; Quebec: n=2; Nova Scotia: n=2; Nunavut: n=1) and had various levels of expertise in providing services to individuals disproportionately affected by STBBIs
- Three focus groups (in Fredericton, New Brunswick [n=9], Toronto, Ontario [n=6], and Thunder Bay, Ontario [n=12]) with individuals living with or affected by STBBIs to gather their insights into how service settings could be made safer and more inclusive. Focus group participants described experiencing internalized stigma in response to an STBBI diagnosis, and echoed findings from the literature on the factors that contribute to stigma, for example, moral judgment from service providers, particularly in relation to gender and sexual diversity and substance use; service provider discomfort in discussing sexual activity and substance use; a lack of services tailored to culture and community; a lack of time to discuss broader issues that impact health, such as housing and transportation; cost of treatment; and a dearth of harm reduction and anonymous STBBI testing services in the community

Development of a conceptual framework

The scoping efforts led to the development of a conceptual framework of STBBI stigma that was then used to guide the development of project resources (**Figure 1**). This framework highlights the various forms of stigma identified in the literature, including internalized, perceived, enacted, structural and layered stigma; some examples of intersecting sources of stigma, such as racism, classism and heterosexism are also identified as well as the various levels in society (e.g. individual, community, policy/legal) at which stigma may be experienced and confronted.

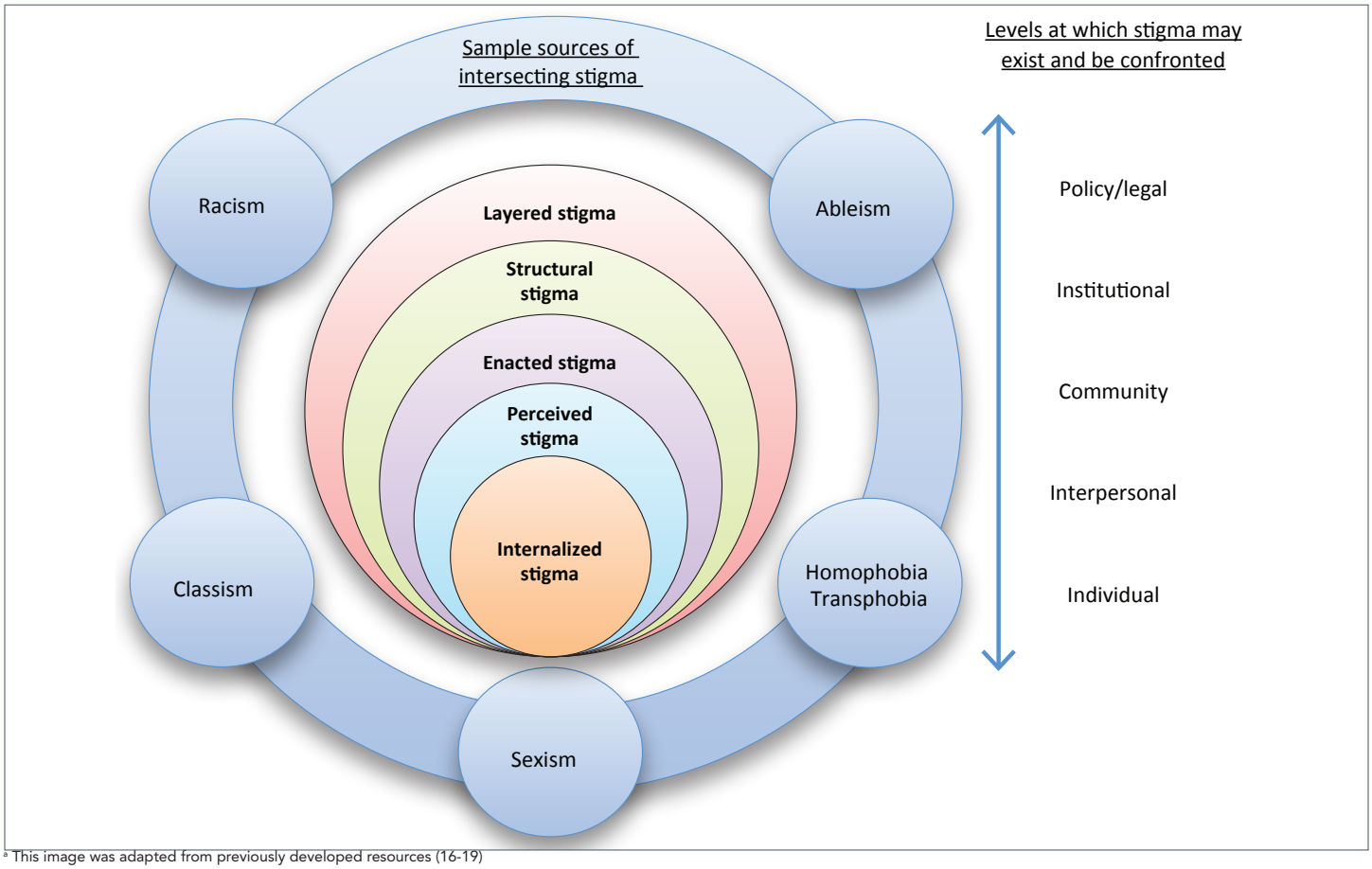
Development of resources

Although the scoping activities described above identified a number of resources that focused on sexual health and harm reduction, there was a paucity of Canadian continuing education resources that focused on reducing STBBI stigma. To address this gap, the CPHA partnered with various experts and community-based organizations to develop four KT resources: a tool for health and social service providers to self-assess attitudes and beliefs about STBBIs and stigma; a discussion guide to facilitate respectful and inclusive discussions on issues related to sexuality, substance use and STBBIs; a toolkit focused on stigma reduction, privacy, confidentiality and the criminalization of HIV non-disclosure; and an organizational assessment tool related to STBBIs and stigma for health and social service settings. These KT resources were subsequently integrated into three face-to-face training workshops, developed in partnership with the Calgary Sexual Health Centre (CSHC) and piloted and evaluated to ensure relevancy and utility.

Self-assessment tool

The self-assessment tool was developed to help service providers reflect on their personal attitudes towards and beliefs about various STBBIs. This resource was adapted from the previously validated *Healthcare provider HIV/AIDS stigma scale* (14) in partnership with Dr. Anne Wagner, who led the research team that devised the original stigma scale, to incorporate a broader range of STBBIs and reflect the continual shift towards a more integrated approach to STBBIs (15). The revised tool was psychometrically validated following two rounds of pilot testing with 144 service providers from across Canada. Analysis of the pilot test findings demonstrated that the self-assessment tool has good to excellent internal consistency, as well as convergent and divergent validity with other measures of HIV stigma and social desirability. However, this second finding should be interpreted with caution due to the low reliability of the other measures of HIV stigma and social desirability in this sample.

Figure 1: Defining STBBI stigma[a]



[a] This image was adapted from previously developed resources (16-19)

Service provider discussion guide

This discussion guide highlights the communication strategies that service providers can use to ensure discussions related to sexuality, substance use and STBBIs are respectful and inclusive. The discussion guide was adapted from the Centers for Disease Control and Prevention document *A guide to taking a sexual health history* (20) and revised based on best practices identified in the literature; key informant interviews with physicians, nurses, nurse practitioners, public health program managers, educators and researchers; pilot testing by physicians, nurses and nurse practitioners; and feedback from 14 individuals, including people living with HIV, people who use substances and sex workers, through three focus groups held in Victoria, British Columbia, Winnipeg, Manitoba and Toronto, Ontario. Following these consultations, changes were made to ensure the language used throughout the discussion guide was respectful and inclusive, and to include further dialogue examples.

Reducing stigma and discrimination through the protection of privacy and confidentiality

In partnership with the Canadian HIV/AIDS Legal Network, this guidance was developed in response to key informants identifying the criminalization of HIV non-disclosure as a significant source of stigma in Canada and as an issue that service providers often have difficulty discussing with clients/patients. This resource explains the important role of privacy and confidentiality in reducing stigma related to STBBIs. It suggests several strategies that health and social service providers can use to deal with privacy, confidentiality, the criminalization of HIV non-disclosure and stigma reduction.

Organizational assessment tool for STBBIs and stigma

This tool includes 30 questions to help health and social service organizations assess their strengths and challenges relevant to the provision of welcoming and inclusive sexual health, harm reduction and STBBI services. The assessment tool was developed based on proven stigma reduction interventions described in the literature and following consultation with and piloting by experts in the field.

Training workshops

Three training workshops, founded on adult learning principles, were developed to help increase awareness and adoption of stigma reduction strategies within sexual health, harm reduction and STBBI services. To ensure the relevancy and utility of the workshops, CPHA and CSHC delivered 19 pilot workshops in 14 communities across Canada throughout 2015 and 2016. The 589 pilot workshop participants included nurses, nurse practitioners, social workers, physicians, counsellors, health educators, midwives, etc. They had varying levels of knowledge and experience in sexual health and harm reduction, although

many provided specialized services to population groups disproportionately affected by STBBIs. The participants were asked to complete evaluation questionnaires before and after the pilot workshops, with the exception of a few workshops where there were time constraints. The findings were used to revise the workshop content and ensure relevance to the learning needs of service providers. Once validated for relevance and utility, the workshop materials, including facilitation manuals, participant workbooks and presentation slide decks, were made available to community organizations across the country to support their professional development efforts.

Evaluation

Measurement of the project impact focused primarily on immediate changes in awareness and knowledge via participation in the pilot workshops. Of the 589 health and social service providers who attended the pilot workshops, 483 were asked to complete pre- and post-workshop questionnaires, and an overall response rate of 85% was achieved. Participants were asked to rate what they learned, the applicability of the workshop content, and to identify areas for workshop improvement. Based on these evaluation findings, revisions were made to the workshop content. The large majority of participants self-reported an increase in knowledge through the pilot workshops; those that did not largely self-identified as experts in the area. Analyses of post-workshop questionnaire responses and sample participant comments are summarized in **Table 1**.

Table 1: Workshop participants' feedback summary

Item assessed (Number of respondents)[a]	Number of respondents in agreement (%)	Sample participant comment
Increased awareness of various forms of stigma (n=397)	349 (88%)	"Breakdown of different types of stigma and their impact was helpful."
Increased comfort discussing sexuality, substance use and harm reduction with clients/ patients (n=378)	330 (87%)	"Role playing allowed people to practice using the skills learned and feel the discomfort a service user likely feels."
Increased awareness of organizational strategies to reduce stigma (n=93)	84 (90%)	"Good way of making us realize the effect of our language, build greater awareness of the types of comments we make and reflect on how to change structural problems."
Able to integrate workshop learnings into practice (n=398)	372 (93%)	"I hope to be able to make sustainable or at least start making steps in the right direction within my organization."
General feedback	N/A	"It would be good if this was a mandatory workshop for all people who work with people on any level."

Abbreviation: N/A, not applicable

[a] Overall findings are from across the three training workshops; given the unique learning objectives of each, the post-workshop questionnaire varied slightly for each and therefore the sample size for each item assessed varies

Workshop materials as well as the complementary KT resources are available on the CPHA website at https://www.cpha.ca/sexually-transmitted-and-blood-borne-infections-and-related-stigma.

Discussion

This project demonstrated that considerable progress can be made in improving health and social service professionals' capacity to reduce stigma when providing sexual health, harm reduction and STBBI services. Through project-scoping activities, CPHA was able to gather insight from both individuals affected by STBBIs as well as experts on optimal strategies for reducing stigma within health and social service settings. The CPHA was also able to leverage a great deal of knowledge and expertise by partnering with community-based organizations as well as professionals during resource development and piloting. The majority of the participants reported improved awareness of STBBI stigma reduction strategies following participating in the pilot workshops; they also indicated their intention to apply workshop learnings and share the workshop resources with colleagues.

Despite these successes, there were some limitations. Most notably, post-workshop measurement focused primarily on immediate changes to attitudes and knowledge. To assess changes in provider practices as well as changes within organizational policies and procedures, intermediate and longer-term follow-up is required. Also of note is that the project resources do not address the specific needs of the various populations disproportionately affected by STBBIs. The resources may therefore need to be adapted for working with specific population groups. Finally, further effort is needed to ensure these resources and other similar initiatives reach a broader audience of service providers in Canada interested in training resources related to STBBI stigma reduction.

The CPHA has recently been awarded a project to continue to develop training opportunities for health and social service providers, and to work with other organizations to support their use of workshop materials, particularly where training opportunities are scarce. Future efforts will also focus on assessing intermediate and longer-term changes (e.g. through six-month follow-up surveys) in provider- and organizational-level practices.

Conclusion

Reduction of STBBI stigma reduction represents an issue of continuing public health importance. This project demonstrated that evidence-based, user-friendly, culturally safe resources incorporated into training workshops can be effective in improving service provider capacity to reduce stigma. Our evaluation indicates a strong willingness among service providers in Canada to engage in these opportunities.

Author's statement

RM – Conceptualization, Methodology, Project administration, Writing – original draft, review and editing

Conflict of interest

None.

Contributor

Laura Bouchard, Canadian Public Health Association – Writing – review and editing

Acknowledgements

This project was made possible by the support and involvement of the many organizations and professionals who reviewed project resources and provided expert feedback through key informant interviews, community consultations and pilot testing. We are also indebted to the members of the project's Expert Reference Group who offered expert guidance and support throughout various stages of the project. Finally, we would like to acknowledge the individuals from various communities who participated in focus groups and shared their stories, insight and wisdom.

Funding

This project was funded by the Public Health Agency of Canada for the period April 2014 to March 2017. The CPHA has also been funded by the Public Health Agency of Canada to continue its efforts in this field from April 2017 to March 2022.

The views expressed herein do not necessarily represent the views of the Public Health Agency of Canada.

References

1. Joint United Nations Programme on HIV/AIDS (UNAIDS). UNAIDS terminology guidelines, 2015. Geneva (CH): Joint United Nations Program on HIV/AIDS; 2015. http://www.unaids.org/sites/default/files/media_asset/2015_terminology_guidelines_en.pdf
2. Rueda S, Mitra S, Chen S, Gogolishvili D, Globerman J, Chambers L et al. Examining the associations between HIV-related stigma and health outcomes in people living with HIV/AIDS: a series of meta-analyses. BMJ Open 2016 Jul;6(7):e011453. DOI (http://dx.doi.org/10.1136/bmjopen-2016-011453). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=27412106&dopt=Abstract).
3. Mill J, Edwards N, Jackson R, Austin W, MacLean L, Reintjes F. Accessing health services while living with HIV: intersections of stigma. Can J Nurs Res 2009 Sep;41(3):168–85. PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=19831060&dopt=Abstract).
4. Foster LR, Byers ES. Predictors of the Sexual Well-being of Individuals Diagnosed with Herpes and Human Papillomavirus. Arch Sex Behav 2016 Feb;45(2):403–14. DOI (http://dx.doi.org/10.1007/s10508-014-0388-x). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=25408498&dopt=Abstract).
5. Wagner AC, Girard T, McShane KE, Margolese S, Hart TA. HIV-related stigma and overlapping stigmas towards people living with HIV among health care trainees in Canada. AIDS Educ Prev 2017 Aug;29(4):364–76. DOI (http://dx.doi.org/10.1521/aeap.2017.29.4.364). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=28825863&dopt=Abstract).
6. Collins E, Cain R, Bereket T, Chen YY, Cleverly S, George C et al. Living & serving II: 10 years later - the involvement of people living with HIV/AIDS in the community AIDS movement in Ontario. Toronto (ON): The Ontario HIV Treatment Network; 2007.
7. Worthington C, Jackson R, Mill J, Prentice T, Myers T, Sommerfeldt S. HIV testing experiences of Aboriginal youth in Canada: service implications. AIDS Care 2010 Oct;22(10):1269–76. DOI (https://doi.org/10.1080/09540121003692201). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=20635240&dopt=Abstract).
8. Gagnon M. Rethinking HIV-related stigma in health care settings: a research brief. Ottawa (ON): uOttawa; 2014. https://www.cocqsida.com/assets/files/Research-Brief_RethinkingHIV-17juillet2014.pdf
9. Jaworsky D, Gardner S, Thorne JG, Sharma M, McNaughton N, Paddock S et al.; CHIME Research Group. The role of people living with HIV as patient instructors - reducing stigma and improving interest around HIV care among medical students. AIDS Care 2017 Apr;29(4):524–31. DOI (https://doi.org/10.1080/09540121.2016.1224314). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=27577683&dopt=Abstract).
10. Brener L, Von Hippel W, Kippax S, Preacher KJ. The role of physician and nurse attitudes in the health care of injecting drug users. Subst Use Misuse 2010 Jun;45(7-8):1007–18. DOI (https://doi.org/10.3109/10826081003659543). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=20441447&dopt=Abstract).
11. Fuzzell L, Fedesco HN, Alexander SC, Fortenberry JD, Shields CG. "I just think that doctors need to ask more questions": sexual minority and majority adolescents' experiences talking about sexuality with healthcare providers. Patient Educ Couns 2016 Sep;99(9):1467–72. DOI (https://doi.org/10.1016/j.pec.2016.06.004). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=27345252&dopt=Abstract).
12. Gott M, Galena E, Hinchliff S, Elford H. "Opening a can of worms": GP and practice nurse barriers to talking about sexual health in primary care. Fam Pract 2004 Oct;21(5):528–36. DOI (https://doi.org/10.1093/fampra/cmh509). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=15367475&dopt=Abstract).
13. Nyblade L, Stangl A, Weiss E, Ashburn K. Combating HIV stigma in health care settings: what works? J Int AIDS Soc 2009 Aug;12(1):15. DOI (https://doi.

org/10.1186/1758-2652-12-15). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=19660113&dopt=Abstract).

14. Wagner AC, Hart TA, McShane KE, Margolese S, Girard TA. Health care provider attitudes and beliefs about people living with HIV: Initial validation of the Health Care Provider HIV/AIDS Stigma Scale (HPASS). AIDS Behav 2014 Dec;18(12):2397–408. DOI (https://doi.org/10.1007/s10461-014-0834-8). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=24965675&dopt=Abstract).
15. Paquette D. Integrated approach to the prevention and control of sexually transmitted and blood borne infections. Ottawa (ON): Public Health Agency of Canada. http://www.catie.ca/sites/default/files/2-845-1-DanaPaquette.pdf
16. Churcher S. Stigma related to HIV and AIDS as a barrier to accessing health care in Thailand: a review of recent literature. WHO South East Asia J Public Health 2013 Jan-Mar;2(1):12–22. DOI (http://dx.doi.org/10.4103/2224-3151.115829). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=28612818&dopt=Abstract).
17. Loutfy MR, Logie CH, Zhang Y, Blitz SL, Margolese SL, Tharao WE et al. Gender and ethnicity differences in HIV-related stigma experienced by people living with HIV in Ontario, Canada. PLoS One 2012;7(12):e48168. DOI (http://dx.doi.org/10.1371/journal.pone.0048168). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=23300514&dopt=Abstract).
18. Stangl AL, Brady L, Fritz K. Measuring HIV stigma and discrimination: Technical Brief July 2012. Washington, DC: International Centre for Research on Women; 2012. http://strive.lshtm.ac.uk/system/files/attachments/STRIVE_stigma%20brief-A4.pdf
19. Corrigan PW, Markowitz FE, Watson AC. Structural levels of mental illness stigma and discrimination. Schizophr Bull 2004;30(3):481–91. DOI (http://dx.doi.org/10.1093/oxfordjournals.schbul.a007096). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=15631241&dopt=Abstract).
20. A guide to taking a sexual health history. Atlanta (GA): Centers for Disease Control and Prevention, US National Center for HIV Viral Hepatitis STD and TB Prevention; 2011. http://www.cdc.gov/std/treatment/SexualHistory.pdf

Rolling out HIV antiretroviral therapy in sub-Saharan Africa: 2003–2017

G Taylor[1]*

Affiliation

[1] Department of Medicine, University of Alberta, Edmonton, AB

***Correspondence:** geoff.taylor@ualberta.ca

Abstract

Multiple issues need to be addressed in order to control the HIV pandemic in sub-Saharan Africa. Combination antiretroviral therapy (cART) is key to reducing morbidity and mortality among people living with HIV and has a role in preventing HIV transmission. However, access to cART is very unevenly distributed globally, especially in sub-Saharan Africa. Although cost of cART is no longer a major barrier as effective treatment can be had for under US$100 per year, HIV management is compromised by the inadequate number of trained clinicians, the lack of clinical and laboratory infrastructure and the increased prevalence of co-morbidities (e.g., tuberculosis).

To address this disparity, a number of initiatives have been undertaken. One of these was the development of the Infectious Diseases Institute (IDI) at Makerere University, Kampala, Uganda. The goals of the IDI are the clinical care of people living with HIV, clinical research relevant to Uganda (in particular) and sub-Saharan Africa, and clinical training. My initial participation was as a trainer in a program to educate large numbers of clinicians in antiretroviral therapy and other aspects of HIV/AIDS management, with the intention that they become leaders of large clinical programs in their home communities.

Major progress has been made in providing access to cART, and HIV/AIDS mortality and incidence of new cases is decreasing. Nertheless, to reach the World Health Organization 90–90–90 targets by 2020, there remains a need to expand services and develop novel approaches to HIV management. In addition to providing hands-on clinical care, Canadian health care providers can help by transferring clinical skills to local clinicians or by developing streamlined clinical paradigms or new technologies for long-term HIV management in resource-limited settings.

Suggested citation: Taylor G. Rolling out HIV antiretroviral therapy in sub-Saharan Africa: 2003–2017. Can Commun Dis Rep. 2018;44(2):68-70. https://doi.org/10.14745/ccdr.v44i02a06

Introduction

According to the Joint United Nations Programme on HIV/AIDS (UNAIDS), there have been more than 35 million HIV-related deaths since the onset of the HIV/AIDS pandemic in the early 1980s. As of 2016, an estimated 36.7 million people globally were living with HIV, with 25 million living in sub-Saharan Africa. In that year, there were 1.8 million new cases and 1.0 million deaths worldwide (1).

Antiretroviral therapy (ART) has been used for the treatment and prevention of HIV infection since its introduction in the late 1980s. Since the introduction of combination ART (cART) in high-income countries, morbidity and mortality among people living with HIV has been markedly reduced, and cART is currently indicated for all HIV-positive people (2). By suppressing viral replication, cART renders HIV-positive people effectively noninfectious for their intimate contacts. Consequently, pending the development of other biomedical interventions such as an effective vaccine, cART has become an important part of the approach to HIV prevention (2).

In the early 2000s, global access to cART was very unevenly distributed. In his keynote address to the International AIDS Society (IAS) in Durban, South Africa in 2000, then IAS President Mark Wainberg stated that as few as 7,000 individuals in all of sub-Saharan Africa were receiving cART. To address this disparity, in 2001 a group of physicians from the Infectious Diseases Society of America (IDSA) partnered with colleagues at Makerere University, Kampala, Uganda to develop the Infectious Diseases Institute (IDI) at Makerere University (3). The goals of the IDI are the clinical care of people living with HIV, clinical research relevant to sub-Saharan Africa and clinical training.

My initial participation was as a trainer in a program educating large numbers of clinicians in ART and other aspects of HIV/AIDS management, with the intention that they become leaders of large clinical programs in their home communities. With the development of local expertise, responsibility for training later transferred to local faculty. Since then I became an external examiner for Makerere University, to ensure maintenance of standards.

Clinical training at IDI involves a combination of didactic learning and clinical experiences with patients in inpatient and outpatient clinics in Kampala and the surrounding rural communities. The principal students, graduate physicians from multiple sub-Saharan countries, attend the training program for a two- to four-week period.

As of 2016, IDI has trained 19,691 health care providers, including physicians, pharmacists, lab technicians and research associates, from 28 African countries (4).

The current Situation

The following are a number of entirely personal observations on the evolution of an approach to addressing HIV/AIDS management in sub-Saharan Africa.

Access to antiretroviral drugs is no longer a major issue

Initially, brand-name antiretroviral agents (ARVs) were prohibitively expensive for both patients and public programs in sub-Saharan Africa, costing upwards of US$10,000 per year per person (3). A number of workarounds were developed: generic ARVs, produced off patent licence, partially filled the gap; later, brand-name manufacturers licensed generic manufacturers to produce a larger range of ARVs. Currently, cART can be had for as little as US$100 per year (5). Donors have been crucially important in supporting public programs; primary donors are the Global Fund, currently spending US$4 billion per year supporting locally run programs that combat HIV/AIDS, tuberculosis and malaria, and the United States President's Emergency Plan for AIDS Relief (PEPFAR; a US government program), which has provided US$72 billion in HIV/AIDS support since 2003. Together, these and other initiatives have allowed African governments to progressively increase ART availability (1).

Shortage of clinicians trained in HIV management is a huge barrier to treatment

Uganda, a country of 41 million (versus 36 million in Canada), has four medical schools; there are 17 in Canada. The physician to population ratio is 10:100,000 in Uganda, compared with 228:100,000 in Canada. Similarly, the nurse to patient ratios are very low in inpatient units, and patients are expected to have an "attendant," a family member who provides much of the hands-on care.

Most clinicians providing HIV care are generalists and need a straightforward approach to ART. Typically, clinicians use the World Health Organization guidelines (2), which follow a public health approach to therapy rather than more complex specialist guidelines.

Physician salaries are typically very low; even in academia specialists supplement their meagre salaries with after-hours private practice. Salaries offered by non-governmental organizations (NGOs) may be higher than those in the public sector—an important issue for NGOs if they are to avoid distorting the medical labour market by drawing clinicians away from understaffed public programs. Some students in the IDI training programs are seeking certification specifically to make themselves more attractive to recruitment by higher paying NGOs.

Clinical challenges

Health care providers in sub-Saharan Africa are functioning under major disadvantages compared with those in high-income settings. They have to address challenges associated with very high numbers of HIV-positive patients and growing numbers requiring treatment needing close follow-up. In addition, HIV is only one of the conditions requiring active attention. Tuberculosis infection, together with or separate from HIV, is very common in inpatient units in Uganda, yet sensitive tuberculosis diagnostics are lacking. Negative air pressure hospital rooms are non-existent. Disposable N95 respirators are rare and, when available, are usually reused. As a result, tuberculosis transmission on inpatient units (to patients and staff) has not been uncommon.

In ambulatory settings, lab infrastructure for HIV monitoring, particularly quantitative plasma HIV RNA (i.e. viral load) to assess ART effectiveness, is rarely available (6). Instead, clinicians see patients much more frequently than is the case in Canada, examining them for signs of clinical failure. In so doing, they impose an even greater burden on both patients and clinic infrastructure. When treatment failure occurs, antiretroviral resistance testing is non-existent, so the clinicians rely only on educated guesses about salvage therapy (2). A number of newer ARVs have a much higher barrier to development of resistance (7). These agents are not currently first line therapy in sub-Saharan Africa because of cost; if they could be made available they would provide a potential solution to the problem of antiretroviral drug resistance.

Discussion

Across sub-Saharan Africa, major strides have been made in expanding ART. In 2015, approximately 17 million of 37 million HIV-positive people worldwide and 12 million in sub-Saharan Africa were receiving treatment (1). HIV/AIDS mortality is falling across the continent. Nevertheless, much is still to be done. In 2016, the total population of Ugandans living with HIV was estimated to be 1.4 million (compared with 75,500 Canadians in 2014), and there were 52,300 new cases (compared with 2,570 in Canada in 2014) (1,8). Each case is a candidate for identification, evaluation, counselling, ART initiation, long-term monitoring and retention in care.

What does the future hold?

To reach the UNAIDS 90–90–90 target for 2020 (of having 90% of all people living with HIV knowing their status; 90% of those diagnosed on antiretroviral treatment; and 90% of those on antiretroviral treatment virologically suppressed) (2), ART programs across sub-Saharan Africa will need to be greatly expanded. This will need to be accomplished without losing contact with and virologic control in currently treated patients; nor should this be done at the expense of other health care priorities. This is a daunting prospect; it remains to be seen if HIV can become the first viral condition ever controlled without the

use of an effective vaccine. Novel approaches to management need to be devised, such as initiating ART at first contact. Lab infrastructure needs to be addressed. The CD4 counts no longer have a central role in determining eligibility for treatment. Viral load determination in dried blood spots rather than plasma can greatly increase access to information on viral load, especially in settings far from processing laboratories. Although there is some loss in sensitivity when using dried blood spots, it may be the preferable option given that viral load testing capacity is currently weak across sub-Saharan Africa (6,9).

What can Canadian health care providers do?

Participating in controlling the pandemic in sub-Saharan Africa and other low resource settings can take different forms. Hands-on direct patient care can be highly satisfying, and extended direct clinical care by Canadian clinicians can make a difference.

For the uninitiated, clinical practice in sub-Saharan Africa is very different from that in Canada: clinics are high volume; investigative resources, even in tertiary care public hospitals, are often lacking. Clinicians often need to adopt a syndromic rather than a diagnostic approach to patient management. Familiarity with a basic but not necessarily subspecialist level of HIV/AIDS management, including cART, is needed, as are skills in management of related complications, particularly tuberculosis. I strongly recommend linking to an existing NGO with a record of accomplishment rather than attempting to develop a new program. Sustainability of any initiative is key to success.

Canadian health care providers can also assist in other ways. Clinicians, especially clinician–educators familiar with HIV/AIDS or related conditions, can transfer clinical skills to local providers. Laboratorians, health system analysts and health policy consultants can advise on developing streamlined clinical paradigms or new technologies for long-term HIV management in resource-limited settings.

Great strides have been made in managing the HIV/AIDS pandemic in sub-Saharan Africa. However, many challenges remain and opportunities still abound for Canadian health care providers to help.

Conflict of interest

None.

Acknowledgements

My participation in the Infectious Diseases Institute (IDI) and Makerere University clinical training program has been supported by multiple sources, including the Infectious Diseases Society of America (IDSA), Makerere University, Rotary Club of Edmonton, the University of Alberta and the Accordia Global Health Foundation.

References

1. UNAIDS data. 2017. Geneva: Joint United Nations Programme on HIV/AIDS (UNAIDS); 2017. http://www.unaids.org/en/resources/documents/2017/2017_data_book
2. World Health Organization. Consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection. Recommendations for a public health approach. 2nd ed. Geneva: World Health Organization; 2016. http://www.who.int/hiv/pub/arv/arv-2016/en/
3. Ronald A, Kamya M, Katabira E, Scheld WM, Sewankambo N. The Infectious Diseases Institute at Makerere University, Kampala, Uganda. Infect Dis Clin North Am 2011 Jun;25(2):369–83. DOI (http://dx.doi.org/10.1016/j.idc.2011.02.007). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=21628052&dopt=Abstract).
4. Infectious Diseases Institute. College of Health Sciences, Makerere University: annual report July 2015–June 2016. Kampala (UG): Makerere University; 2016. http://www.idi-makerere.com/docs/IDI%20Annual%20Report%202015.pdf
5. UNAIDS. Press release: HIV treatment now reaching more than 6 million people in sub-Saharan Africa. Geneva: Joint United Nations Programme on HIV/AIDS; 6 July 2012. http://www.unaids.org/en/resources/presscentre/pressreleaseandstatementarchive/2012/july/20120706prafricatreatment
6. Lecher S, Williams J, Fonjungo PN, Kim AA, Ellenberger D, Zhang G et al. Progress with Scale-Up of HIV Viral Load Monitoring - Seven Sub-Saharan African Countries, January 2015-June 2016. MMWR Morb Mortal Wkly Rep 2016 Dec;65(47):1332–5. DOI (http://dx.doi.org/10.15585/mmwr.mm6547a2). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=27906910&dopt=Abstract).
7. Panel on Antiretroviral Guidelines for Adults and Adolescents. Guidelines for the use of antiretroviral agents in adults and adolescents living with HIV. Washington (DC): US Department of Health and Human Services; 2017. http://www.aidsinfo.nih.gov/ContentFiles/AdultandAdolescentGL.pdf
8. Public Health Agency of Canada. HIV and AIDS in Canada, Surveillance Report to December 31, 2014. Ottawa (ON): Public Health Agency of Canada; 2015. https://www.canada.ca/en/public-health/services/publications/diseases-conditions/hiv-aids-canada-surveillance-report-december-31-2014.html
9. Johannessen A, Garrido C, Zahonero N, Sandvik L, Naman E, Kivuyo SL et al. Dried blood spots perform well in viral load monitoring of patients who receive antiretroviral treatment in rural Tanzania. Clin Infect Dis 2009 Sep;49(6):976–81. DOI (http://dx.doi.org/10.1086/605502). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=19663598&dopt=Abstract).

Outbreak of Seoul virus among rats and rat owners — United States and Canada, 2017

JL Kerins[1,2]*, SE Koske[3], J Kazmierczak[3], C Austin[4], K Gowdy[5], A Dibernardo[6], Seoul Virus Working Group, Canadian Seoul Virus Investigation Group (Federal), Canadian Seoul Virus Investigation Group (Provincial)[†]

Summary

What is already known about this topic?

Seoul virus, a type of hantavirus, is carried by Norway rats. Humans become infected through contact with virus shed in rat urine or droppings, or inhalation of virus particles in dust from contaminated bedding. Infected rats do not develop disease, but humans can experience symptoms ranging from mild influenza-like illness to severe disease with kidney failure and death. Although infections have been previously reported in humans after contact with wild rats, Seoul virus infections had not been reported in pet rats in the United States or Canada.

What is added by this report?

This report describes the first known outbreak of Seoul virus infections in humans from contact with pet rats in the United States and Canada. This investigation identified 31 United States facilities with human and/or rat Seoul virus infections in 11 states, including six that exchanged rats with Canadian ratteries. Seventeen persons had recent infection with Seoul virus, eight became ill, and three were hospitalized and recovered.

What are the implications for public health practice?

Human hantavirus infections are reportable to state or local health departments in the United States. Clinicians should consider Seoul virus infection in patients with a history of rat contact and compatible symptoms. Pet rat owners and breeders should also be aware of Seoul virus and should practice good hand hygiene and safe rodent handling to prevent infection.

Suggested citation: Kerins JL, Koske SE, Kazmierczak J, Austin C, Gowdy K, Dibernardo A, Seoul Virus Working Group, Canadian Seoul Virus Investigation Group (Federal), Canadian Seoul Virus Investigation Group (Provincial). Outbreak of Seoul virus among rats and rat owners — United States and Canada, 2017. Can Dis Commun Rep. 2018;44(2): 71-4. https://doi.org/10.14745/ccdr.v44i02a07

Affiliations

[1] Epidemic Intelligence Service, Centers for Disease Control and Prevention (CDC), Atlanta, GA

[2] Chicago Department of Public Health, Chicago, IL

[3] Wisconsin Department of Health Services, Madison, WI

[4] Illinois Department of Public Health, Springfield, IL

[5] Population and Public Health Division, Ontario Ministry of Health and Long-Term Care, Toronto, ON

[6] National Microbiology Laboratory, Public Health Agency of Canada, Winnipeg, MB

[†] This paper is identical in content to the primary article published in the *Morbidity and Mortality Weekly Report* (MMWR) and released electronically on February 1, 2018 having met the guidelines for simultaneous publication as set forth by the International Committee of Medical Journal Editors (www.icmje.org).

***Correspondence:** jkerins@cdc.gov

Introduction

In December 2016, the Wisconsin Department of Health Services (WDHS) notified Centers for Disease Control and Prevention (CDC) of a patient hospitalized with fever, leukopenia, elevated transaminases, and proteinuria. The patient owned and operated an in-home rattery, or rat-breeding facility, with approximately 100 Norway rats, primarily bred as pets. A family member developed similar symptoms four weeks later, but was not hospitalized. Because both patients were known to have rodent contact, they were tested for hantavirus infections. In January 2017, CDC confirmed recent, acute Seoul virus infection in both patients. An investigation was conducted to identify additional human and rat infections and prevent further transmission. Ultimately, the investigation identified 31 facilities in 11 states with human and/or rat Seoul virus infections; six facilities also reported exchanging rats with Canadian ratteries. Testing of serum samples from 183 persons in the United States (US) and Canada identified 24 (13.1%) with Seoul virus antibodies; three (12.5%) were hospitalized, and no deaths occurred. This investigation, including cases described in a previously published report from Tennessee (1), identified the first known transmission of Seoul virus from pet rats to humans in the US and Canada. Pet rat owners should practice safe rodent handling to prevent Seoul virus infection (2).

Seoul virus is an Old World hantavirus in the Bunyaviridae family. Its natural reservoir is the Norway rat (Rattus norvegicus). Rats infected with Seoul virus are asymptomatic, but can transmit the virus to humans through infectious saliva, urine, droppings, or aerosolization from contaminated bedding. Human signs and symptoms range from mild influenza-like illness to hemorrhagic fever with renal syndrome (HFRS). HFRS causes acute renal failure and can result in death; however, asymptomatic Seoul virus infections also occur. Wild Norway rats in the US have been known to harbour Seoul virus infection (3), but transmission to humans is rare (4). Seoul virus is not known to spread

from person to person. In the United Kingdom, Seoul virus transmission has occurred from pet rats to humans (5), but before this outbreak, infections had not been reported in pet rats in the US or Canada.

Investigation and results

After confirming Seoul virus infection in the Wisconsin patients, CDC and WDHS initiated investigations into rat shipments to (trace-back) and from (trace-forward) the rattery to identify suspected and confirmed facilities. Trace-back investigations initially extended back two months prior to onset of clinical disease, based on the known maximum incubation period for Seoul virus in humans. As additional confirmed facilities were identified, tracing focused instead on interactions with known infected facilities, sometimes as much as one year prior. Suspected facilities included ratteries, homes, or pet stores that sold rats to a confirmed facility (a facility where at least one human or rat tested positive for Seoul virus infection) or housed rats that lived at or comingled with rats from a confirmed facility. Once a suspected facility was identified, local or state health officials interviewed persons with a history of rodent contact associated with the facility about their rat exposure and health history. Additionally, the primary rodent caretaker was interviewed using a standardized questionnaire to identify movement of rats into and out of the facility, including dates and locations where the rats were obtained. Local or state health officials offered laboratory testing for Seoul virus infection to all persons with rodent contact. Officials recommended testing for persons with a history of febrile illness and exposure to rats from a confirmed facility and for rats at suspected and confirmed facilities. Trace-forward and trace-back investigations of rat shipments at confirmed facilities identified additional suspected facilities, which were similarly assessed.

A suspected human case of Seoul virus infection was defined as a febrile illness (recorded temperature >101°F [38.3°C] or subjective history of fever) or an illness clinically compatible with Seoul virus infection (myalgia, headache, renal failure, conjunctival redness, thrombocytopenia, or proteinuria) without laboratory confirmation in a person reporting contact with rats from a confirmed or suspected facility. Human Seoul virus infections were laboratory-confirmed by detection of Seoul virus-specific immunoglobulin M (IgM) and/or immunoglobulin G (IgG) (6) antibodies by enzyme-linked immunosorbent assay (ELISA). In the US, Seoul virus infections in rats were confirmed through detection of viral RNA by reverse transcription–polymerase chain reaction (RT-PCR) and/or IgG ELISA at CDC, or by CDC-validated commercial IgG testing. In Canada, public health officials investigated rat breeding facilities that exported rats to and imported rats from affected US facilities. Seoul virus infection was detected in Canadian rats from breeding facilities using the same serologic and molecular-based protocols described for US facilities.

By March 16, 2017, trace-forward and trace-back investigations identified approximately 100 suspected facilities in 21 states. Among these, 31 facilities in 11 states had laboratory-confirmed human or rat infections, including a previously reported household in Tennessee with two confirmed human infections (1). Six confirmed facilities in six states (Georgia, Illinois, Missouri, South Carolina, Tennessee, and Utah) reported exchanging rats with Canadian ratteries during their trace-forward and trace-back investigations. A total of 163 persons in the US and 20 in Canada consented to serologic testing; 17 (10.4%) US residents and one (5.0%) Canadian resident had detectable IgM and IgG antibodies, indicating recent infection, and four (2.5%) US residents and two (10.0%) Canadian residents had only IgG antibodies, indicating past or convalescent infection. Among the 17 US patients with recent Seoul virus infection, eight reported recent febrile illness. Three were hospitalized, but did not develop HFRS, and all recovered. Serious illness was not reported in any Canadian patients. All strains detected in Canada and the US were indistinguishable from one another based on nucleotide sequencing (7), indicating that a single strain was responsible for the outbreak. No single facility was identified as the origin of the outbreak.

Public health response

On January 24, CDC issued a Health Alert Notice to notify health departments and health care providers of the Seoul virus investigations. On February 10, the World Health Organization was notified of the US and Canadian infections and investigations as required by International Health Regulations. On January 31 and May 9, 2017, CDC and the Pet Industry Joint Advisory Council hosted calls to provide updates on the Seoul virus outbreak and to answer questions for the pet industry and fancy rat community. The CDC created a website with Seoul virus facts and frequently asked questions for the public.

Health departments notified suspected and confirmed facilities, and placed those facilities under quarantine, allowing no rats to enter or leave. Rat contact was limited to as few persons as possible to reduce transmission. In suspected facilities, CDC recommended rat testing be performed under the supervision of a public health official or licensed veterinarian. The quarantine was lifted when at least four weeks had elapsed since the newest animal was introduced, and all rats subsequently tested negative. Rats belonging to owners who refused to test their animals could remain quarantined for life or be euthanized. The CDC recommended euthanasia of all rats in confirmed facilities as the most effective method to prevent transmission, although control recommendations differed by state and country according to local policies and response capacities. If euthanasia was not possible, then owners could either quarantine all rats for life or pursue quarantine with testing and culling. The testing and culling strategy entailed testing all rats and euthanizing only infected rats. Testing and euthanasia were repeated at four week intervals until all rats tested negative and the quarantine was lifted. In Canada, public health officials opted for education and a voluntary testing and culling approach to control Seoul virus transmission.

Discussion

This outbreak report, in parallel to the previously described investigation in Tennessee (1), describes the first known cases of Seoul virus infection in humans attributable to contact with pet rats in the US and Canada. Human hantavirus infections

are nationally notifiable in the US and suspected cases should be reported to state or local health departments. Health care providers should consider Seoul virus infection in patients with febrile illness who report rat exposure; CDC recommends testing for any person with compatible illness and rodent contact. Testing is available at CDC and through some state and commercial laboratories. In Canada, testing is available for symptomatic persons with rat exposure, rattery owners associated with this investigation, and their rats through public health laboratories; for individually owned pet rats and ratteries not associated with the investigation, testing is available through a commercial laboratory.

Pet rat owners should be aware of the potential for Seoul virus infection. To keep themselves and their pets healthy, all persons with rodent contact should avoid bites or scratches and practice good hand hygiene, especially children and persons with compromised immune systems (2). The CDC recommends hand washing after caring for rodents and before eating, drinking, or preparing food (2). If a pet rat is suspected of having Seoul virus, the person cleaning the rodent environment should wear a respirator, gloves, and cover any scratches or open wounds (8). An adult should routinely disinfect rat cages and accessories, including used bedding, with a 10% bleach solution or a commercial disinfectant (8). More information about rodent contact and disease prevention is available from CDC (8,9).

Rattery owners are encouraged to quarantine any newly acquired rats for four weeks and to test these rats for Seoul virus antibodies before allowing them to comingle with other rats. Commercial laboratories can perform Seoul virus testing of rodent blood samples, and comparisons of results from shared samples have been concordant with CDC's ELISA and RT-PCR assays. To prevent transmission to humans, CDC recommends euthanasia of all rats in facilities with human or rat Seoul virus infections. Further guidance on methods to eradicate Seoul virus from infected ratteries should be obtained from local or state health departments.

Conflict of Interest

No conflicts of interest were reported.

Contributors

Seoul Virus Working Group

Jan Achenbach, Chester County Department of Health
Jill Baber, North Dakota Department of Health
Gary Balsamo, Louisiana Department of Health
Casey Barton Behravesh, CDC
David Blythe, Maryland Department of Health and Mental Hygiene
Iwona Boraks-Pielechaty, Pennsylvania Department of Health; Shelley M. Brown, CDC
Jennifer Brown, Indiana State Department of Health
Robert Brucker, Montgomery County Health Department
Barbara A. Bruen, Pennsylvania Department of Health
Colin Campbell, New Jersey Department of Health
Deborah Cannon, CDC
Beth Carlson, North Dakota Department of Agriculture
Kris Carter, CDC, Idaho Department of Health and Welfare
Cynthia Cary, CDC
Caroline Castillo, CDC, Michigan Department of Health and Human Services
Cheng-Feng Chiang, CDC
Mary Choi, CDC
Ellen Christel, Manitowoc County Health Department
April Clayton, CDC
Leah Colton, Colorado Department of Public Health and Environment
Laura Cronquist, North Dakota Department of Health
David Damsker, Bucks County Health Department
William G. Davis, CDC
Annabelle de St Maurice, CDC
Jordan Dieckman, Wisconsin Department of Health Services
John Dunn, Tennessee Department of Health
Drew D. Dycus, Bucks County Health Department
Elizabeth Ervin, CDC
Michelle Feist, North Dakota Department of Health
Amanda Feldpausch, Georgia Department of Public Health
Mary Margaret Fill, CDC, Tennessee Department of Health
Julie Gabel, Georgia Department of Public Health
Ann Garvey, Iowa Department of Public Health
Sarah Genzer, CDC; Suzanne Gibbons-Burgener, Wisconsin Department of Health Services
James Graziano, CDC
Victoria Hall, CDC, Minnesota Department of Health
Russel Heisey, Pennsylvania Department of Health
Heather Henderson, Tennessee Department of Health
Janemarie Hennebelle, Georgia Department of Agriculture
Leslie Hiber, Minnesota Department of Health
Stacy Holzbauer, CDC, Minnesota Department of Health
Jennifer House, Colorado Department of Public Health and Environment
Eddie Jackson, CDC
Mary H. Jenks, CDC
Dee Jones, Alabama Department of Public Health
Susan Keller, North Dakota Department of Agriculture
John D. Klena, CDC
Rachel F. Klos, Wisconsin Department of Health Services
Barbara Knust, CDC
Anna Kocharian, Wisconsin Department of Health Services
Katrin Kohl, CDC
Gregory Langham, CDC
George Lathrop, CDC
Jennifer Layden, Illinois Department of Public Health
Kathryn Lehatto, Pennsylvania Department of Health
Jodi Lovejoy, Indiana State Board of Animal Health
Kenneth Lowery, Georgia Department of Public Health
Nicole Lukovsky-Akhsanov, CDC
Nhiem Luong, Delaware Health and Social Services
Michael Maglio, Chester County Department of Health
Craig Manning, CDC
Chandra Marriott, Pennsylvania Department of Health
Natalie Marzec, Colorado Department of Public Health and Environment
Michel Masters, Montgomery County Health Department
Susan McClanahan, Minnesota Board of Animal Health
Lisa McCloskey, Bucks County Health Department
Shannon McKnight, Pennsylvania Department of Health
Jennifer McQuiston, CDC
Sara McReynolds, North Dakota Department of Agriculture
Gianna Megaro, Chester County Department of Health

Maria Morales-Betoulle, CDC
Allyn K. Nakashima, Utah Department of Health
Stuart Nichol, CDC
Julie Paoline, Montgomery County Health Department
Nishi Patel, CDC
Ketan Patel, CDC
Dallin Peterson, Utah Department of Health
Leah Posivak-Khouly, Montgomery County Health Department
Nathaniel Powell Jr., CDC
Howard Pue, Missouri Department of Health & Senior Services
Lawrence Purpura, CDC
Rachel Radcliffe, South Carolina Department of Health & Environmental Control
Nicole Reynolds, Minneapolis Medical Research Foundation
Linda Roesch, CDC
Pierre Rollin, CDC
Andrea L. Sandberg, Brown County Health and Human Services
Joni Scheftel, Minnesota Department of Health
Betsy Schroeder, CDC, Indiana State Department of Health
Irshad A. Shaikh, Montgomery County Department
Trevor Shoemaker, CDC
Jennifer Sidge, Michigan Department of Health and Human Services
Tom Sidwa, Texas Department of State Health Services
Kim Signs, Michigan Department of Health and Human Services
Amber Singh, Ohio Department of Health
Aaron Smee, Pennsylvania Department of Health
Danielle Stanek, Florida Department of Health
Mary Grace Stobierski, Michigan Department of Health and Human Services
Anne Straily, CDC
Ute Ströher, CDC
Cassandra Tansey, CDC
Leslie Tengelsen, Idaho Department of Health and Welfare
Beth Thompson, Minnesota Board of Animal Health
Susan L. Ward, Bucks County Department of Health
Kimberly Warren, Pennsylvania Department of Health
Susan Weinstein, Arkansas Department of Health
Deborah Weiss, CDC, Wisconsin Department of Health Services
Andre Weltman, Pennsylvania Department of Health
Tigist Yirko, Pennsylvania Department of Health
Joyce Zuzack, Bucks County Department of Health

Canadian Seoul Virus Investigation Group (Federal)

Peter A. Buck, Public Health Agency of Canada (PHAC)
Allen Grolla, PHAC
Chris Huynh, PHAC
L. Robbin Lindsay, PHAC
Courtney Loomer, PHAC
David Safronetz, PHAC
Angela Sloan, PHAC
Jim E. Strong, PHAC
Joanne R. Tataryn, PHAC
Linda Vrbova, PHAC

Canadian Seoul Virus Investigation Group (Provincial)

Office of the Chief Medical Officer of Health
Ontario Ministry of Agriculture, Food and Rural Affairs
Population and Public Health Division, Ministry of Health and Long-Term Care
Public Health Ontario
Ontario Public Health Units

References

1. Fill MA, Mullins H, May AS, et al. Notes from the Field: Multiple Cases of Seoul Virus Infection in a Household with Infected Pet Rats - Tennessee, December 2016-April 2017. MMWR Morb Mortal Wkly Rep 2017;66:1081–2. DOI (https://doi.org/10.15585/mmwr.mm6640a4). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=29023435&dopt=Abstract).
2. Centers for Disease Control and Prevention. Key Messages about Pet Rodents. January 19, 2017. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention; 2017. https://www.cdc.gov/healthypets/pets/small-mammals/petrodents.html
3. Childs JE, Korch GW, Smith GA, Terry AD, Leduc JW. Geographical distribution and age related prevalence of antibody to Hantaan-like virus in rat populations of Baltimore, Maryland, USA. Am J Trop Med Hyg 1985;34:385–7. DOI (https://doi.org/10.4269/ajtmh.1985.34.385). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=3885776&dopt=Abstract).
4. Knust B, Rollin PE. Twenty-year summary of surveillance for human hantavirus infections, United States. Emerg Infect Dis 2013;19:1934–7 10.3201/eid1912.131217. DOI (https://doi.org/10.3201/eid1912.131217). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=24274585&dopt=Abstract).
5. Jameson LJ, Taori SK, Atkinson B, et al. Pet rats as a source of hantavirus in England and Wales, 2013. Euro Surveill 2013;18:20415. PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=23470018&dopt=Abstract).
6. Ksiazek TG, West CP, Rollin PE, Jahrling PB, Peters CJ. ELISA for the detection of antibodies to Ebola viruses. J Infect Dis 1999;179(Suppl 1):S192–8. DOI (https://doi.org/10.1086/514313). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=9988184&dopt=Abstract).
7. Woods C, Palekar R, Kim P, et al. Domestically acquired seoul virus causing hemorrhagic fever with renal syndrome-Maryland, 2008. Clin Infect Dis 2009;49:e109–12. DOI (https://doi.org/10.1086/644742). PubMed (https://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=19848600&dopt=Abstract).
8. Centers for Disease Control and Prevention. Cleaning Up After Pet Rodents to Reduce the Risk of Seoul Virus Infection. January 19, 2017. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention; 2017. https://www.cdc.gov/hantavirus/outbreaks/seoul-virus/cleaning-up-pet-rodents.html
9. Centers for Disease Control and Prevention. Healthy Pets Healthy People. April 5, 2017. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention; 2017. https://www.cdc.gov/healthypets/

CCDR

CANADA COMMUNICABLE DISEASE REPORT

Public Health Agency of Canada
130 Colonnade Road
Address Locator 6503B
Ottawa, Ontario K1A 0K9
ccdr-rmtc@phac-aspc.gc.ca

To promote and protect the health of Canadians through leadership, partnership, innovation and action in public health.

Public Health Agency of Canada

Published by authority of the Minister of Health.

This publication is also available online at

https://www.canada.ca/en/public-health/services/reports-publications/canada-communicable-disease-report-ccdr/monthly-issue/2018-44.html

Également disponible en français sous le titre :
Relevé des maladies transmissibles au Canada