

Chlamydial Testing Practice Effectiveness in a High Incidence Area of Northern Canada: An Aggregate Data Analysis and Chart Review

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Abstract

Background: *Chlamydia trachomatis* infections are increasing in Canada and its North, with female rates several times higher than males. Understanding testing practices may aid in the development of strategies to reduce chlamydial rates.

Research questions: To what effect are testing frequencies contributing to the difference in chlamydial rates between females and males? Which testing approaches are most effective in identifying chlamydia infections?

Methods: Aggregated data for 2009 to 2012 of Northern Saskatchewan chlamydial testing was analyzed utilizing age, gender, and positivity. Additionally, a chart review on testing practices was conducted on 400 chlamydial tests at a Northern medical clinic.

Results: In an area of high incidence of chlamydia infections, the annual incidence of chlamydia for females was 2.49 times the rate in males. Women's testing rates were 3.46 times the rate in males. However, men had a 1.52 fold greater rate of positivity. For one medical clinic, contact tracing returned the greatest percent positive cases, with 50% positivity. Females were identified to be high risk, and tested significantly more often, than males. Routine tests on patients 30 years old and over were 35.3% of the total tests, although male and female positive rates in these ages were 0.72% and 0.85% respectively.

Discussion: If males were tested to a similar frequency as females, male rates may increase. Female and male chlamydia rates were over 4000/100,000 until age 30, suggesting that screening recommendations include both sexes in these ages, especially in high incidence populations. Contact tracing resulted in the most percent positive cases, highlighting its importance. While routine screening occurred frequently, many occurred in older age groups with low prevalence, producing very few positive results.

Keywords: Chlamydia; Sexually Transmitted infections; Screening; Incidence; Canada

Abbreviations:

CI: Confidence Interval; NAAT: Nucleic Acid Amplification Test; PHAC: Public Health Agency of Canada; PID: Pelvic Inflammatory Disease; SDCL: Saskatchewan Disease Control Laboratory; USPSTF: United States Preventive Services Task Force.

Introduction

Chlamydial infections are the most common bacterial sexually transmitted infections in the world [1], and cost Canada \$115 million per year [2]. In Northern Saskatchewan, the crude rate rose 58% in eight years since 2000 [3], and was 2912 positive cases per 100,000 of the entire population, in 2008. This rate was six times higher than the rest of the province, and 12 times higher than the rest of Canada, for the same time period [3].

There are differences in the incidence between males and females. In Canada, chlamydia rates in females are 1.9 times greater than in males [4], and in Northern Saskatchewan (defined as the area covered by Athabasca Health Authority, Keewatin Yatthe Regional Health Authority, and Mamawetan Churchill River Regional Health Authority), females rates are 2.16 times higher than those of males [3]. This may be a result of an increased rate of testing in females, better-targeted screening, or a true reflection of the differences in disease rates. Guidance on female testing may have contributed to these testing differences. The United States Preventive Services Task Force (USPSTF) has published recommendations on chlamydial infection screening, with strong recommendations for female screening [5]. However, there are various opinions on the practice of routine chlamydia screening in males. The USPSTF has not found any evidence that male screening resulted in decreased chlamydial infections in women [5]. They do state however that "untreated infections in men provide a reservoir of infection that may make it difficult to improve health outcomes in women through screening programs that target only women" [5], and they go on to identify this

as “a critical gap in the evidence” [5]. The Public Health Agency of Canada (PHAC) shares this sentiment [6].

In females with chlamydia, 50-70% is asymptomatic [7,8]. In males, 50-90% of chlamydial infections are asymptomatic [7,9]. The transmission rate of a single exposure from female to male is approximately 32%, while male to female transmission is up to 40% [10]. Chlamydial infections in males can therefore have a great impact on the total prevalence. Enhanced male screening may be crucial to ultimately influencing this rate. Kretzschmar et al. [11] found in a mathematical model that screening males aged 15 to 24 years resulted in a decreased total prevalence of chlamydia compared to screening women alone. PHAC states that until there is evidence to influence otherwise, all sexually active men under the age of 25 should be screened [6]. Despite this recommendation, routine screening of young males is not a common practice. For example, one study showed that 55% of nurse practitioners that were sampled had never tested a male patient for chlamydial infection [12].

Various types of screening methods have been shown to be cost-effective, especially when focused upon specific, high-incidence populations [13-16]. Some studies suggest that 30% of untreated female chlamydial infections develop into pelvic inflammatory disease (PID) [13]. Howell et al. [17] found that screening all women under the age of 30 using the urine nucleic acid amplification test (NAAT) would prevent 56% of the PID cases, and would decrease healthcare costs attributed to genital chlamydial infections by 45%.

In order to further examine the increased rates of chlamydial infections in women, this study will evaluate the volume of tests conducted on males and females in a high incidence area of Canada. This study will also investigate whether an increased number of female investigations may be resulting in more positive results compared to males, which could ultimately be underestimating male rates. Additionally, it will explore the testing practices of healthcare workers in order to determine if males and females are tested differently, and the effectiveness in testing of various age and gender groups with various medical clinic presentations.

Research Questions

To what effect are testing frequencies contributing to the difference in chlamydial rates between females and males?

Which testing approaches are most effective in the identification of chlamydia infections?

Methods

Ethical approval

Ethics approval was received from the University of Saskatchewan BioMedical Research Ethics Board in an Application to Access Existing Health Data for Research. Approval was also received from the Mamawetan Churchill River Health Region and the La Ronge Medical Clinic, in association with Northern Medical Services of the University of Saskatchewan, where the chart review took place.

Northern Saskatchewan testing data

The researchers began by evaluating the current status of chlamydial testing and results in all of Northern Saskatchewan covering three health authority areas of 36,000 predominately

Aboriginal people across the northern half of Saskatchewan. Aggregate data was obtained from the Saskatchewan Disease Control Laboratory (SDCL) on every chlamydial test conducted in Northern Saskatchewan from April 2009 to September 2012. Data included date of test, location of test, result of test, sex, and age of patient, but did not contain any unique patient identifiers.

Medical clinic testing practices

The largest medical clinic in northern Saskatchewan was chosen to be the study clinic for the remainder of the data collection and analysis. The Study Clinic practices universal screening, also called routine screening for the purposes of this study, for patients presenting for complete physicals. Every patient who presents for a complete medical exam, regardless of age or sex, is asked to submit urine to screen for gonorrhea and chlamydia. The 400 most recent chlamydial tests were identified, 200 for each sex. This was done by using a physician reporting function in the electronic medical record that allowed for a data search of patients who had undergone urine NAAT testing. The Saskatchewan Personal Health Numbers of these individuals were then compiled to create a Master List. These numbers were linked to a unique identification number, which was used for the remainder of the research project to ensure confidentiality.

The data collection tool was a Microsoft Excel spreadsheet. The tool included the patient’s identification number, sex, indication for testing, and result of test. The age groupings were categorized into the following years: under 15, 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, and over 55 years. The indications for NAAT testing were categorized as listed in Table 1. The data was analyzed using Microsoft Excel pivot tables. Significance was determined using Mid-P exact test with 95% confidence intervals on OpenEpi [18].

Indication for NAAT Testing	Description of Indication
Contact	Asymptomatic patients that were notified by health care worker, public health, or sexual contact
Provider Request/Routine	Asymptomatic patients having complete physicals, prenatal work-up, or if standard protocol (eg. Intra-uterine device insertion)
Provider Request/High Risk	Asymptomatic patients deemed to be high risk by the physician due to age, situation, and/or presentation (eg: Hepatitis C)
Patient’s Request	Asymptomatic patients specifically requesting testing
Symptomatic Patients	Patients with dysuria, penile or vaginal discharge, genital itching, vague genital symptoms, and/or lower abdominal pain
Other	Collection was done for gonorrhea specific testing, or any other reason

Table 1: Indications for chlamydial testing.

Results

Northern Saskatchewan data

From April 1, 2009 to September 30, 2012, 26848 tests were conducted in Northern Saskatchewan to look for *Chlamydia trachomatis*. This included 20626 female tests and 6221 male tests for a testing rate of 337.1 tests per 1000 of the general population per year

for females and 97.5/1000/year for males. Among both males and females, the age group that received the highest rate of tests was that of 20-24 years (Table 2). Females were tested more often than males in all age groups except over 55 years. The age group with the highest rate of positive tests was 15-19 years in females, and 20-24 years in males, although the rate of positive tests was similar between sex across most age groups. The age group that had the most percent positive cases was

the 15-19 year olds, in both males and females (31.01% and 20% respectively). Male investigation resulted in more positive cases per test conducted than female investigation, in all age groups except in the under 15 year-old group. If males were tested to the same frequency as females in each age group, there would be more male positive cases than female positive cases in all but the youngest age groups.

Male								Female						
Age	Positive	Negative	Total	% Positive	Annual Positive Rate (per 100,000)	Positive	Negative	Total	% Positive	Annual Positive Rate (per 100,000)	Female/Male Total Tests	Female/Male Positive Tests	Female/Male % Positive	Corrected Female/Male Positive
< 15	5	57	62	8.06	24.2	60	438	498	12.05	307.3	8.0	12.0	1.5	1.49
15-19	269	598	867	31.03	4005.1	898	3593	4491	20.00	14058.7	5.2	3.3	0.6	0.64
20-24	393	1142	1535	25.60	6699.6	745	4707	5452	13.66	13303.6	3.6	1.9	0.5	0.53
25-29	187	838	1025	18.24	4193.8	351	3412	3763	9.33	7786.6	3.7	1.9	0.5	0.51
30-34	95	616	711	13.36	2366.4	100	2184	2284	4.38	2643.1	3.2	1.1	0.3	0.33
35-39	43	426	469	9.17	1147.1	63	1563	1626	3.87	2602.9	3.5	1.5	0.4	0.42
40-44	28	413	441	6.35	722.7	38	1101	1139	3.34	1027.2	2.6	1.4	0.5	0.53
45-49	10	304	314	3.18	280.9	7	643	650	1.08	201.1	2.1	0.7	0.3	0.34
50-54	5	238	243	2.06	155.6	7	342	349	2.01	232	1.4	1.4	1.0	0.97
>55	7	545	552	1.27	50.9	0	360	360	0.00	0	0.7	0.0	0.0	0.00
Total	1042	5177	6219	16.76	5218.6	2269	18343	20612	11	13001.4	3.3	2.2	0.7	0.66

Table 2: Northern Saskatchewan test results per age group and sex, with female to male ratios.

	<29		>30	
	Male	Female	Male	Female
Positive	854	2054	188	215
Negative	2635	12150	2542	6193
Total	3489	14204	2730	6408
% Positive	24.48	14.46	6.89	3.36
Population	10776	10291	7462	7190
Yearly Testing Rate (per 1000)	92.5	394.4	104.5	254.6
Yearly Positive Rate (per 100,000)	2270	5630	720	850

Table 3: Northern Saskatchewan chlamydial test results and population rate, per age and sex.

Females under the age of 30 were tested for chlamydia 2.22 times more often than females 30 years and older (Table 3). In males, those

under 30 were tested 1.28 times more often than those over 30 years. Between the two age groups, tests conducted in the younger group resulted in many more positive cases per test conducted, with males under the age of 30 having the highest percent positive. The calculated rate of chlamydial infectivity in Northern Saskatchewan using 2010 population data was 2270/100,000 in males under the age of 30, and 5630/100,000 in females under the age of 30. These rates dropped considerably in the 30 years and older age group with rates of 720/100,000 for males and 850/100,000 for females.

Study clinic data

Results of the screening practices at the Study Clinic are listed in Table 4.

187 working days of healthcare provider testing were required in order to conduct 200 chlamydial investigations in males. Females were tested 2.79 times more often, requiring 67 working days to conduct 200 investigations. If a single time frame was evaluated, and everything else remained constant, there would be many more female tests than male tests for all indications for testing except for contact tracing, where males would still be tested much more often.

Indication for testing	Females Tested (n, %, with 95% CI)	Female Positive Results (n, %, with 95% CI)	Males Tested (n, %, with 95% CI)	Male Positive Results (n, %, with 95% CI)	Total Positive Cases (n, %, with 95% CI)	Female/Male Testing Ratio	Corrected* Female/Male Testing Ratio
Contact Tracing	1 (0.5%, 0.02-2.44)	1 (100%, 5-100)	17 (8.5%, 5.2-13)	8 (57.1%, 24.78-70.27)	9 (50%, 27.81-72.19)	0.06	0.16
Routine Screening	79 (39.5%, 32.9-46.4)	2 (2.5%, 0.43-8.11)	90 (45%, 38.2-51.94)	0 (0%, 0-3.27)	2 (1.18%, 0.2-3.85)	0.88	2.45
High Risk for STI	30 (15%, 10.55-20.46)	5 (16.7%, 6.37-33.15)	8 (4%, 1.88-7.45)	0 (0%, 0-31.23)	5 (13.16%, 4.99-26.78)	3.75	10.46
Asymptomatic Patient Request	37 (18.5%, 13.57-24.34)	5 (13.5%, 5.12-27.44)	42 (21%, 15.78-27.06)	3 (7.1%, 1.85-18.22)	8 (10.13%, 4.82-18.32)	0.88	2.46
Symptoms	53 (26.5%, 20.73-32.94)	7 (13.2%, 5.96-24.39)	41 (20.5%, 15.33-26.52)	7 (17.1%, 7.79-30.88)	14 (14.89%, 8.74-23.19)	1.29	3.61
Other	0	0	2 (1%, 0.17-3.26)	0 (0%, 0-77.64)	0 (0%, 0-77.64)	0	0
Total	200	20 (10%, 6.39-14.76)	200	18 (9%, 5.59-13.59)	38 (9.5%, 6.91-12.68)	1	2.79

*Correction factor for single time frame, rather than out of 200 tests, as females were tested 2.79 times more often than males.

Table 4: Study Clinic test results per indication and sex, with female to male testing ratio.

Of the 169 patients who were tested under the 'routine' category, only two (1.18%, 95% CI 0.2-3.85) tests were positive for chlamydial infection (Table 5). Of all routine screening tests conducted on males, 7 (7.78%, 95% CI 3.47-14.78) of the patients were under age 30, while 83 (92.22%, 95% CI 85.22-96.54) were 30 years and older. None of the results were positive for chlamydia. There were 38 high-risk patients tested within both sexes, with 76% of them being under the age of 30. 17.2% (95% CI 6.6-34.16) of those under the age of 30 years were positive for chlamydial infections. Females were identified as being high risk 3.75 times more frequently than males. Contact tracing occurred in males significantly more often than in females.

	<29		>30	
	Male	Female	Male	Female
Positive	0	1	0	1
Negative	7	19	83	57
Total	7	20	83	58
% Pos	0	5	0	1.72

Table 5: Study Clinic chlamydial test results per age and sex for clinic visits classified as 'routine'.

Discussion

This study looked at incidence rates at a population level across a large geographic area, then looked specifically at the testing patterns for those attending a large general family medicine clinic.

Chlamydial infection rates in females were higher than in males in Northern Saskatchewan, which is consistent with national trends [4]. However, females were tested much more often than males, with less percent positive results. Additionally, in patients at the Study Clinic deemed to be high risk for acquiring a STI, an indication with one of

the highest likelihoods of a positive case for females, females were tested 10.45 times more often than males. This would suggest that if the same number of tests were conducted on males as there were on females, male rates of chlamydia could be higher than currently stated. If this were true, there may be a role in including males in screening programs in an attempt to increase male screening and decrease the total prevalence of chlamydia. In Australia for example, recommendations call for screening of both males and females aged 15 to 29 [19]. This suggestion may have influenced the female-to-male rate ratios in Australia, who have the lowest difference between sexes of the amount of tests conducted, at 1.4:1, compared to Canada, at 1.9:1, and United States, at 2.7:1 [4].

At the Study Clinic, females were also tested more often than males when presenting with symptoms that could be attributed to a genital chlamydial infection. This clinical significance is difficult to analyze however, as female genital and abdominal symptoms can be quite vague at times, which results in chlamydial testing being ordered as one of many diagnostic investigations.

Alternately, significantly more males presented for testing after being identified through contact tracing. Contact tracing resulted in the highest percent positive cases of all presenting concerns. However, the total number of tests was relatively low. With so many positive chlamydial cases throughout Northern Saskatchewan, one would expect to have many more contacts. This highlights the importance of healthcare workers completing contact tracing forms, following up with this information, and ensuring further testing and treatment in these new contacts. Getting patients to return to a clinic a second time for contact tracing may be difficult, especially if treatment has already occurred. Asking for contacts at the initial visit, and waiting for a positive result before pursuing those contacts, may be a way to ease the process and insure contacts are provided. Alternately, expedited partner therapy, in which the patient is given antibiotics to give to their sexual partner without the partner undergoing a medical evaluation, can be considered. This practice works especially well for

partners who are unlikely or unable to receive in-person treatment, and has been shown to reduce recurrent sexually transmitted infections in a cost-effective manner [20]. However, expedited partner therapy would not allow for identification of the partner's contacts, and there would be a missed opportunity for counseling. Additionally, the legality of the practice is ambiguous in some areas [21].

The prevalence of disease affects the positive predictive value of tests. The sensitivity of the NAAT commonly used in Northern Saskatchewan for chlamydia reaches 94.7%, with a specificity of 98.9% [22,23]. This compares to a culture specificity of 100%, although culture sensitivity can be as low as 50% [24]. Tests that screen low prevalence populations have lower positive predictive value, with the increased possibility for false positives. A false positive with NAAT testing has the potential negative consequences of increased healthcare visits, increased medication use, an increase in associated costs, social stigma, psychological harm, stress on relationships, and the potential for overestimated rates. At the Study Clinic, routine screening was the indication for testing that had the lowest percent of positive cases, with only 1.2% of them returning positive. This type of screening targeted patients who presented for complete medical exams, which were typically older individuals who would ultimately be deemed low-risk. Screening this low prevalence population may be unnecessary, and will continue to miss the majority of young, high-risk people, particularly young males who rarely attend clinics for this indication.

The incidence of disease may affect screening recommendations. Higher chlamydial rates in females result in screening programs that can be considered more cost effective. Men on the other hand currently have less positive cases overall. Including males in screening programs may therefore be controversial, as it may not result in many positive returns. Kohl et al. [25] discussed the cost effectiveness of universal chlamydial screening for women of reproductive age. They noted that universal screening was more cost effective than no screening at all, as it decreased infection sequelae such as pelvic inflammatory disease. In Saskatchewan, based on personal communications with G. Horsman of SDCL, NAATs that go through the SDCL for evaluation cost 25 dollars, compared to much more spent on PID treatment [13]. Others however are uncertain regarding the effectiveness of universal screening [26]. Regardless, focusing on specific high-risk and high-incidence populations has been found to greatly increase the cost effectiveness of screening programs when compared to universal screening [13-16,25]. In deciding which screening approach to follow, the overall objective of the screening also needs to be considered. If the goal is to reduce the total incidence of chlamydia, screening males may be worthwhile. Alternately, if the target is to reduce complications of chlamydia, such as PID and infertility, it may be acceptable to only screen females. However, even if the intention is the latter, lessening male rates may subsequently lower female rates, thereby decreasing sequelae. This is especially true given the ease of male to female transmission [10]. Untreated males will re-infect the female partner, making it difficult to decrease female rates.

North American recommendations call for screening all sexually active females under the age of 25 [5]. In Canada in 2009, chlamydial rates for these populations were 1720.3 for females 15-19 years, and 1871.4 for females 20-24 years, per 100,000 [4]. These rates drop to 788.4 in the 25-29 years age group. It can be postulated through these national policies therefore, that screening should occur for chlamydia when infectivity rates are approximately 1700/100,000 or higher. In Northern Saskatchewan, both males under the age of 35, and females

under the age of 40, would fall into this category. This would suggest that screening all males and females up to the age of 30, or even 40, might be appropriate in high-incidence populations.

There were very few asymptomatic males screened in the Study Clinic who were under 30 years. These low testing rates could be due to the fact that young men traditionally attend health clinics less often than women [27], who present for issues such as birth control, prenatal care, and PAP smear screening [28]. This provides fewer opportunities to evaluate males for whether testing should be conducted. If the suggestion to screen all younger adults were to be followed, a more active approach would likely be required, as it has been recognized that male screening techniques are different than those targeting women [29]. For example, young men could be routinely screened in Emergency Departments and Walk-in Clinics, as they are more likely to be seen in these settings rather than in a booked appointment at an office [27]. Some effective male screening efforts have focused on school-based health centres or on the job training programs [26,30,31]. Financial incentives have also been used with success, especially the distribution of vouchers to patients presenting for screening [32]. There has been some increased discussion on self-testing as well as mail-in screening programs [26], which can be considered. These tests target at-risk populations, and return up to 11 times higher testing rates in comparison to screening in the clinic [26]. Additionally, repeat testing in three to six months of patients who are found to be positive, as is suggested by several countries [6,33,34], may be effective, as these patients are at a high risk of reinfection.

Limitations

One of the limits in this study included the low sample size for the chart review. With increased case numbers, the differences between sex, age, and the indication for testing should become that much more apparent. However, conducting a repeat study to obtain adequate power may not have any significance clinically, as trends can be evaluated to make suggestions regarding testing. The aggregate data can also be utilized to extrapolate some information from Study Clinic results. Secondly, using a correction factor during the analysis of data required the assumption that all else would remain equal, including who and why patients were tested. Conducting a chart review on tests conducted within a specific time frame, rather than the most recent 'X' number of tests, would have been a variation to remove this assumption. Additionally, only one institution was evaluated by the chart review, and testing practices between clinics can be quite varied. The researchers also acknowledge that although there were firm guidelines as to how to classify the indication for testing, healthcare provider charts are not always explicitly clear. This may have led to some indications being misclassified.

Recommendations

In high-incidence populations, focus testing efforts on sexually active males and females beyond 25 years of age but not over the age of 40.

Review the practice of routinely testing low risk clients.

Complete contact tracing with every positive result and implement effective follow-up strategies to reach those contacts.

Competing Interests

The authors have nothing to declare.

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