CCDR | CANADA COMMUNICABLE DISEASE REPORT

1975–2024 50TH ANNIVERSARY

canada.ca/ccdr

July/August 2024 - Volume 50-7/8

SEXUAL HEALTH

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

Canada

CCDR
CANADA COMMUNICABLE DISEASE REPORT

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ISSN 1481-8531 / Cat. HP3-1E-PDF / Pub. 230010

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SEXUAL HEALTH

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Summary of the National Advisory Committee on Sexually Transmitted and Blood-Borne Infections (NAC-STBBI) Statement: Recommendations on Screening for Syphilis in Non-Pregnant Adults and Adolescents

Housne Begum[1], Stephan Gadient[1], Jared Bullard[2], Jennifer Gratrix[2], Troy Grennan[2], Todd Hatchette[2], Annie Fleurant-Ceelen[1], on behalf of the National Advisory Committee on Sexually Transmitted and Blood-Borne Infections*

Abstract

Background: Sustained and significant increases in Canadian rates of infectious syphilis prompted the National Advisory Committee on Sexually Transmitted and Blood-Borne Infections (NAC-STBBI) to update the existing screening recommendation for non-pregnant adults and adolescents.

Methods: These guidelines were developed following the 2014 World Health Organization Handbook. The research question was: "What is the clinical utility of syphilis screening using risk-based versus population-wide approaches for adolescents and adults?" The evidence was assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach.

Results: The environmental scan included 11 guidelines on syphilis screening published between 2014 and January 2023. Two systematic reviews were identified and included. In the updated literature search from November 6, 2019, to January 17, 2023, there were no published systematic reviews on the effectiveness of risk-based screening or the comparison of risk-based and interval screening; however, one recent randomized control trial in Canada was published. Evidence for outcomes, patient values and preferences, resources, acceptability, equity, cost and cost effectiveness and feasibility were reviewed.

Conclusion: This statement provides two screening recommendations for adults and adolescents. Recommendation 1: NAC-STBBI recommends syphilis screening in all sexually active persons with a new or multiple partners and/or upon request of the individual. They also recommend screening every three to six months in individuals with multiple partners. Recommendation 2: NAC-STBBI recommends that targeted "opt-out" screening programs should be considered as frequently as every three months when serving population groups and/or communities experiencing a high prevalence of syphilis (and other STBBI). Both are strong recommendations with moderate certainty of evidence.

Suggested citation: Begum H, Gadient S, Bullard J, Gratrix J, Grennan T, Hatchette T, Fleurant-Ceelen A, on behalf of the National Advisory Committee on Sexually Transmitted and Blood-Borne Infections. Summary of the National Advisory Committee on Sexually Transmitted and Blood-Borne Infections (NAC-STBBI) Statement: Recommendations on Screening for Syphilis in Non-Pregnant Adults and Adolescents. Can Commun Dis Rep 2024;50(7/8):233–40. https://doi.org/10.14745/ccdr.v50i78a01

Keywords: screening for syphilis, recommendations, non-pregnant adults and adolescents

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Introduction

Syphilis is a sexually transmitted infection (STI) caused by the organism *Treponema pallidum* subspecies pallidum and can have significant morbidity if left untreated. In 2020, the World Health Organization (WHO) estimated that 7.1 million new syphilis infections occurred globally (1). Infectious (primary, secondary and early latent stages) and congenital syphilis are on the rise in Canada. Other high-income countries, such as the United States (US), Australia and the United Kingdom have reported similar trends (2–4).

Syphilis is the third most reported STI in Canada, but over the past decade (2013–2022) rates have increased by 393.1%, compared to 33.1% and 181.7% increases in rates for chlamydia and gonorrhea, respectively. The national rate of infectious syphilis increased from 5.1 cases per 100,000 population in 2011 to 24.6 per 100,000 population in 2019 and 36.1 cases per 100,000 population in 2022 (5,6). While rates have historically been higher in males than in females, reported rates of infectious syphilis have been increasing faster among females. Between 2010 and 2019, the rate in females increased by 1,446.8% compared to a 287.9% increase in the rate in males (5). As of January 2020, all provincial/territorial jurisdictions have declared increased rates of infection. The majority of cases continue to be among gay, bisexual and other men who have sex with men (gbMSM), but an increase has been reported in the heterosexual population with the most significant increase being in women of childbearing age, leading to increases in rates of congenital syphilis (6,7).

Sustained and significant increases in Canadian rates of syphilis prompted the National Advisory Committee on Sexually Transmitted and Blood-Borne Infections (NAC-STBBI) to prioritize the review and update of the Public Health Agency of Canada's (PHAC) existing screening recommendation. Screening is defined as the testing of asymptomatic individuals.

Methods

Syphilis screening recommendations were developed following the methods outlined in the 2014 edition (8) of WHO handbook for guideline development. A working group (WG) for guideline development comprising four members of NAC-STBBI was established and supported by PHAC secretariat. A methodologist and a team of systematic reviewers from the PHAC STBBI Guidance for Health Professionals Section (PHAC team) independently conducted a systemic review (SR) update of major studies on syphilis screening and scanned previously published syphilis screening guidelines using Google, the websites of international organizations, provincial/territorial organizations and a SR in 2022 by Canada's Drug Agency (CDA-AMC), formerly Canadian Agency for Drugs and Technologies in Health (CADTH) (9). The PHAC SR team examined studies published between January 2010 and January 2023 on syphilis screening, patient values and preferences, equity, feasibility, acceptability, economic analyses and health technology assessments. The evidence was assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach.

The WG identified the key questions that formed the basis for the SR and the recommendations as follows:

- Population: adolescents and adults
- Intervention: risk-based screening for syphilis (screening based on clinician assessment and opinion for syphilis with serologic testing using traditional or reverse sequence algorithms)
- Comparator: population-wide screening, at any time interval (e.g., three months, six months, 12 months) for syphilis with serologic testing using traditional or reverse sequence algorithms known as Interval screening
- Outcomes: clinical utility (e.g., incidence of infectious/non-infectious syphilis, neurosyphilis or congenital syphilis), proportion of participants who receive unnecessary or inadequate treatment (e.g., due to false positive/negative test results), participant acceptability and safety (e.g., adverse events, psychosocial harms)
- Study designs: health technology assessments, systematic reviews, randomized controlled trials (RCTs) and non-randomized studies

An environmental scan on existing syphilis screening recommendations of different organizations was conducted. The PHAC SR team also searched for SRs, then primary studies when no SRs were available. Evidence for outcomes, patient values and preferences, resources, acceptability, equity and feasibility were reviewed from published and unpublished literature. Comprehensive searches for previously conducted SR, RCTs and non-randomized studies were performed in September 2019 and updated in January 2023. Two members of the PHAC SR team screened studies, extracted and analyzed the data and assessed the quality/certainty of the evidence using the GRADE approach (10). A total of 11 guidelines on syphilis screening published between 2014 and January 2023 were reviewed (11–21). The most common screening intervals were every three to six months. The Appraisal of Guidelines for Research & Evaluation (AGREE) II instrument (22) was used to evaluate the methodological quality of the identified guidelines. From a literature search with the Health Canada Librarian in 2019, two systematic reviews (23,24) were identified and included.

The updated literature search from November 6, 2019, to January 17, 2023, with the librarian resulted in 220 records. After removal of duplicates, there were a total of 176 articles. The WG members shared four additional articles and one more was found in an article reference list. After title and abstract screening 31 records were included for full text screening

and a final total of nine records were included. There were no published SRs on the effectiveness of risk-based screening or the comparison of risk-based screening with interval screening; however, one RCT was published (25). There were two more updated SR findings included from CDA-AMC (9) and the US Preventive Services Task Force (USPSTF) (26). Of the 1,032 search records found by CDA-AMC, only one overview of reviews by Fernane and Fowler (27) met the pre-specified inclusion criteria focusing on screening adult patients (16 years of age and older) at low risk for syphilis (27). The updated search by the USPSTF included one study by Chow *et al.* (28) on screening effectiveness. In addition, 10 studies were included from the librarian's search, hand search and suggested citations from the WG members on "risk-based screening vs. interval screening", "comparison of annual, three months and six-month screening intervals", "syphilis screening as part of HIV [human immunodeficiency virus] viral load testing" and "opt-in vs. opt-out approach."

Results

The evidence review included three SRs (23,24,27) and 11 studies on syphilis screening: one randomized (25) and 10 non-randomized studies, including three cohort studies (29–31), seven retrospective chart reviews and cross-sectional studies (see **Appendix** for Evidence Profiles, **Table A1**) (28,32–37). The certainty of the evidence for the screening of syphilis was moderate. An environmental scan of 11 guidelines on syphilis screening published between 2014 and January 2023 was completed (11–21). All organizations recommend risk-based screening. Four organizations recommend screening for those at increased risk of infection at varying intervals, from annual screening to up to four times a year depending on risk behaviours. The most common intervals were every three to six months.

From PHAC search results, one RCT (25) reported that in risk-based screening versus interval screening, the average annual number of syphilis tests per individual increased from 0.53 to 2.02 tests and the time-adjusted rate ratio was 2.03 (1.85–2.22) (25). With intervention, the annualized proportion of newly identified early syphilis increased from 0.009 to 0.032 and the odds of annual screening increased nearly four-fold while the mean number of tests per year increased two-fold (25). Comparison of annual, three and six-month screening intervals during routine serology taken as part of HIV monitoring resulted in a marked increase in the proportion of HIV-positive men who have sex with men (MSM) diagnosed with asymptomatic syphilis (28,29,32,33,37). Additional studies using modelling projected similar results (38,39). These studies showed that increasing the frequency of syphilis screening to every three months was the most effective strategy for reducing infectious syphilis cases.

Targeted screening was more effective than universal screening as part of HIV viral load testing when using the opt-out strategy (30). Over 50.8% of incident syphilis cases were asymptomatic and were only identified through routine screening (30). One observational study compared risk-based screening, opt-in and opt-out approaches for HIV-positive gbMSM (31). The authors found that the opt-in (opt-in means offering syphilis testing to HIV-positive MSM and conducting the test in those that agree, which may be related to their perceived risk) and opt-out (opt-out refers to syphilis testing done automatically on all HIV-positive MSM unless a patient declines to have the test) approaches led to increased uptake of syphilis testing. A risk-based testing approach (risk-based involves assessing risk and then offering a syphilis test accordingly) resulted in lower testing frequencies and potentially missed opportunities (31). Reekie *et al.* (34) also examined the uptake of opt-out versus opt-in screenings in a remand facility in Alberta, Canada, between March 1, 2018, and February 28, 2020, among individuals younger than 35 years. They found that the opt-out approach screened more admissions among those younger than 25 years, even though the total opt-out uptake was low (n=902/2,906; 31.2%). Opt-in screenings achieved significantly high positivity rates for syphilis. Opt-out screening resulted in higher STI positivity rates compared to other STIs (chlamydia, gonorrhea) (29.5%), however, lower than rates from opt-in screening (35.8%). Both found similar HIV-positivity rates (34).

Another study in the US (35) found a large number of missing cases while targeting screening to only those deemed "high-risk" by behaviour or symptoms. Venegas *et al.* (30) also found opt-out screening using technology and risk factors identified 27 of the 59 patients with reactive syphilis tests considered newly diagnosed syphilis infection (no history of syphilis infection reported in the system) and requiring follow-up treatment.

A qualitative study reported on patient values and preferences, feasibility and equity for syphilis screening in males accessing HIV care (40). Most males were in favour of routinely testing for syphilis as part of conventional HIV care. The routine method was thought to have a destigmatizing effect on syphilis testing. From the patient's point of view, HIV care clinics are easy locations to be tested for syphilis. Reekie *et al.* reported (34) the feasibility of opt-out screening in a short-term correctional facility for individuals younger than 35 years in Alberta, Canada. They reported that opt-out screening at admission is feasible and can improve STI testing in high-risk individuals experiencing incarceration in Canada (34,40).

Four cost effectiveness modelling studies examining either risk-based screening or interval screening were included (41–44). The modelling studies were based in Canada, the US, Germany and Australia. The studies did not directly compare the cost effectiveness of risk-based screening to interval screening for syphilis. Studies also focused primarily on high-risk population groups, such as gbMSM, people living with HIV and sex workers.

Generally, targeted screening at three or six-month intervals was considered more cost-effective compared to universal annual screening in these populations (41–44).

Recommendations

Following the review of available evidence, NAC-STBBI recommends the following two recommendations for healthcare professionals. Recommendations developed by NAC-STBBI are made at the population level. It is important to note that they may not apply to specific individuals within those groups, particularly as it relates to groups and communities who may have higher rates of syphilis when compared to the general public. It is always essential to consider each case on an individual basis in the context of the risk behaviours and epidemiological factors outlined in the recommendation. The full statement contains a more detailed explanation of the recommendations, dissemination, implementation, monitoring and evaluation.

Syphilis screening for sexually active adults and adolescents

NAC-STBBI recommends syphilis screening in all sexually active persons with a new or multiple partners and/or upon request of the individual. NAC-STBBI recommends screening every three to six months in individuals with multiple partners. (***Strong recommendation, moderate certainty of evidence***)

Syphilis screening for high prevalence groups/ communities

NAC-STBBI recommends that targeted opt-out screening programs should be considered as frequently as every three months when serving population groups and/or communities experiencing high prevalence of syphilis (and other STBBI), such as gbMSM, people living with HIV, people who are or have been incarcerated, people who use substances and/or access addiction services and/or some Indigenous communities. (***Strong recommendation, moderate certainty of evidence***)

Screening programs should consider aligning screening with other health services ("opportunistic screening") for individuals living with HIV and other individuals at increased risk accessing care services. Opportunistic screening is defined as offering screening when an individual is accessing non-emergency health services and has not undergone recent STBBI testing.

Screening programs should consider local epidemiology when determining which groups/communities to target and for a specific individual, travel history and patient risk factors need to be considered.

Discussion

When determining who to screen for syphilis and other STBBIs, providers should consider the individual risk factors for the person seeking care. Nurses and physicians therefore must discuss these factors with the individual to determine their sexual health history and identify the appropriate screening tests. Unfortunately, many individuals may not feel comfortable discussing their sexual health due to stigma and/or prior poor experience with the healthcare system. Additionally, individuals will often underestimate their own personal risk when it comes to STBBI. To address these challenges, healthcare providers are encouraged to consider implementing strategies such as an opt-out approach to screening, thereby removing the need for an in-depth discussion on the person's sexual history. These programs have experienced greater success compared to opt-in programs in certain settings. Applying opt-out programs can further normalize STBBI screening and help reduce the discomfort and, more importantly, stigma related to sexual health.

Healthcare providers should also consider offering screening when patients are accessing other non-emergency healthcare services to increase instances of STBBI screening. Opportunistic screening for STBBI is a mechanism healthcare providers should consider implementing for individuals with limited or infrequent access to care. Regardless of whether the individual is there for STBBI-related care, healthcare providers should take the opportunity to determine when they last underwent STBBI screening and offer it as appropriate. Screening can occur as frequently as every three months for individuals who engage in behaviours that increase their risk level (e.g., multiple partners) or are part of a high prevalence population (e.g., people who use substances). Importantly, normalizing and standardizing the offering of STBBI screening can help mitigate and reduce the perception of stigma.

Healthcare providers must also be aware of the increasing rates of congenital syphilis across Canada. There were 117 cases of confirmed congenital syphilis in 2022, compared to only eight cases in 2017, representing an increase of more than 1,300%. Additionally, cases of infectious syphilis among females increased by 720% over that span (6,42). It is essential that healthcare providers be mindful of these trends when providing care to females of childbearing age (approximately ages 15–45 years) to ensure the proper STBBI screening is offered. Care providers are reminded that universal STBBI screening is recommended in all pregnant people.

It should be noted that much of the evidence used to develop these recommendations were focused on gbMSM populations and individuals living with HIV. Considering that gbMSM populations continue to have higher rates of STBBI infections compared with other communities and that individuals living with HIV are at increased risk of acquiring other STBBI, the

recommendations may overestimate the frequency of screening needed in the public. Additionally, the rapidly changing epidemiology has resulted in significant change to the incidence and prevalence of syphilis, which can result in certain studies becoming quickly outdated when the population being assessed no longer reflects the population being impacted by the bacteria. Ongoing review and monitoring of the most up-to-date surveillance data is integral to ensure individuals/populations with high infection prevalence are identified quickly.

Prioritizing STBBI research on the general public should be considered given studies focused on the general population are lacking and can result in a gap in the evidence. Extrapolating evidence from these groups to apply to the general population is not always feasible given significant differences in population groups and their respective risk factors.

Conclusion

Recent increases in rates of infectious syphilis and congenital syphilis can be addressed and mitigated through proper screening. It is important for healthcare providers to be aware of the growing public health burden of syphilis so that cases can be identified, treated and the onward transmission of the infection interrupted. Overall, NAC-STBBI recommends that syphilis screening should be offered to all sexually active persons with a new or multiple partners and/or upon request of the individual. NAC-STBBI recommends that screening should be offered every three to six months in individuals with multiple partners. They also agreed that targeted opt-out screening programs should be considered as frequently as every three months for health services serving population groups and/or communities experiencing a high prevalence of syphilis (and other STBBI). The certainty of the evidence for the screening of syphilis is moderate.

Authors' statement

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Competing interests

None.

Acknowledgements

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Funding

The systematic review was supported by the Public Health Agency of Canada (PHAC). The authors have no sources of external funding to declare. The National Advisory Committee on Sexually Transmitted and Blood-Borne Infections (NAC-STTBI) is supported by PHAC.

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Appendix

Table A1: Evidence profiles

Question 1: Should [risk-based approaches] vs. [population wide/interval screening approaches] be used for [syphilis screening among sexually active adolescents and adults]?	
Outcome	**Evidence**
Risk-based screening vs. interval screening	
Syphilis screening Number of serological tests performed (1 RCT) (25)	Average annual number of syphilis tests per individual increased from 0.53 to 2.02 tests Time-adjusted rate ratio: 2.03 (1.85–2.22)
Untreated early syphilis cases diagnosed (1 RCT) (25)	With intervention, the annualised proportion of newly identified early syphilis increased from 0.009 to 0.032
Annual screening (1 RCT) (25)	The odds of annual screening increased nearly 4-fold
Certainty of evidence	⊕⊕⊕◯[a] MODERATE Imprecision
Comparison of annual, 3-month and 6-month screening intervals	
Number/proportion of serological tests performed (5 observational studies) (28,29,32,33,37)	The inclusion of routine syphilis serology taken as part of HIV monitoring resulted in a marked increase in the proportion of HIV-positive MSM diagnosed with asymptomatic syphilis
Certainty of evidence	⊕⊕⊕◯ MODERATE[b,c] Risk of bias
Projected number of reported incident syphilis cases from studies using modelling (38,39)	Increasing the frequency of syphilis screening to every three months was the most effective strategy for reducing infectious syphilis cases Focused screening was more effective than universal screening Enhanced screening of MSM with prior syphilis may efficiently reduce transmission, especially when identification of high-risk men via self-reported partner numbers or high-frequency screening is difficult to achieve
Opt-in vs. opt-out approach	
Diagnosed higher new syphilis cases (4 observational studies) (31,34–36)	Opt-out screening: Diagnosed higher new syphilis cases (case-finding rate). Opt-out: 7.3% (150/2,053 tests); opt-in 7.1% (150/1,995 tests) Number of syphilis tests per man increased from 1.3 in 2006 to 2.2 in 2007 (p<0.01) In 2010, the proportion of men having ≥3 syphilis tests in a year was highest in the clinics with the opt-out strategy (48%; range: 35%–59%) compared to the opt-in (39%, p=0.12) and risk-based (8.4%; range: 5.4%–12%, p<0.01)
Certainty of evidence	⊕⊕⊕◯ MODERATE[b,c] Risk of bias
Syphilis screening as part of HIV viral load testing	
Syphilis tests on the same day as HIV viral loads (1 observational study) (30)	In 2010, same day tests was highest in clinics with the opt-out strategy (87%; range: 84%–91%), compared with opt-in (74%, p=0.121), and risk-based (22%; range: 20%–24%, p<0.01)
Certainty of evidence	⊕⊕◯◯ LOW[a,b,c] Risk of bias, imprecision
Number of syphilis tests (1 observational study) (30)	Over 50.8% of incident syphilis cases were asymptomatic and were only identified through routine screening
Certainty of evidence	⊕⊕◯◯ LOW[a,b,c] Risk of bias, imprecision

Abbreviations: MSM, men who have sex with men; RCT, randomized control trial
[a] Total number does not meet the optimum sample size
[b] One arm of the study was considered and the authors did not mention any information related to the use of an appropriate analysis method that adjusted for all the critically important confounding domains
[c] It was a retrospective study and the authors did not mention any information related to the use of an appropriate analysis method that adjusted for all the critically important confounding domains

SURVEY REPORT

Exploring the need for sexually transmitted infection education among university student athletes in Saskatchewan

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Abstract

Background: Sexually transmitted infections (STIs) are common in young adults in Canada and their prevalence is rising. Assessing sexual health knowledge among young adults is essential for developing effective STI education strategies. However, there is limited research on the sexual health knowledge of Canadian university athletes, who have increased risks of STIs.

Objective: To determine perceived and objective levels of knowledge on STIs among university athletes and their preferred methods of knowledge translation regarding sexual health information.

Methods: U SPORTS athletes at the University of Saskatchewan and the University of Regina were invited to complete an electronic survey between January–March 2022. Participants completed the Sexual Transmitted Disease Knowledge Questionnaire (STD-KQ) and self-reported their confidence in their answers. Participants were asked about testing beliefs, where they receive their sexual health information and their preferred format for STI information delivery.

Results: One hundred participants completed the survey (14% response rate). Participants had a median composite self-reported STI knowledge score of 2.8 out of 5 (interquartile range [IQR]: 2.4–3.6). The median participant scored 12 out of 27 (44%) on the STD-KQ (IQR: 8–17). Sixty-seven percent of participants received sexual health information from a physician. Sixty-one percent of participants believed embarrassment may prevent them from getting tested or screened. The three most popular methods of health information sharing were online modules (34%), in-person lectures/conferences (24%) and self-paced videos (20%).

Conclusion: This study highlighted that STI knowledge is limited in university athletes. Comprehensive online educational interventions may be effective at improving knowledge.

Suggested citation: Hedayat I, Steinberg N, Akhtar S, Clay AT, Frost DR. Exploring the need for sexually transmitted infection education among university student athletes in Saskatchewan. Can Commun Dis Rep 2024;50(7/8):241–9. https://doi.org/10.14745/ccdr.v50i78a02

Keywords: sexually transmitted infections, knowledge, athletes, survey, Saskatchewan, universities, educational needs assessment, college

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Introduction

Sexually transmitted infections (STIs) are common in young adults in Canada and their prevalence is rising (1). With few exceptions, STIs are not vaccine-preventable. Though many STIs are asymptomatic and almost all are either treatable or curable, many complications can result from contracting an STI. These can include infertility, life-threatening complications and increased risk of cancer. Additionally, treatment-resistant STIs have emerged, which highlights the need for both education on STI treatment and prevention (2).

Research on the university and college student population has focused on sexual health behaviours and negative health

outcomes (3). However, sexual health knowledge may impact sexual behaviour and health-seeking behaviour of young adults. Lack of knowledge may lead to delayed treatment (4), which can lead to complications. Few studies have focused on the sexual health knowledge among university students, but the literature suggests students outside of Canada generally have a low level of sexual health knowledge (5–7).

Relative to non-athletes, university and college athletes may be at an increased risk, as they report more sexual partners, unsafe sex and drinking before or during sex (8,9). A study from South Africa found significant limitations in knowledge about STIs in college athletes (10). English athletes in the SPORTSMART trial were found to engage in riskier sexual practices than age-matched counterparts who were not athletes (9). Limitations in knowledge and high-risk sexual activity may put university athletes at increased risk of contracting and transmitting STIs, compared to the general population.

Comprehensive sexual education can influence sexual practices (11,12). Assessing sexual health knowledge among young adults is essential for developing effective STI education strategies (13). To our understanding, there has been no published research on the sexual health knowledge of Canadian university athletes. As such, we sought to determine perceived and objective levels of knowledge on STIs among athletes at two Canadian universities. To inform the design of effective educational interventions, we also sought to determine sources of health information for athletes and their preferred methods of knowledge translation regarding sexual health information.

Methods

All athletes governed by the national body for university sports (U SPORTS) at the University of Regina (n=314) and University of Saskatchewan (n=424) were invited to participate in an anonymous online survey in January 2022. Athletes, who were all registered students meeting course load requirements, were invited by e-mails sent by the Athletic Director (University of Saskatchewan) or by the student athletics website (University of Regina) to participate in the survey hosted on SurveyMonkey. Participants were informed of the option to participate in a prize draw for one of four $75 gift cards as an incentive for participation. A reminder to complete the survey was sent in February 2022. The survey was open until March 2022. Athletes participated in the survey remotely at the time and place of their choice, without investigators present.

The survey consisted of demographic questions, the objective Sexually Transmitted Disease Knowledge Questionnaire (STD-KQ, which is a collection of validated true/false questions to assess knowledge of STIs) (14), and questions to evaluate self-reported STI knowledge (which was presented using a five-point Likert scale [range of "1=not at all confident" to "5=very confident"]). Additionally, participants were asked about what they believe is involved in STI testing, what they perceived as barriers to getting tested for STIs and preferred methods of health education delivery.

Descriptive statistics were calculated. Intergroup comparisons were performed using a Mann-Whitney U test (knowledge score), Fisher exact test, or chi-squared test, as appropriate. Spearman rank correlation coefficients were calculated to determine the relationship between self-reported knowledge and STD-KQ scores. Multiple linear regression was performed to predict STD-KQ scores from demographic variables (gender of sport team, age and university). Scores from the STD-KQ were the total number of correct answers, with a score of zero for wrong and a score of one for correct. "Don't know" answers were counted as wrong. All analysis was performed using the IBM SPSS version 28 statistical software. Since all athletes were invited to participate, a sample size was not calculated *a priori*.

This project was reviewed and approved by the University of Saskatchewan Research Ethics Board (Beh #3033) and received approval from athletics authorities at the University of Regina and the University of Saskatchewan prior to distribution. Participants provided consent by voluntarily starting the survey after being presented with a written informed consent form outlining its objective, how long it would take to complete and how personal information would be protected.

Results

The survey was started by 105 participants (14% response rate). One hundred participants provided information on demographics, practices and beliefs. Ninety-four completed the STD-KQ questionnaire (13%). The median age of the participants was 20 years (interquartile range [IQR]: 19–22 years). Fifty-five (55%) participants played on women's teams and 45 (45%) played on men's teams. Thirty-four (34%) were students at the University of Regina and 65 (65%) were students at the University of Saskatchewan. Athletes participated in track and field/cross country (n=34; 34%), ice hockey (n=20; 20%), wrestling (n=11; 11%), volleyball (n=10; 10%), football (n=8; 8%), soccer (n=8; 8%), basketball (n=6; 6%) and swimming (n=3; 3%).

Sexually transmitted infection knowledge

The median participant score on the STD-KQ was 12 out of 27 (44%; IQR: 8–17). A multiple regression was run to predict STD-KQ scores from gender of sports team, age and university. The variables did not predict knowledge (F(3,1.235), p=0.302, R^2=0.040). Responses to individual STD-KQ items are provided in **Appendix**, **Table A1**. When the self-reported confidence was averaged across the different STI knowledge areas (transmission, prevention, etc.) the median composite score was 2.8 out of 5 (IQR: 2.4–3.6), which roughly corresponds to the 'somewhat confident' option. There was a weak correlation (r_s=0.321, p=0.003) between average self-reported confidence in STI knowledge and objective STD-KQ scores.

Sexually transmitted infection beliefs and sources of health information

Athletes reported that they would seek STI screening or testing in a variety of settings (**Table 1**). They also specified what tests they believed would be involved and outlined several potential barriers to getting tested (Table 1). Similarly, athletes sought general and sexual health information from multiple sources and preferred online modules to learn about health topics (**Table 2**).

The results of this survey were used to propose recommendations for interventions aimed at improving STI knowledge and for linking university athletes with appropriate medical care (**Table 3**).

Table 1: Sexually transmitted infection screening practices and testing beliefs

Question stem	Question response options	Women (n=55)	Men (n=45)	Total (n=100)	*p*-value (men vs. women)
Where would you go for STI screening and/or testing?	Family doctor's office	18 (33%)	8 (18%)	26 (26%)	0.071
	Sexual health clinic	15 (27%)	6 (13%)	21 (21%)	
	Walk-in clinic	13 (24%)	17 (38%)	30 (30%)	
	Not sure	7 (13%)	13 (29%)	20 (20%)	
	Buy online STI testing kits	1 (2%)	0 (0%)	1 (1%)	
	Other	1 (2%)	1 (2%)	2 (2%)	
What do you believe STI testing involves?	Urine tests	50 (91%)	38 (84%)	88 (88%)	0.322
	Blood tests	48 (87%)	36 (80%)	84 (84%)	0.324
	Detailed sexual history	36 (65%)	14 (31%)	50 (50%)	<0.001
	Pap smear	26 (47%)	7 (16%)	33 (33%)	<0.001
	Examination of reproductive organs	22 (40%)	17 (38%)	39 (39%)	0.821
	Urethral swab	19 (35%)	12 (27%)	31 (31%)	0.397
	Semen tests	16 (29%)	10 (22%)	26 (26%)	0.436
	Rectal swab	15 (27%)	7 (16%)	22 (22%)	0.159
What might prevent you from getting STI screening and/or testing?	Embarrassment/uncomfortable conversations	36 (65%)	25 (56%)	61 (61%)	0.313
	Don't know where to go	18 (33%)	23 (51%)	41 (41%)	0.063
	Difficulty in getting an appointment	18 (33%)	8 (18%)	26 (26%)	0.090
	Worries that someone (partner(s), friends, family) would find out	16 (29%)	15 (33%)	31 (31%)	0.648
	Lack of time during business hours	15 (27%)	9 (20%)	24 (24%)	0.397
	Breach of confidentiality (specifically within your sports/ extracurricular activities)	12 (22%)	7 (16%)	19 (19%)	0.427
	Fear of invasive examination or testing (other than needles)	11 (20%)	6 (13%)	17 (17%)	0.377
	Fear of needles	4 (7%)	2 (4%)	6 (6%)	0.688
	Other	0 (0%)	2 (4%)	2 (2%)	0.198
	None of the above	6 (11%)	6 (13%)	12 (12%)	0.711

Abbreviation: STI, sexually transmitted infection

Table 2: Sources of health information

Question stem	Question response options	Women (n=55)	Men (n=45)	Total (n=100)	*p*-value (men vs. women)
Where do you get your health information from?	Your physician	44 (80%)	36 (80%)	80 (80%)	1.000
	Friends and family	36 (65%)	32 (71%)	68 (68%)	0.546
	Internet	33 (60%)	32 (71%)	65 (65%)	0.246
	Your physiotherapist	21 (38%)	27 (60%)	48 (48%)	0.030
	Other healthcare professional	20 (36%)	15 (33%)	35 (35%)	0.752
	Athletic therapist	18 (33%)	17 (38%)	35 (35%)	0.598
	Social media	12 (22%)	10 (22%)	22 (22%)	0.961

Table 2: Sources of health information (*continued*)

Questions		Women (n=55)	Men (n=45)	Total (n=100)	*p*-value (men vs. women)
Where do you get your health information from? (*continued*)	TV, radio, podcasts	7 (13%)	7 (16%)	14 (14%)	0.685
	Coach	6 (11%)	5 (11%)	11 (11%)	0.974
	School	4 (7%)	2 (4%)	6 (6%)	0.688
	Advertisement such as billboards or posters	1 (2%)	0 (0%)	1 (1%)	1.000
	Scientific articles	0 (0%)	1 (2%)	1 (1%)	0.450
Where do you get your sexual health information from?	Your physician	36 (65%)	31 (69%)	67 (67%)	0.716
	Friends and family	29 (53%)	19 (42%)	48 (48%)	0.296
	Social media	17 (31%)	12 (27%)	29 (29%)	0.641
	Other healthcare professional	9 (16%)	11 (24%)	20 (20%)	0.150
	School	7 (13%)	5 (11%)	12 (12%)	0.804
	Internet	6 (11%)	9 (20%)	15 (15%)	0.268
	TV, radio, podcasts	6 (11%)	7 (16%)	13 (13%)	0.492
	Your physiotherapist	2 (4%)	0 (0%)	2 (2%)	0.500
	Athletic therapist	1 (2%)	2 (4%)	3 (3%)	0.587
	Nobody	1 (2%)	0 (0%)	1 (1%)	1.000
	Scientific articles	0 (0%)	1 (2%)	1 (1%)	0.450
	Coach	0 (0%)	0 (0%)	0 (0%)	-
What method of information delivery do you prefer for health education?	Online modules	14 (25%)	20 (44%)	34 (34%)	0.130
	Self-paced videos	13 (24%)	7 (16%)	20 (20%)	
	In-person lecture/conference	12 (22%)	12 (27%)	24 (24%)	
	In-person course	8 (15%)	4 (9%)	12 (12%)	
	Handouts	8 (15%)	2 (4%)	10 (10%)	

Abbreviation: -, not applicable

Table 3: Summary of potential interventions

Interventions	Considerations
Comprehensive STI education	• Online and self-paced video preferred ◦ Some online courses exist but effectiveness has not been fully evaluated • Same education could be targeted to multiple athlete demographic groups • Provide athletes with the information, motivation and behavioural skills to enhance their sexual health (not just information aimed at avoiding negative health outcomes)
Digital literacy skills	• Digital literacy skills are needed to enable athletes to find accurate and unbiased sexual health information online
Access to clinical services	• Physicians were most frequent source of sexual health information • Preparticipation physicals may be an opportune time to provide STI screening and testing information • Provide athletes with a list of local sexual health services in that specific community/campus

Abbreviation: STI, sexually transmitted infection

Discussion

Participants demonstrated low knowledge of STIs, as assessed by the STD-KQ. This study found that 20% of participants were unsure of where to go to get STI testing locally and many had false beliefs related to what this testing would involve. For example, 47% of female participants thought that STI testing included a Pap smear. Participants were asked to indicate, "I don't know", in their STD-KQ responses if they did not know the answer, but many incorrect responses were provided. This suggests that participants may be receiving and believing incorrect sexual health information, which highlights the need for reliable sources.

Previous studies have used a wide range of measurement tools and sexual health knowledge outcomes (15). This makes direct comparison challenging, but this study's findings are consistent with previous studies that found gaps in knowledge about STI transmission and prevention (10). To the authors' understanding, this is the first study identifying limited STI knowledge among Canadian university athletes. The results of this survey were used to propose recommendations for interventions aimed at

improving STI knowledge and for linking university athletes with appropriate medical care (Table 3), which are described in more detail below.

Sports-based educational interventions have been found to increase STI knowledge and condom use (16). Our study provides information that can be used in designing effective educational interventions targeting athletes at Canadian universities. While many of the previous studies focused on a single-sex in a specific sport, this study found that the demographic variable did not predict STD-KQ scores. There was only a weak correlation between the objectively measured STD-KQ and self-reported STI knowledge. Considering this, an educational intervention could be targeted at university athletes, regardless of sex or self-perceived knowledge.

This is the first study to investigate what type of educational materials athletes prefer for STI information. The administered survey suggests that online modules and self-paced videos are popular in this population. This study's results are consistent with others (17) in showing that young people use the internet to find general and sexual health information. This suggests that online modules might be effective tools for student athletes. Online sexual health education has been developed for some target groups, but the effectiveness of these interventions has not been fully evaluated (18). The high use of the internet for information-seeking also highlights the importance of teaching digital literacy skills to athletes to enable them to find accurate and unbiased sexual health information online.

Sexual health education programs are most effective when combined with access to clinical services (19). There were multiple potential barriers identified concerning STI screening and testing, many of which may have simple solutions. In terms of athletes not knowing where to go for testing, this could be addressed in a comprehensive educational intervention, or advertisements could be created that identify where these services are available within a community. Another option would be bringing testing services to athletes and students. For example, when testing kits and information were made readily available in a team's change rooms, there was an increased identification of STIs and an increased ability to provide one-on-one counselling and treatment (9,20,21). However, this may be less effective in the setting used for this study, as participants identified embarrassment/uncomfortable conversations and fear of people finding out that they are getting STI testing as potential barriers. This study also showed that physicians were the top source of general and sexual health information for participants. Thus, a potential location for STI intervention could be during the preparticipation physical examinations completed by an athlete's physician before competition, which would allow for more private access to sexual health resources. Inclusion of STI screening has been suggested (22), but is not included in guidelines for preparticipation physical examinations (23). One reason may be limited time during these preparticipation physicals, which already include many aspects of athlete health. However, it would take little time for a physician conducting a physical with an athlete to encourage the athlete to be screened for STIs regularly and to potentially provide the athlete with information or resources to then follow-up on in the near future.

Limitations

There were some limitations to our research. While our survey was sent to all eligible athletes from two universities, there is the potential for non-response bias. The survey had respondents from each of the U SPORTS sports teams. However, the proportion of survey respondents from a particular sport did not match the proportion of U SPORT athletes overall (e.g., football players represented only 8.8% of survey respondents but represent 24% of U SPORT athletes at the two universities). U SPORT athletes are less ethnically diverse and women are underrepresented when compared to the overall population of Canadian universities (24,25). Thus, the results for this study should not be generalized to the overall student population. This study focused on levels of knowledge about STIs. Sexual health education should provide athletes with the information, motivation and behavioural skills to enhance their sexual health and not just information aimed at avoiding negative health outcomes (19). Additionally, it is assumed that self-reported preferences among students for types of educational materials will be reflected in their tendency to use these materials, as well as in their ability to retain adequate knowledge from them.

Future studies could be completed within other institutions in Canada to see if the findings are replicable. Future research could look at the uptake and effectiveness of various methods of providing sexual health education. Finally, another area of research could investigate whether these educational interventions result in changes in behaviour towards obtaining STI screening, testing and treatment for STIs and improving sexual wellbeing.

Conclusion

Participants self-reported an intermediate knowledge and had a median score of 44% on the STD-KQ. A comprehensive online educational intervention may be effective at improving knowledge and sexual wellbeing, as would incorporate information about STI screening and testing into preparticipation physicals.

Authors' statement

IH — Conceptualization, methodology, writing–original draft
NS — Conceptualization, methodology, writing–original draft
SA — Conceptualization, methodology, writing–original draft
ATC — Conceptualization, formal analysis, methodology, writing–review & editing
DRF — Conceptualization, methodology, writing–review & editing, supervision

The contents of this article and the opinions expressed therein are those of the authors and do not necessarily reflect those of the Government of Canada.

Competing interests
None.

Acknowledgements
The authors have no disclosures to acknowledge. The authors would like to thank Dr. Kim Dorsch and Ms. Adrienne Healey for their assistance in distributing the surveys to student athletes. We would also like to thank Mr. Lance Fox for his assistance with the literature review.

Funding
Funding for the participant incentive was provided by the Resident Scholarship Fund, Department of Academic Family Medicine, University of Saskatchewan.

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Appendix

Survey questions are available upon request to the author at: drf575@usask.ca

Table A1: Responses to the sexual transmitted disease knowledge questionnaire

Question stem	Question response options	Women	Men	Total
Genital herpes is caused by the same virus as HIV	True	8 (15%)	2 (5%)	10 (11%)
	False[a]	16 (31%)	19 (45%)	35 (37%)
	Don't know	28 (54%)	21 (50%)	49 (52%)
Frequent urinary infections can cause chlamydia	True	3 (6%)	5 (12%)	8 (9%)
	False[a]	22 (42%)	9 (21%)	31 (33%)
	Don't know	27 (52%)	28 (67%)	55 (59%)
There is a cure for gonorrhea	True[a]	24 (46%)	21 (51%)	45 (48%)
	False	7 (13%)	1 (2%)	8 (9%)
	Don't know	21 (40%)	19 (46%)	40 (43%)
It is easier to get HIV if a person has another sexually transmitted disease	True[a]	14 (27%)	8 (19%)	22 (23%)
	False	13 (25%)	10 (24%)	23 (24%)
	Don't know	25 (48%)	24 (57%)	49 (52%)
Human papillomavirus (HPV) is caused by the same virus that causes HIV	True	8 (15%)	3 (7%)	11 (12%)
	False[a]	17 (33%)	14 (33%)	31 (33%)
	Don't know	27 (52%)	25 (60%)	52 (55%)
Having anal sex increases a person's risk of getting hepatitis B	True[a]	15 (29%)	7 (17%)	22 (23%)
	False	8 (15%)	7 (17%)	15 (16%)
	Don't know	29 (56%)	28 (67%)	57 (61%)

Table A1: Responses to the sexual transmitted disease knowledge questionnaire (*continued*)

Question stem	Question response options	Women	Men	Total
Soon after infection with HIV a person develops open sores on his or her genitals (penis or vagina)	True	11 (21%)	1 (2%)	12 (13%)
	False[a]	18 (35%)	16 (38%)	34 (36%)
	Don't know	23 (44%)	25 (60%)	48 (51%)
There is a cure for chlamydia	True[a]	35 (67%)	29 (69%)	64 (68%)
	False	6 (12%)	1 (2%)	7 (7%)
	Don't know	11 (21%)	12 (29%)	23 (24%)
A woman who has genital herpes can pass the infection to her baby during childbirth	True[a]	29 (58%)	18 (44%)	47 (52%)
	False	4 (8%)	1 (2%)	5 (5%)
	Don't know	17 (34%)	22 (54%)	39 (43%)
A woman can look at her body and tell if she has gonorrhea	True	3 (6%)	2 (5%)	5 (5%)
	False[a]	27 (52%)	16 (38%)	43 (46%)
	Don't know	22 (42%)	24 (57%)	46 (49%)
The same virus causes all of the sexually transmitted diseases	True	0 (0%)	0 (0%)	0 (0%)
	False[a]	44 (85%)	30 (71%)	74 (79%)
	Don't know	8 (15%)	12 (29%)	20 (21%)
Human papillomavirus (HPV) can cause genital warts	True[a]	11 (21%)	11 (27%)	22 (24%)
	False	4 (8%)	0 (0%)	4 (4%)
	Don't know	37 (71%)	30 (73%)	67 (72%)
Using a natural skin (lambskin) condom can protect a person from getting HIV	True	15 (29%)	12 (29%)	27 (29%)
	False[a]	13 (25%)	10 (24%)	23 (24%)
	Don't know	24 (46%)	20 (48%)	44 (47%)
Human papillomavirus (HPV) can lead to cancer in women	True[a]	21 (40%)	16 (38%)	37 (39%)
	False	4 (8%)	0 (0%)	4 (4%)
	Don't know	27 (52%)	26 (62%)	53 (56%)
A man must have vaginal sex to get genital warts	True	2 (4%)	2 (5%)	4 (4%)
	False[a]	40 (77%)	31 (74%)	71 (76%)
	Don't know	10 (19%)	9 (21%)	19 (20%)
Sexually transmitted diseases can lead to health problems that are usually more serious for men than women	True	4 (8%)	3 (7%)	7 (7%)
	False[a]	25 (48%)	16 (38%)	41 (44%)
	Don't know	23 (44%)	23 (55%)	46 (49%)
A woman can tell that she has chlamydia if she has a bad smelling odour from her vagina	True	19 (37%)	7 (17%)	26 (28%)
	False[a]	12 (23%)	14 (33%)	26 (28%)
	Don't know	21 (40%)	21 (50%)	42 (45%)
If a person tests positive for HIV the test can tell how sick the person will become	True	2 (4%)	1 (2%)	3 (3%)
	False[a]	39 (75%)	26 (62%)	65 (69%)
	Don't know	11 (21%)	15 (36%)	26 (28%)
There is a vaccine available to prevent a person from getting gonorrhea	True	6 (12%)	0 (0%)	6 (6%)
	False[a]	22 (42%)	14 (33%)	36 (38%)
	Don't know	24 (46%)	28 (67%)	52 (55%)
A woman can tell by the way her body feels if she has a sexually transmitted disease	True	8 (15%)	4 (10%)	12 (13%)
	False[a]	29 (56%)	16 (39%)	45 (48%)
	Don't know	15 (29%)	21 (51%)	36 (39%)

Table A1: Responses to the sexual transmitted disease knowledge questionnaire (*continued*)

Question stem	Question response options	Women	Men	Total
A person who has genital herpes must have open sores to give the infection to his or her sexual partner	True	10 (19%)	9 (21%)	19 (20%)
	False[a]	27 (52%)	12 (29%)	39 (41%)
	Don't know	15 (29%)	21 (50%)	36 (38%)
There is a vaccine that prevents a person from getting chlamydia	True	2 (4%)	1 (2%)	3 (3%)
	False[a]	26 (50%)	18 (43%)	44 (47%)
	Don't know	24 (46%)	23 (55%)	47 (50%)
A man can tell by the way his body feels if he has hepatitis B	True	4 (8%)	1 (2%)	5 (5%)
	False[a]	16 (31%)	17 (40%)	33 (35%)
	Don't know	32 (62%)	24 (57%)	56 (60%)
If a person had gonorrhea in the past, he or she is immune (protected) from getting it again	True	0 (0%)	1 (2%)	1 (1%)
	False[a]	31 (60%)	17 (40%)	48 (51%)
	Don't know	21 (40%)	24 (57%)	45 (48%)
Human papillomavirus (HPV) can cause HIV	True	2 (4%)	2 (5%)	4 (4%)
	False[a]	12 (23%)	14 (33%)	26 (28%)
	Don't know	38 (73%)	26 (62%)	64 (68%)
A man can protect himself from getting genital warts by washing his genitals after sex	True	4 (8%)	3 (7%)	7 (7%)
	False[a]	26 (50%)	17 (40%)	43 (46%)
	Don't know	22 (42%)	22 (52%)	44 (47%)
There is a vaccine that can protect a person from getting hepatitis B	True[a]	35 (67%)	19 (45%)	54 (57%)
	False	7 (13%)	4 (10%)	11 (12%)
	Don't know	10 (19%)	19 (45%)	29 (31%)

[a] Correct response

Acceptability, feasibility, equity and resource use for prenatal screening for chlamydia and gonorrhea: A systematic review

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Abstract

Background: A systematic review on acceptability, feasibility, equity and resource use was conducted as part of updating recommendations from the Public Health Agency of Canada on prenatal screening for *Chlamydia trachomatis* (CT) and *Neisseria gonorrhoeae* (NG).

Methods: Information sources, including MEDLINE® All, Embase and Cochrane CENTRAL (January 2003–January 2021) electronic databases were searched for studies that assessed acceptability, feasibility, equity and resource use of screening for CT or NG in pregnant persons aged ≥12 years. The Risk of Bias Assessment Tool for Non-Randomized Studies was used for quality assessment and a narrative synthesis was prepared.

Results: Of the 1,386 records identified, nine observational studies (approximately 5,000 participants) and three economic evaluations met the inclusion criteria. In general, pregnant persons and healthcare providers accepted screening. Most pregnant persons and partners supported universal testing for CT. Pregnant persons preferred non-invasive sampling methods. Inequities in feasibility (accessibility to screening) exist in certain populations. Studies have shown that targeted screening can miss cases. Screening all pregnant persons for CT has net cost savings compared to no screening. Limitations include not identifying eligible literature on acceptability of prenatal screening for NG among partners of pregnant persons and some studies with increased risk populations that restrict the generalizability of the findings highlighting areas for future research.

Conclusion: Prenatal screening for CT and NG is generally acceptable among pregnant persons and healthcare providers. Evidence has shown that targeted screening can miss cases. The findings were included when updating PHAC's recommendations on prenatal screening for CT and NG. This work was presented at the Society of Obstetricians and Gynaecologists of Canada's 2024 Annual Clinical and Scientific Conference in Edmonton, Alberta.

Suggested citation: Shanmugasegaram S, Auguste U, Fleurant-Ceelen A, Sabourin S, Labbé AC, Bullard J, Ogilvie G, Yudin MH, Santesso N. Acceptability, feasibility, equity and resource use for prenatal screening for chlamydia and gonorrhea: A systematic review. Can Commun Dis Rep 2024;50(7/8):250–8. https://doi.org/10.14745/ccdr.v50i78a03

Keywords: chlamydia, gonorrhea, pregnancy, antenatal, prenatal, screening, testing, acceptability, feasibility, equity, resource use

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Introduction

In Canada, *Chlamydia trachomatis* (CT) and *Neisseria gonorrhoeae* (NG) are the most common reported sexually transmitted infections (STIs), with rates markedly increasing between 2010 and 2019 (CT, 33.1% and NG, 181.7%) (1). In 2010, 94,716 cases of CT and 11,381 cases of NG were reported in Canada, corresponding to rates of 278.5 and 33.5 per 100,000 population, respectively (1,2). In 2019, 139,386 cases of CT and 35,443 cases of NG were reported in Canada, corresponding to rates of 370.8 and 94.3 per 100,000 population, respectively (1,2).

Chlamydia trachomatis and NG infections are often asymptomatic in females and can go undetected. In pregnant women/pregnant individuals (PWPI), this can lead to adverse outcomes. If the birthing parent has not received an effective treatment during the perinatal period, infection can potentially be transmitted to the neonate during delivery and lead to adverse neonatal health outcomes. If left untreated, CT in the birthing parent carries a 30%–50% risk of the neonate developing ophthalmia neonatorum and 10%–20% risk of developing CT pneumonia (3). *Neisseria gonorrhoeae* infection in the birthing parent carries a 30% risk of the neonate developing gonococcal ophthalmia neonatorum (4,5). Potential consequences of ophthalmia neonatorum include permanent visual impairment. There is lack of national surveillance information on gonococcal ophthalmia neonatorum, chlamydial ophthalmia neonatorum and neonatal pneumonia cases.

In 2010, the Public Health Agency of Canada (PHAC) recommended that all pregnant women should be evaluated for STI risk factors prior to and during pregnancy. Any woman with ongoing risk factors for STI acquisition during pregnancy should be considered for rescreening each trimester (6). In 2010, PHAC also recommended screening for CT early in pregnancy. Repeat screening should be performed in the third trimester for women at continuing risk for STI acquisition (6). In 2016 (reaffirmed in 2021), the Canadian Paediatric Society stated, "Neonatal ocular prophylaxis with erythromycin, the only agent currently available in Canada for this purpose, may no longer be useful and, therefore, should not be routinely recommended" (7). Variation in practice exists with regard to offering neonatal ocular prophylaxis to prevent ophthalmia neonatorum. Evidence shows that approximately 15%–22% of PWPI are not being screened for CT and NG (8–10). Screening and testing for these infections could help prevent adverse pregnancy and neonatal outcomes.

Given the increasing rates of reported cases of CT and NG in the general population and suboptimal rates of prenatal screening for CT and NG in Canada (8–10), the National Advisory Committee on Sexually Transmitted and Blood-Borne Infections (NAC-STBBI) reviewed and updated PHAC's recommendations on prenatal screening for CT and NG. Canada's Drug Agency (CDA-AMC), formerly Canadian Agency for Drugs and Technologies in Health (CADTH) conducted a health technology assessment (HTA) (11). The main objective of PHAC's systematic review was to search, identify and synthesize relevant literature on acceptability, feasibility, equity and resource use on prenatal screening for CT and NG to support updating of the PHAC recommendations based on the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach (12–14) *(unpublished document, Shanmugasegaram S/Public Health Agency of Canada, Methods Manual for the Public Health Agency of Canada Sexually Transmitted and Blood-Borne Infections Recommendations, 2019)*.

Methods

According to the GRADE approach, the determinants of the strength and direction of guideline recommendations include acceptability among stakeholders, feasibility of the intervention, equity (the likelihood to reduce inequities or increase equity) and resource implications (resource intensity) of the intervention (12,13). In alignment with the GRADE approach, this systematic review aimed to assess the domains of acceptability, feasibility, equity and resource use for prenatal screening for CT and NG. **Table 1** shows the eligibility criteria for study selection.

Table 1: Eligibility criteria

Criteria	Description
Population	Pregnant adults and adolescents (12 years of age and older, up to and including delivery)
Intervention(s)	A screening strategy involving: • Nucleic Acid Amplification Test (NAAT) for CT and NAAT or culture for NG • Urine, vaginal, or cervical samples for NAATs; urethral or endocervical samples for cultures • A universal or targeted approach • Any timing (i.e., the point during pregnancy at which the screening test is performed) • Any frequency (i.e., number of times the screening test is conducted during pregnancy) • Any subsequent management of pregnant persons with confirmed infection, including no active management
Comparator(s)	An alternative screening strategy conducted with an alternative test, specimen, approach, timing, different frequencies, any subsequent management strategy for pregnant persons with confirmed infection (including no management), as well as no screening strategy
Outcome(s)	Studies should assess one or more of the following factors: • Acceptability of any strategy to screen for CT or NG during pregnancy from the perspective of any stakeholder • Feasibility/quality of implementation of any strategy to screen for CT or NG during pregnancy • Cost/resources or cost effectiveness • Equity of any strategy to screen for CT or NG during pregnancy including socioeconomic status, age, race/ethnicity, religion, geographical location (urban/rural), education level, income level and health insurance coverage ◦ The following definition of equity by the World Health Organization (WHO) (15) was used for this systematic review: "the absence of avoidable, unfair, or remediable differences between groups of people, whether those groups are defined socially, economically, demographically or geographically or by other means of stratification. Health equity or equity in health implies that ideally, everyone should have a fair opportunity to attain their full health potential and that no one should be disadvantaged from achieving this potential"
Types of studies	Any study design, except for the following: case studies, case reports of an individual patient, letters, commentaries, opinion pieces and editorials
Type of setting	Studies conducted in Australia, Canada, the European Economic Area, New Zealand, the United Kingdom or the United States of America
Timeframe	Studies published between January 1, 2003, and January 14, 2021

Abbreviations: CT, *Chlamydia trachomatis*; NG, *Neisseria gonorrhoeae*

Information sources

Studies were identified by searching electronic databases, scanning reference lists of included articles and consulting subject matter experts from the NAC-STBBI. The CDA-AMC HTA report on screening for CT and NG during pregnancy, consisting of a review of the clinical literature, an economic analysis and a review of qualitative studies on patients' preferences and experiences (11), was also reviewed to identify relevant studies. In consultation with an external methodology expert, the GRADE search strategy tool (not yet validated) for identifying published literature on acceptability, feasibility, equity and resource use was modified to avoid limiting the search by country. During screening, studies conducted in countries comparable to Canada's healthcare context were included in the review.

A Health Canada librarian incorporated the modified GRADE search strategies within the original CDA-AMC HTA clinical review search strategy. The MEDLINE search strategy was reviewed by the evidence review team. MEDLINE® All, Embase and the Cochrane Central Register of Controlled Trials (Cochrane CENTRAL) were searched on the Ovid platform from 2003 to present (January 14, 2021). The search start year of 2003 was informed by PHAC's laboratory diagnosis recommendations of STIs (16). No study design limit was applied and language was limited to English or French. The search strategies for the three databases are presented **in Appendix**, **Supplemental material**, **Appendices A to F**. Results from the original search were exported on September 19, 2019, and results from the update search were exported on January 14, 2021 (to identify any relevant new studies published since June 1, 2019). RefWorks was used to remove duplicates and store the citations. Microsoft Excel databases were used to record the process.

Study selection and data extraction

For the original search, the number of retrieved records was split among three individuals and screened by title and abstract based on inclusion criteria. For the update search, the retrieved records were independently screened by two individuals. For both searches, any differences were resolved through discussion between the reviewers or in consultation with another individual. Any uncertainty in the inclusion of titles and abstracts led to the retrieval of the full text article.

Any full text articles that were not available online were retrieved via the PHAC library. For the original search, the number of selected full text articles was split among three individuals and assessed based on inclusion criteria, which were then verified by another individual. For the update search, one individual assessed the selected full text articles based on inclusion criteria, which were then verified by two individuals. For both searches, any differences were resolved through discussion between the reviewers and in consultation with another individual.

A data extraction form was developed, pilot-tested on two randomly selected included studies and revised accordingly. Reviewers were trained on extracting data using the form by the primary author. For the original search, the number of articles that met the inclusion criteria was split among three individuals who then extracted data and another individual verified the extracted data. For the update search, an individual extracted data from the articles that met the inclusion criteria and two individuals verified the extracted data. The information extracted from each study included study design, study funding source, number of participants, participant age, race/ethnicity, study duration, country where the study was conducted, setting, intervention(s) and results on acceptability, feasibility, equity and resource use. The data extraction form template is presented in Supplemental material, **Appendix G**.

Quality assessment

The Risk of Bias Assessment Tool for Non-Randomized Studies (RoBANS) was used for quality assessment of the included observational studies (17). The RoBANS tool consists of six domains and a judgment of "high", "low" or "unclear" can be assigned to each domain. Each included study was assessed for risk of bias by a reviewer and another reviewer verified the assessments.

Synthesis of evidence

A narrative synthesis of the included studies was performed for this review. Findings were presented by acceptability, feasibility, equity, resource use or combination thereof.

Results

Supplemental material, **Figure S1** shows the flow diagram of study selection. Of the 1,386 records (original search=1,226 and update search=160) identified through searching electronic databases and reviewing the CDA-AMC HTA report (11), 12 articles (original search=9 and update search=3) met the inclusion criteria and were included in this systematic review. The combined results from the original search and the update search are presented herein.

Supplemental material, **Table S1** displays the characteristics and findings of the included studies on acceptability, feasibility, equity and resource use. The study designs were cross-sectional, retrospective chart reviews and economic evaluations. The studies were conducted in Australia, Canada, the Netherlands, the United Kingdom and the United States. Supplemental material, **Table S2** shows the risk of bias assessment findings for each included observational study. The quality of the included articles was generally strong. Selection bias was "high" for eight studies. Four studies did not report on sources of funding and three studies did not report on competing interests.

Acceptability

Four studies reported on acceptability of prenatal screening for CT or NG. Logan *et al.* compared screening approaches to identify CT in a sample of 209 miscarriage individuals at a hospital in Scotland, United Kingdom (18). Among participants, a urine sample was significantly preferred over vulval swab ($p<0.0001$) or endocervical swab ($p<0.0001$). A vulval swab was significantly preferred compared to an endocervical swab ($p<0.0001$). However, there was reduced test performance with urine sample. The reasons for declining the endocervical method were categorized into the following themes: physically negative aspects, positive aspects of non-invasive testing, not wishing to repeat an internal exam, feeling psychologically unable to cope with the procedure and the impact of the screening procedure on the pregnancy.

As part of a larger study assessing the prevalence and factors associated with CT in pregnancy (19), Bilardi *et al.* examined the acceptability of screening for CT in 100 pregnant persons aged 16–25 years at four major antenatal services across Melbourne, Australia (20). The researchers found that all participants supported testing for CT as part of their routine antenatal care and nearly all strongly preferred urine testing compared to the other methods, as it was quick, easy and non-invasive. The main motivating factor in the acceptability of screening was concern for the health of the baby and the main concern expressed was whether testing and treatment could potentially harm the baby.

Pereboom *et al.* assessed knowledge, attitudes and experiences of CT screening in 383 pregnant persons and 282 partners at 22 primary midwifery care practices in the Netherlands (21). In this study, 347 (54.2%) pregnant persons and partners reported that all pregnant people should routinely be tested for CT in antenatal care and 85 (13.3%) reported that only those at increased risk should be tested. The researchers found that 3.7% of pregnant persons and 1.8% of partners felt stigmatized and 2.7% of pregnant people and 1.1% of partners felt ashamed by having a CT test offered.

Vainder *et al.* assessed prenatal screening for NG and CT in 1,220 pregnant persons at an urban tertiary care centre in Ontario, Canada (8). Of the 733 individuals with a record of testing method, 92.0% were tested by urine and 8.0% by cervical swab. There was no statistically significant difference in the testing rates among midwives (93.8%), family physicians (91.4%) and obstetricians (88.5%).

Feasibility and equity

Four articles reported on feasibility and equity for prenatal screening for CT or NG. Miller *et al.* (2003) assessed NG in 751 pregnant persons attending a community-based prenatal program in an underserved area in Louisiana, United States (22). The researchers found that among pregnant individuals aged ≤19 years, 23 (7.2%) were positive in the initial testing and 11 (3.5%) were positive only in the later testing. Among those aged ≥20 years, 15 (3.5%) were positive in the initial testing and 8 (1.8%) were positive only in the later testing.

Miller *et al.* (2005) examined identifying CT through initial versus repeat screening in 752 pregnant persons attending a community-based prenatal program in an underserved area in Louisiana, United States (23). The researchers found that at the time of initial testing, pregnant individuals aged ≤19 years had significantly higher rates of CT compared to those aged ≥20 years (odds ratio [OR] 2.19; 95% CI: 1.44–3.23; $p<0.001$). Among those with an initial negative test, pregnant individuals aged ≤19 years had significantly higher rates of CT compared to those aged ≥20 years at 34-week follow-up testing (OR 4.24; 95% CI: 1.85–9.74; $p<0.001$). Eight infections would have been missed if repeat testing had been limited to those aged ≤19 years.

Chen *et al.* assessed risk factors associated with CT and the sensitivity and specificity of these when used for selective screening in 987 pregnant persons aged 16–25 years at four major antenatal services across Melbourne, Australia (19). The researchers found that having more than one sexual partner in the past year was associated with CT infection (adjusted OR 11.5; 95% CI: 7.1–18.5). They noted that screening restricted to pregnant persons who reported more than one sexual partner in the past year would have detected 44% of CT in those aged 16–25 years and would have required only 7% of individuals to be screened. The addition of pregnant persons aged ≤20 years would have required 27% to be screened and detection of 72% of CT.

Leichliter *et al.* assessed receipt of CT screening in the past 12 months in 1,155 people who were pregnant in the past 12 months or at time of interview in the United States (24). The researchers found that those who reported receiving prenatal care were significantly more likely to receive CT testing than individuals who had not received prenatal care (adjusted OR 2.10; 95% CI: 1.35–3.28). People living in other areas of a metropolitan statistical area were significantly less likely to receive CT testing than those living in the principal city of an metropolitan statistical area (adjusted OR 0.62; 95% CI: 0.44–0.86). People who were born outside of the United States were also significantly less likely to receive CT testing than those who were born in the United States (adjusted OR 0.35; 95% CI: 0.19–0.64).

Feasibility and resource use

One observational study and three economic evaluations reported on feasibility and resource use of prenatal screening for CT or NG. Tyker *et al.* examined screening for CT and NG in 102 pregnant persons aged 13–19 years at an adolescent obstetrics practice in Ontario, Canada (25). Urine Nucleic Acid Amplification Test (NAAT) was used for 88 of 89 (98.9%) patients screened in the third trimester. The researchers noted that the decision to use urine samples was based on feasibility and ease

of collecting samples, whereas using an endocervical swab in the third trimester is more resource intensive and invasive.

Ong *et al.* assessed the cost effectiveness of screening all pregnant persons aged 16–25 years for CT compared with selective screening or no screening using a 12-month time horizon and from a third-party payer perspective, in Australia (26). With a CT prevalence estimate of 3%, screening all pregnant persons aged 16–25 years during their first antenatal visit compared to no screening was cost-effective, as it would cost the health system 1,641 Australian dollars (AUD) per CT case detected and treated and 34,931 AUD per quality-adjusted life year (QALY) gained. Screening all pregnant persons aged 16–25 years compared to no screening would have cost savings when CT prevalence was above 11%. With a CT prevalence estimate of 3%, screening all pregnant persons aged 16–25 years compared to selective screening would cost the health system 5,448 AUD per CT case detected and treated, and 116,213 AUD per QALY gained. Screening all pregnant persons aged 16–25 years was cost-effective compared to selective screening when CT prevalence was above 5%.

Rours *et al.* analyzed the cost effectiveness of antenatal screening of all pregnant persons for CT from a societal perspective (inclusion of non-medical [indirect] costs due to production losses) in the Netherlands (27). In the base-case analysis, they estimated 527,900 euros (EUR) to detect and treat CT for 1,000 pregnant persons and their partners, and averted medical costs were estimated at 626,800 EUR. In sensitivity analysis, the net cost savings remained with test costs up to 22 EUR (test price: 19 EUR) for a range of underlying assumptions. In scenario and probabilistic analyses, the cost savings increased with targeted screening of pregnant persons aged ≤30 years or with first pregnancies only.

Ditkowsky *et al.* (2017) assessed the cost-benefit of screening all pregnant persons aged 15–24 years for CT compared with no screening using a 12-month time horizon and from a third-party payer perspective in a high burden setting in the United States (28). Screening was proven to offer net cost savings when prevalence estimates were above 16.9%. At the prevalence estimate of 6.7%, there was an estimated net increase in expenditure of 142,66 million US dollars (USD) (22.14 USD/individual) with 204,630 cases of treated CT.

Discussion

This is the first systematic review on acceptability, feasibility, equity and resource use for prenatal screening for CT and NG. Nine observational studies reporting on approximately 5,000 participants and three economic evaluations were included in this review.

In general, pregnant persons and healthcare providers accepted prenatal screening for CT and NG. Most pregnant persons and partners supported testing of all pregnant individuals for CT as part of routine antenatal care. Some pregnant persons and partners reported feelings of stigma and shame when offered testing for CT. Similarly, Pavlin *et al.* found that barriers to acceptance of CT testing among women in general include denial of risk of infection; stigma associated with a positive diagnosis; feelings of shame, guilt, embarrassment, anger, fear and anxiety; concerns around privacy and confidentiality; time; and sample collection method (29).

Pregnant persons preferred non-invasive sampling approaches compared to other methods. Similarly, Oakeshott *et al.* found that among pregnant persons with less than 10 weeks of gestation, 47% preferred urine, 5% preferred self-collected vulval swab and 48% indicated no preference (30). In addition, Pimenta *et al.* found that pregnant persons aged 16–24 years preferred urine screening over cervical or vaginal swabs taken by healthcare providers across a variety of healthcare settings (31).

In terms of feasibility and equity, persons who did not receive prenatal care and individuals born outside of the United States were less likely to receive CT testing compared to their counterparts. These findings may have been underestimated if CT testing during pregnancy had occurred outside the survey timeframe of the past 12 months. These findings are also generally in alignment with literature showing inequities in access to prenatal care in Canada. Findings from the Maternity Experiences Survey (32) in mothers aged ≥15 years showed that the prevalence of inadequate prenatal care was 18.9% in Canada, with the highest estimates in Nunavut (28.8%) and the Northern Territories (24.9%). In addition, mothers who were immigrants were more likely to receive inadequate prenatal care compared to individuals born in Canada (OR 1.40; 95% CI: 1.13–1.74).

Individuals who were pregnant in the past 12 months and living outside of the principal city of metropolitan statistical areas (e.g., suburban area) were less likely to receive CT testing compared to those living in other areas. This finding is in slight contrast to evidence showing that pregnant individuals living in rural or remote areas may not always have access to trained prenatal healthcare providers in Canada (33). Evidence on pregnant persons with high risk for and a high prevalence of CT and NG from an underserved area in the United States showed that, if repeat screening was limited to individuals aged ≤19 years, eight cases could have been missed among those aged ≥20 years. This finding highlights how targeted screening could miss cases in those who do not meet the screening criteria and that limiting screening to earlier in pregnancy could potentially miss detecting new infections and reinfections (11).

With regard to resource use, screening all pregnant persons compared to no screening has cost savings. In general, the studies showed that an increase in the prevalence of CT and NG infections contributes to better cost-effectiveness.

Limitations

The included studies have several limitations to consider when interpreting the findings. Firstly, some of the observational studies were conducted in a miscarriage sample, younger age groups or those with a high risk for and a high prevalence of CT and NG that could contribute to selection bias. The findings from these studies may not be generalizable to the larger population of pregnant persons and those with lower prevalence of CT or NG. Secondly, some of the observational studies used self-report questionnaires (e.g., self-reported CT testing) that could potentially introduce recall bias. Thirdly, the economic evaluations focused on CT only. In addition, two of these studies were limited to younger age groups, a 12-month time horizon and a third-party payer perspective (26,28). One study was conducted in a higher burden setting and the researchers noted possible uncertainty in the estimated rates of CT-related sequelae that could contribute to overestimating the cost savings of CT screening (28). The strengths of the studies included in this review were the use of semi-structured interviews and the inclusion of a variety of healthcare settings.

This systematic review did not identify eligible literature on acceptability, feasibility, equity and resource use of timing of repeating universal screening (e.g., third trimester or at delivery). It also did not identify eligible literature on acceptability of prenatal screening for NG among partners of pregnant persons. These gaps in the literature highlight areas for future research.

The strengths of this review include the incorporation of the GRADE search strategies on acceptability, feasibility, equity and resource use and inclusion of different types of studies.

Implications

The evidence from this systematic review supported the development of the updated NAC-STBBI recommendations on prenatal screening for NG and CT in Canada (34). Screening all PWPI at first and third trimesters is likely more acceptable than targeting high-risk PWPI because it may reduce the stigma associated with screening for an STI. A recommendation about the sampling method for screening was not made since the preference and capacity may vary according to the individual, healthcare provider and the healthcare system. The updated NAC-STBBI recommendations are as follows (34):

- We suggest screening all PWPI for NG and CT during the first trimester or at the first antenatal visit and again in the third trimester (conditional recommendation; low certainty evidence)
- We suggest screening PWPI at the time of labour for NG and CT in any of the following situations (conditional recommendation; low certainty evidence):
  - No prenatal screening has occurred (no valid results available at the time of labour)
  - Third trimester screening has not occurred
  - A positive test result was obtained for NG or CT during pregnancy without appropriate follow-up, including treatment and a test-of-cure

Conclusion

In general, prenatal screening for CT and NG is acceptable among pregnant persons and healthcare providers. Most pregnant persons and partners supported testing of all pregnant individuals for CT as part of routine antenatal care. Inequities in feasibility (accessibility to screening) exist in certain populations. Studies have shown that targeted screening can miss cases. Screening all pregnant persons for CT has net cost savings compared to no screening in the included studies. More comparative research is needed on acceptability, feasibility, equity and resource use for prenatal screening for CT and NG in the Canadian context. These findings were used to support the updated NAC-STBBI recommendations on prenatal screening for CT and NG.

Authors' statement

SS — Conceptualization, data collection, analysis, writing–original draft, writing–review & editing
UA — Data collection, writing–review & editing
AF-C — Writing–review & editing
SS — Data collection, writing–review & editing
A-CL — Writing–review & editing
JB — Writing–review & editing
GO — Writing–review & editing
MHY — Writing–review & editing
NS — Writing–review & editing

Competing interests

None.

Acknowledgements

We acknowledge the Health Canada librarian Katherine Merucci for performing the electronic database searches. We thank Margaret Gale-Rowe for her assistance with this work and the National Advisory Committee on Sexually Transmitted and Blood-Borne Infections members for their continued support.

Funding

The systematic review was supported by the Public Health Agency of Canada (PHAC). The authors have no sources of external funding to declare. The National Advisory Committee on Sexually Transmitted and Blood-Borne Infections is supported by PHAC.

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Appendix

Supplemental tables, figure, search strategies and template for data extraction form are available upon request to the corresponding author: shamila.shanmugasegaram@phac-aspc.gc.ca

Appendix A: Database(s): Ovid MEDLINE® ALL 1946 to September 17, 2019
Appendix B: Database(s): Embase 1974 to September 18, 2019
Appendix C: Database(s): EBM Reviews - Cochrane Central Register of Controlled Trials August 2019
Appendix D: Database(s): Ovid MEDLINE® ALL 1946 to January 13, 2021
Appendix E: Database(s): Embase 1974 to January 13, 2021
Appendix F: Database(s): EBM Reviews - Cochrane Central Register of Controlled Trials November 2020
Appendix G: Template for Data Extraction Form - Acceptability, Feasibility, Resource Use and Equity of NG/CT Screening During Pregnancy
Table S1: Study characteristics and findings on acceptability, feasibility, equity and resource use for prenatal screening for CT and NG
Table S2: Quality assessment of included studies
Figure S1: Flow diagram of study selection for original and update searches

INFOGRAPHIC

HIV among African, Caribbean and Black people in Ontario

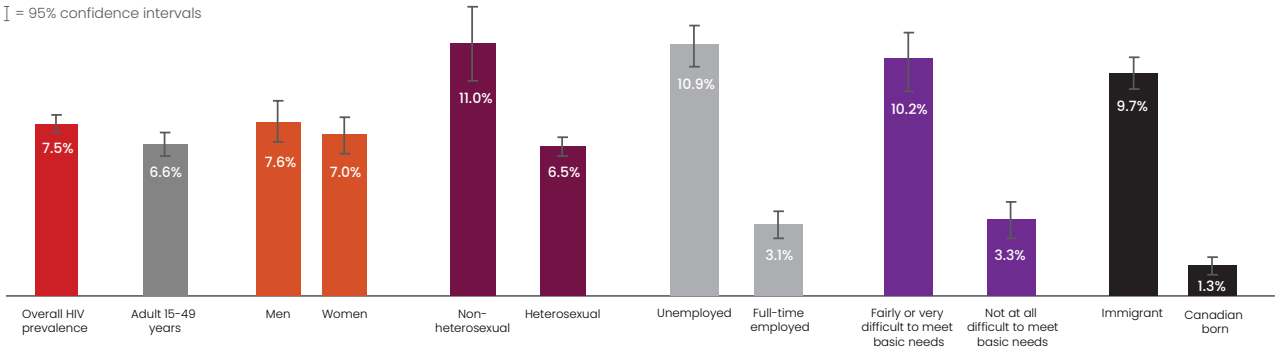
Research on HIV and other sexually transmitted and blood-borne infections among African, Caribbean and Black (ACB) people in Canada has been relatively limited. Most studies have been concentrated in Ontario[a].

According to 2022 provincial data, 29.8% of first-time HIV diagnoses in Ontario[b] were among ACB people[1]. Most infections are acquired in Ontario[2].

A research study (the A/C study[3]) provided more insights about HIV among ACB people in Ontario. The A/C study was a community-based research project conducted among first and second generation self-identified Black people in Toronto and Ottawa in 2018—2019. It included a bio-behavioural survey (n=1,380 participants) and 12 focus group discussions (n=107 participants).

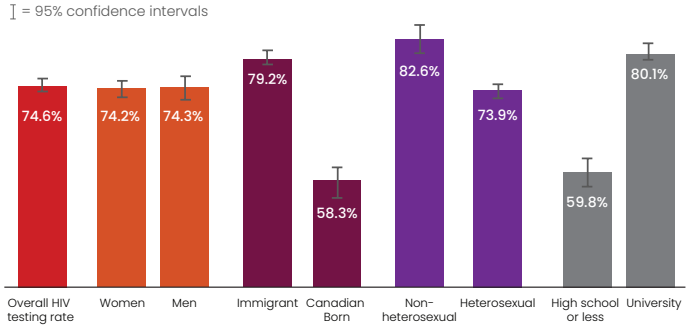
Social determinants of health play a role in the prevalence of HIV[4]

HIV prevalence[c] among ACB people in Ontario according to selected social determinants of health



Self-reported HIV testing[d]

Self-reported HIV testing rate (ever) among subgroups[e]



35.0% tested in the last 6 months

Main barriers to testing[3]:

According to focus group participants, the main barriers to HIV testing include:

- Racism
- Stigma
- Fear of being deported if found to be living with HIV
- Lack of information about HIV
- Lack of connection to health care
- Poor relationships with healthcare providers

Access to care

Experiences of racism

According to focus group participants, ACB people experience racism on a daily basis while trying to access housing, employment, education and health care, which may increase their likelihood of acquiring HIV[3].

21.8% of participants reported difficulties in accessing health care[d]

Of the 21.8%[5]:

- **28.6%** said the provider was trying to give as little services as possible
- **23.8%** reported the provider was insensitive or racist
- **10.7%** said the provider judged people on appearance, ancestry or accent

HIV treatment accessibility among ACB people living with HIV

86.7% Had access to professional HIV care[3]

88.0% Had access to antiretroviral therapy[3]

96.0% Of those on antiretroviral therapy had a suppressed viral load, according to provincial data[6]

Barriers to accessing HIV treatment include cost of medication, geographic access, clinic and pharmacy hours and not having a doctor.

[a]According to a scoping review performed by the Public Health Agency of Canada (PHAC). [b]Ethnicity/race status were not reported in 35.3% of first-time HIV diagnoses. [c]Standardized estimate. [d]Unadjusted. [e]According to secondary analysis performed by PHAC.

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Public Health Agency of Canada. HIV among African, Caribbean and Black people in Ontario. Infographic. Can Commun Dis Rep 2024;50(7/8):259.

Social capital interventions for human papillomavirus (HPV) immunization and cervical cancer screening: A rapid literature review

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Abstract

Background: Social capital can be used as a conceptual framework to include social context as a predictor of human papillomavirus (HPV) vaccination and cervical cancer screening behaviours. However, the effectiveness of interventions that use social capital as a mechanism to improve uptake of immunization and screening remains elusive.

Objective: To synthesize empirical evidence on the impact of social capital interventions on HPV immunization and cervical cancer screening and describe key characteristics of such interventions.

Methods: Using a rapid review methodology, a search of literature published between 2012 and 2022 was conducted in four databases. Two researchers assessed the studies according to inclusion criteria in a three-step screening process. Studies were assessed for quality and data concerning social capital and equity components and intervention impact were extracted and analyzed using narrative synthesis.

Results: Seven studies met the inclusion criteria. Studies found improved knowledge, beliefs and intentions regarding HPV immunization and cervical cancer screening. None of the studies improved uptake of immunization; however, three studies found post-intervention improvements in uptake of cervical cancer screening. All studies either tailored their interventions to meet the needs of specific groups or described results for specific disadvantaged groups.

Conclusion: Limited evidence suggests that interventions that consider and reflect local context through social capital may be more likely to increase the uptake of HPV immunization and cervical cancer screening. However, further research must be done to bridge the gap in translating improvements in knowledge and intention into HPV immunization and cervical cancer screening behaviours.

Suggested citation: Gillies C, Allen-Scott LK, Nykiforuk CIJ, Belon AP, Kim MO, Lee B, Nieuwendyk L, Adhikari K, Ori EM. Social capital interventions for human papillomavirus (HPV) immunization and cervical cancer screening: A rapid review. Can Commun Dis Rep 2024;50(7/8):260–73. https://doi.org/10.14745/ccdr.v50i78a04

Keywords: cervical cancer, HPV vaccination, cancer screening, social capital, social support, health equity, public health

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Introduction

Human papillomavirus (HPV) is the most common sexually transmitted infection in North America, affecting most sexually active people at least once in their lifetime, if not immunized (1). Persistent HPV infection can cause cancers of the cervix, as well as the vulva, vagina, penis, anus, mouth and throat (2,3). While cervical cancer incidence has slowly declined, it remains the third most common cancer among people with a cervix aged 35–44 years (4). Due to social and structural determinants,

inequities in HPV infection rates and incidence of cervical cancer are also experienced by Indigenous people, immigrants, sexual and gender minorities and residents in rural and remote communities (1,5). Therefore, slowing the spread of HPV infection and eliminating the incidence of cervical cancer through evidence-based, equitable interventions to improve prevention remains a pressing public health concern.

Morbidity and mortality of cervical cancer can be reduced or eliminated through primary and secondary prevention against HPV. In Canada, publicly funded vaccination programs in school, community and healthcare settings (6) have proven to be a highly effective primary prevention strategy for HPV infection and high-risk precancerous cervical lesions (1). Secondary prevention through publicly funded cervical cancer screening programs (e.g., Pap smears and self-sampling test kits) can also detect cell changes to be treated before they progress to cervical cancer (4). The provincial and territorial final dose uptake rate for HPV vaccination in schools ranges from 57% to 91% (7), while adherence to recommended cervical cancer screening guidelines across the country also ranges, from 63% to 71% (4).

Human papillomavirus immunization and cervical cancer screening behaviours are complex and influenced by numerous factors, including lack of information, vaccine hesitancy and gaps in access and financial coverage (6,8). Social capital has been used as a conceptual framework to broaden the lens beyond conventional predictors of immunization and screening behaviours to include social context. Within public health, social capital most often refers to the resources available to people through their social networks (e.g., families, workplaces) (9). Indicators of social capital fall into two dimensions: cognitive social capital (subjective perception of level of trust, sharing and reciprocity) and structural social capital (observable extent of social participation) (9). Social capital is further understood through three functions: bonding social capital (resources accessed within groups that have similar socioeconomic and demographic characteristics), bridging social capital (resources that may be accessed across groups with different characteristics) and linking social capital (networks of trust connecting groups with differences in power) (9).

Social capital interventions represent activities aimed at improving health through changes in an individual's or group's capacity to mobilize social capital (9), including social norms, social cohesion, community networks, connectedness, belonging and reciprocity. For instance, social capital may help provide underserved individuals with information, financial assistance or transportation to access immunization programs. Such interventions may enhance individual uptake of cancer prevention behaviours, thereby reducing cancer incidence and mitigating cancer-related inequities (8). However, there is limited knowledge concerning social capital as a mechanism to improve uptake of HPV immunization and cervical cancer screening. This paper aimed to synthesize empirical evidence on the impact of social capital interventions on HPV immunization and cervical cancer screening and describe key characteristics of such interventions.

Methods

Evidence concerning social capital and HPV-related cancer prevention was required for the development of a provincial-based intervention to reduce HPV-related cancers in Alberta. Accordingly, a rapid review methodology (10,11) was chosen for evidence-based, rapid decision-making. The research question was: What is the empirical evidence of the impact of social capital interventions on uptake of HPV immunization and/or cervical cancer screening (secondary prevention) to prevent HPV-associated cancers?

The search strategy was developed by a librarian in collaboration with content experts, from May 6 to June 22, 2022. The search strategy included testing, language, development, peer review, translations and deduping. The search was conducted in Ovid Medline, Ovid PsycINFO, Ovid Embase and EBSCOhost CINAHL on June 22, 2022 (the search protocol, including full search strategies, is available upon request). Studies were included if they were peer-reviewed intervention studies, systematic reviews, or meta-analyses published in English between 2012 and 2022 (see **Appendix**, **Table A1** for inclusion and exclusion criteria).

Following a three-step screening process, two researchers began by independently conducting title-abstract screening for the same set of 10% of the studies. A third researcher helped resolve discrepancies. When an inter-rater agreement of 100% was reached, the database was split into two. The same two researchers completed the primary screening separately using half of the database each. This process was repeated for full text screening. Finally, the references of included studies were screened for potential inclusion. No protocol outlining all methodological steps in our rapid review was developed *a priori* or registered in an open-source platform.

One researcher extracted data (e.g., participants' characteristics, study limitations) from the studies using Microsoft Excel and a second researcher verified the data (available upon request). Through group discussion, social capital was categorized by dimensions and functions. The PROGRESS-Plus (12) characteristics from Cochrane Equity were used to organize findings by social factors influencing health inequities. Quality appraisal was performed independently by two researchers for 10% of studies using the Quality Assessment Tool for Quantitative Studies (13). After achieving an inter-rater agreement of 100%, the two researchers completed the remaining quality appraisals. They discussed their independent scoring with each other to determine the final rating (see Appendix, **Table A2**). The 2020 PRISMA checklist (14) was used as a reporting guideline for our rapid review findings.

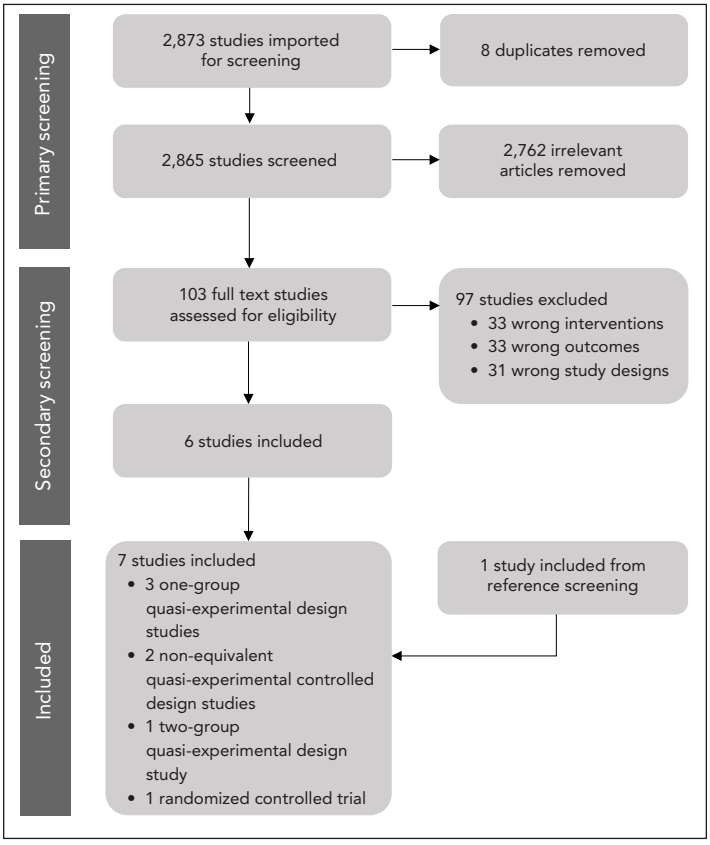
Due to heterogeneity of the data from the included studies, a meta-analysis could not be conducted. Rather, the evidence was synthesized narratively and thematically according to the social dimensions and functions of the interventions and social factors considered. The analysis focused on the characteristics of social capital interventions and their impact on HPV immunization and cervical cancer screening (e.g., uptake, knowledge, intentions).

Results

Overview

The search produced 2,873 studies. Through primary screening, 103 studies met the inclusion criteria. In the secondary screening, 97 studies were excluded. In the reference list screening process, one study met the inclusion criteria. This review included seven studies (15–21) (**Figure 1**).

Figure 1: PRISMA chart of rapid review screening process



Key characteristics

Table 1 summarizes the key characteristics of the included studies. Most studies were conducted in the United States (15,17–20). Six were quasi-experimental studies (15–18,20,21) and one was a randomized control trial (19). All seven studies had an educational component. Six studies incorporated culture into the educational component by utilizing co-ethnic health professionals or lay health educators who came from the same ethnic groups and/or spoke the same language as the participants (15,17–21). All seven studies included a cognitive dimension of social capital and two studies had a structural dimension of social capital (19,21). All studies had a bonding and bridging function of social capital and five had a linking component (16,17,19–21). Six studies had a "weak" quality rating score (15,17–21) and one received a "moderate" rating (16) (Appendix, Table A2). Overall, the evidence was weak due to data collection methods, withdrawal reporting and limitations of blinding.

Impact on human papillomavirus immunization

Only two studies reported the impact of social capital on HPV immunization (15,19) (**Table 2**). Factors associated with uptake included: HPV immunization-related knowledge; perceptions about one's susceptibility to HPV; understanding the risks of HPV-related diseases and benefits of the immunization; intentions to be vaccinated for HPV; and immunization behaviours. One culturally appropriate, community-based education program delivered by co-ethnic health professionals resulted in significant improvement in mothers' knowledge, beliefs and intentions to immunize their own children (15). However, there were no statistically significant differences in HPV immunization uptake among children within a six-month time frame. A narrative intervention also resulted in higher levels of intention to immunize among girls, but no differences in actual HPV immunization uptake (19). Due to the combination of multiple components (e.g., social capital and education) in the intervention, the effects of each component on the outcomes were not described. Despite improving knowledge, beliefs and intentions around HPV immunization, both studies reported the ineffectiveness of educational and narrative interventions in improving HPV immunization uptake in girls and their mothers (15,19).

Impact on cervical cancer screening

Five studies found mixed results regarding the impact of social capital on cervical cancer screening (16–18,20,21) (**Table 3**). One study on Pap smear testing found no significant differences in subjective norms and perceived behavioural control between the groups receiving and not receiving an educational intervention (16). However, these factors increased significantly among the participants within the education intervention groups, according to pre-post analysis. Two other studies found that the group format of the educational sessions contributed to higher overall scores in emotional, instrumental, reciprocal and perceived social support (17,18). One study in local community and faith-based settings examined the knowledge, attitudes and uptake of HPV self-sampling tests that were provided by bilingual health educators (18). All participants completed the HPV self-sample test, with most participants reporting that they were "comfortable/very comfortable" with self-sampling.

Table 1: Description of main study characteristics

Characteristics	Categories	Number (n); proportion (%)	Reference
Location	United States	n=5; 71.4%	Chu *et al.*, 2021; Larkey *et al.*, 2012; Ma *et al.*, 2022; McDonough *et al.*, 2016; Lee *et al.*, 2018
	Iran	n=1; 14.3%	Khani Jeihooni *et al.*, 2021
	Nigeria	n=1; 14.3%	Olubodun *et al.*, 2022
Study design	One-group quasi-experimental study	n=3; 42.9%	Chu *et al.*, 2021; Ma *et al.*, 2022; McDonough *et al.*, 2016
	Non-equivalent quasi-experimental controlled study	n=2; 28.6%	Khani Jeihooni *et al.*, 2021; Olubodun *et al.*, 2022
	Two-group quasi-experimental study	n=1; 14.3%	Larkey *et al.*, 2012
	Randomized controlled trial (RCT)	n=1; 14.3%	Lee *et al.*, 2018
Interventions	Educational component	n=7; 100%	Chu *et al.*, 2021; Khani Jeihooni *et al.*, 2021; Larkey *et al.*, 2012; Lee *et al.*, 2018; Ma *et al.*, 2022; Olubodun *et al.*, 2022; McDonough *et al.*, 2016
	Co-ethnic/speaks the same language as participants'	n=6; 85.7%	Chu *et al.*, 2021; Larkey *et al.*, 2012; Ma *et al.*, 2022; Olubodun *et al.*, 2022; McDonough *et al.*, 2016; Lee *et al.*, 2018
HPV-related outcomes	Cervical cancer screening	n=5; 71.4%	Khani Jeihooni *et al.*, 2021; Larkey *et al.*, 2012; Ma *et al.*, 2022; Olubodun *et al.*, 2022; McDonough *et al.*, 2016
	HPV immunization	n=2; 28.6%	Chu *et al.*, 2021; Lee *et al.*, 2018
Social capital dimensions	Cognitive	n=7, 100%	Chu *et al.*, 2021; Khani Jeihooni *et al.*, 2021; Larkey *et al.*, 2012; Lee *et al.*, 2018; Ma *et al.*, 2022; Olubodun *et al.*, 2022; McDonough *et al.*, 2016
	Structural	n=2; 28.6%	Lee *et al.*, 2018; Olubodun *et al.*, 2022
Social capital functions	Bonding	n=7, 100%	Chu *et al.*, 2021; Khani Jeihooni *et al.*, 2021; Larkey *et al.*, 2012; Lee *et al.*, 2018; Ma *et al.*, 2022; Olubodun *et al.*, 2022; McDonough *et al.*, 2016
	Bridging	n=7, 100%	Chu *et al.*, 2021; Khani Jeihooni *et al.*, 2021; Larkey *et al.*, 2012; Lee *et al.*, 2018; Ma *et al.*, 2022; Olubodun *et al.*, 2022; McDonough *et al.*, 2016
	Linking	n=5; 71.4%	Khani Jeihooni *et al.*, 2021; Larkey *et al.*, 2012; Lee *et al.*, 2018; Olubodun *et al.*, 2022; McDonough *et al.*, 2016

Abbreviation: HPV, human papillomavirus

Table 2: Characteristics of the social capital interventions and their impacts on human papillomavirus immunization

Study (in alphabetical order)	Objective	Country, population size and description	Description of intervention	Social capital dimensions	Social capital functions	Impact and effectiveness
Chu *et al.*, 2021	This one-group quasi-experimental study evaluated the impact of a culturally developed educational intervention for East African immigrant mothers to improve HPV vaccination knowledge, attitudes and intentions to vaccinate their male and female children.	United States 120 participants Sex: female, 100% Age: <30 years, 2.6%; 30–39 years, 57.0%; 40–49 years, 33.3%; ≥50 years, 7.0%	A socio-context framework and Andersen's behavioural model were applied to include social, cultural and religious factors to inform a community-based education intervention delivered by co-ethnic health professionals. A communal dinner for all participating mothers and their children was held prior to the implementation of the education forum. The forum included a 40-minute interactive session with the co-ethnic health professional, a 20-minute presentation in the participants' native languages and a 20-minute question and answer period.	**Cognitive:** • Social norms and influences were measured using survey items. • Focus group findings deepened the understanding of social influences (social, cultural, religious factors). These findings on contextual factors informed the development of the intervention.	**Bridging and bonding:** • The intervention was designed to be sensitive, language and culturally appropriate and audience-centric to appeal to the East African community.	• Within 6 months of the intervention, only 2% (n=2) of the 96 mothers with children who had no HPV vaccination records received the HPV vaccine. • The proportion of mothers who wanted to vaccinate their children increased after intervention (6.3%; n=7/111 to 75.7%; n=84/111). • Post-intervention, 86.4% (n=95/110) of mothers reported that they were more likely to talk with their children's doctors about the HPV vaccine than pre-intervention ($p<0.0001$). • Post-intervention, mothers had a significant increase in knowledge and beliefs about HPV ($p<0.0001$; RR 3.64; 95% CI: 2.89–4.60), HPV vaccination ($p<0.0001$; RR 8.10; 95% CI: 5.26–12.45) and reported positive HPV vaccination intentions ($p<0.0001$; RR 5.03; 95% CI: 3.42–7.39). • Post-intervention, 90.2% (n=101/112) of mothers thought they had enough information to make a decision about vaccinating their children and 92.4% (n=97/105) knew where to get the HPV vaccination compared to baseline (11.6%; n=13 and 25.7%; n=27 respectively; $p<0.0001$).
Lee *et al.*, 2018	This randomized controlled trial examined the feasibility, acceptability and effectiveness of a narrative intervention to promote HPV immunization in Cambodian mothers and daughters.	United States 18 dyads (38 total mothers and daughters), 9 in the intervention and 9 in the control group. Mean age: daughters, 15.3 years old; mothers, 44.9 years old	The intervention included a storytelling narrative of HPV immunization, which was informed by the network episode model. This model describes that interpersonal interactions (e.g., peer influence) within social networks function as a mechanism for health-related decision-making; thus, it is both a social and individual process. The storytelling narrative was a 26-minute storytelling DVD that utilized unscripted, culturally grounded stories in the first person. The real stories increased realism by recruiting important people from the Khmer community, such as physicians and community members who were both vaccinated and unvaccinated. The control group received non-narrative education materials.	**Structural:** • Narrative intervention employed community members, friends, family and doctors (social networks) to encourage vaccination behaviours. **Cognitive:** • The storytelling narrative was developed by other Khmer mothers, daughters and community health leaders. • Participants were recruited through community health leaders, site coordinators and cultural navigators' social networks in addition to other methods, such as advertising on local radios.	**Linking:** • Trusted community health leaders utilized their social networks to aid in study recruitment. **Bridging:** • Participants, community health leaders and actors within the storytelling narrative were all part of the Khmer community. While these groups share similar characteristics or identities, they are part of different networks. **Bonding:** • Dyads of mothers and daughters were recruited because mothers are the primary health decision-makers for their daughters.	• Within one month, daughters from the intervention group reported higher intentions to receive HPV immunization than their control group counterparts. However, there was no difference in actual vaccination initiation between both groups. • Storytellers shared how they were personally influenced by their social networks and norms from friends, mothers and healthcare providers to receive the HPV vaccination. • Social network norms were effective in motivating the vaccination intentions of participants through a positive emotional reaction. Note: No statistical data was provided.

Abbreviations: CI, confidence interval; HPV, human papillomavirus; RR, relative risk

Table 3: Characteristics of the social capital interventions and their impacts on cervical cancer screening

Study (in alphabetical order)	Objective	Country, population size and description	Description of intervention	Social capital dimensions	Social capital functions	Impact and effectiveness
Khani Jeihooni *et al.*, 2021	This non-equivalent quasi-experimental controlled study examined the effect of a Pap smear educational intervention targeting the beliefs, subjective norms and perceived behavioural control in Iranian women.	Iran 300 women (150 in the control group and 150 in the experimental group).	Health belief model and theory of planned behaviour were used to inform an educational program that was based on active learning to enhance the knowledge of cervical cancer, Pap smear tests, barriers to screening and individual and social factors related to Pap smear testing. The experimental group participated in eight 50-minute education sessions once per week that included a group discussion, brainstorming, question and answer and a film display to facilitate motivation and behavioural control in Pap smear testing. Spouses, physicians and healthcare staff were present during these sessions to play supporting roles. These groups helped to influence the subjective norms around cervical cancer screening. Control group participants received no education intervention.	**Cognitive:** • The health belief model, informing the educational intervention, depicts subjective norms as a result of many normative beliefs and perceptions; thus, people will often act based on their perception of what others would think they should do.	**Linking, bridging and bonding:** • The intervention included an educational session with spouses, physicians and health centre staff in attendance to play supporting roles and influence the subjective norms around screening behaviours.	• At 6-month post-intervention, a significantly greater portion of the experimental group received the Pap smear test (72%; n=108/150), compared to the control group (6%; n=9/150; $p<0.05$). • There was no significant difference in knowledge ($p=0.09$), perceived susceptibility to HPV and associated diseases ($p=0.104$) and severity of cervical cancer ($p=0.135$), barriers ($p=0.121$), benefits of cervical cancer screening ($p=0.176$), behavioural control ($p=0.289$), subjective norms ($p=0.322$), or intention scores ($p=0.355$) between control and experimental groups at baseline. • At 6-month post-intervention, there was a significant improvement in knowledge ($p<0.05$) understanding of perceived susceptibility to and severity of cervical cancer ($p<0.05$) and benefits of cervical cancer screening ($p<0.05$), behavioural control ($p<0.05$) and subjective norms ($p<0.05$) in the experimental group compared to the control group. Within the control group, there were no significant changes ($p>0.05$). • At 6-month post-intervention, there was a significant decrease in perceived barriers to cervical cancer screening ($p<0.05$), such as lack of time, in the experimental group. Within the control group, there were no significant changes ($p>0.05$).
Larkey *et al.*, 2012	This two-group quasi-experimental design study examined the effect of using lay health educators to increase cancer screening behaviours in Latinas.	United States 1,006 women (604 women in social support group [SSG] and 402 women in individual [IND] group). Age: mean of 38.4 years old	The same intervention was delivered in two different formats: IND and SSG. The intervention included six 80-minute educational sessions that contained definitions for different cancers; dietary, tobacco and physical activity recommendations for each cancer (cervical, breast and colorectal); and screening information. The SSG intervention was designed to promote group interactions and involvement to encourage women to meet each other's needs and have group goal setting.	**Cognitive:** • A Hispanic Advisory Board reviewed the intervention educational curriculum. They provided insight into how to organize groups and develop a sense of identity and commitment within a group.	**Linking:** • Lay health educators were considered "practical supports", as individuals who can share health information with others. **Bridging and bonding:** • Lay health educators (or *promotoras de salud*) were language-matched and networked in their communities.	• No significant differences in cervical cancer screening between the SSG and IND groups ($p=0.315$). • No significant differences in maintenance of cervical cancer screening ($p=0.971$).

Table 3: Characteristics of the social capital interventions and their impacts on cervical cancer screening (*continued*)

Study (in alphabetical order)	Objective	Country, population size and description	Description of intervention	Social capital dimensions	Social capital functions	Impact and effectiveness
Ma *et al.*, 2022	This one-group quasi-experimental design study evaluated the impact of a culturally tailored intervention for Chinese, Korean and Vietnamese women on HPV self-sampling test uptake.	United States 156 Asian-American women Age: mean of 44.66 years old	The intervention was informed by the health belief model and the community-based participatory research approach. The intervention contained four different components: group education workshops, written and illustrated instructions on the HPV self-sampling test, group discussion session and patient navigation and follow-up care.	**Cognitive:** • Focus groups informed the cultural components of the intervention. • Perceived social support was assessed using 11 survey questions to measure support from spouses, other family members, friends and physicians related to cervical cancer screening.	**Bridging and bonding:** • The intervention contained a group education component with bilingual health educators.	• 100% (n=156/156) of the participants completed the HPV self-sampling test, but only 92.5% (n=145/156) were adequate samples. • HPV-related knowledge, social support, self-efficacy and comfort increased significantly following the intervention (p<0.001).
McDonough *et al.*, 2016	This one-group quasi-experimental design study evaluated the effectiveness of an educational intervention to improve Latina's knowledge, attitudes, behaviours and intentions to get the Pap smear test.	United States 5,211 Latina women Age: mean of 39.07 years old	The intervention included an educational curriculum toolkit for *promotores de salud* (community health workers) to use in delivering cervical cancer screening education to Spanish-speaking Latina women. The toolkit contained bilingual materials of flip charts, key talking points, a *charla* (health education session) guide, educational brochures and a list of local resources for low-cost or free Pap smear testing.	**Cognitive:** • *Promotores de salud* offered social support, a sense of belonging and trust.	**Linking:** • *Promotores de salud* lived in the communities and provided health services and education as trusted members of the community. They acted as cultural brokers between the communities and the healthcare system. **Bridging and bonding:** • The intervention was delivered to a group of participants that identified as Latina and were part of a culturally similar group.	• Intentions to receive a Pap smear test increased significantly (z=−8.94; p<0.001). • Knowledge (p<0.001; 95% CI: −2.67, −2.53; r=0.73), positive attitudes (p<0.001; 95% CI: −0.15, −0.12; r=0.29) and self-efficacy (p<0.001; 95% CI: −0.18, −0.15; r=0.29) related to cervical cancer prevention and screening increased significantly.
Olubodun *et al.*, 2022	This non-equivalent quasi-experimental controlled study examined the effects of a social marketing intervention on Pap smear knowledge, attitudes and behaviours among women living in urban slums.	Nigeria 400 women (200 in the intervention group and 200 in the control group). Age: 21–30 years, 44.1%; 31–40 years, 31.7%; 41–50 years, 18.1%; 51–60 years, 3.8%; 60–65 years, 2.2%	The intervention was informed by the health belief model and focus groups. The intervention group received six health education sessions on cervical cancer and Pap smears, which included education for participants' husbands. As part of the social marketing intervention, community mobilization was implemented to recruit key community members such as religious clerics and community leaders to publicly show support for cervical cancer screening. The control group also received health education sessions on cervical cancer and free Pap smear tests following the study.	**Structural and cognitive:** • The development of the intervention was informed by perceived barriers related to religion, culture, spouses' disapproval and feelings of embarrassment. • Religious leaders, traditional leaders and husbands helped promote the Pap smear services through speeches at health education sessions.	**Bridging and bonding:** • People were assigned to groups based on similar sociodemographic characteristics, beliefs, values and behaviours. • Sensitization and educational sessions were targeted toward husbands to reduce spouses' disapproval.	• Cervical cancer screening uptake significantly increased in the intervention group (0% to 84.3%; p<0.001; 95% CI: 0.8–0.9), but not in the control group (p=1.000). • Change in knowledge was statistically significant in the intervention group (mean=0.0, SD=0.3 to mean=15.1, SD=3.7; p<0.001; 95% CI: 14.3–15.6), but not in the control group (p=0.096). • Attitude scores improved significantly in the intervention group (mean=27.2, SD=1.4 to mean=36.5, SD=4.8; p<0.001; 95% CI: 8.5–10.1), but not in the control group (p=0.068).

Abbreviations: CI, confidence interval; HPV, human papillomavirus; r, effect size; SD, standard deviation; *z*, *z* score

Groups receiving educational interventions reported outcomes that included increased knowledge related to cervical cancer and screening procedures, improved understanding of perceived susceptibility to HPV (i.e., the belief that one is likely to get HPV or HPV-related disease), severity of cervical cancer (i.e., risk and seriousness of HPV, HPV-related disease and associated complications to one's life), benefits of cervical cancer screening (i.e., reduction of risk and severity of getting HPV and HPV-related disease), increased intentions for cervical cancer screening uptake and greater uptake of the Pap smear test (e.g., administered by a physician or HPV self-sampling test) (16,18,20,21). Among the four studies that included uptake measures (12–14,17), three reported increased cervical cancer screening uptake (16,18,21). One study found no significant differences in cervical cancer screening uptake between the cohort receiving education sessions in groups to promote social capital and the cohort receiving the session individually with no social capital component (17). However, it also found that cervical cancer screening increased in both group and individual education sessions.

Equity considerations

Table 4 presents equity-related findings on HPV immunization and cervical cancer. The studies either tailored their interventions to meet the needs of specific groups or described results for specific disadvantaged groups (e.g., immigrants) considering, for example, education level and gender and/or sex.

Discussion

To our knowledge, this is the first review of social capital interventions in public health regarding HPV immunization and cervical cancer screening. Despite interest in the use of social capital to improve cancer outcomes (8,22,23), only seven papers met this review's inclusion criteria. Concerning primary prevention, education interventions containing social capital dimensions and/or functions were found to increase HPV immunization knowledge, attitudes and intentions. They successfully addressed concerns, fears and doubts for providing accurate information, building a trustworthy relationship between participants and researchers or providers and meeting participants' life circumstances and sociocultural needs. However, they seemed to have failed in bridging the intention-uptake gap in HPV immunization. This finding speaks to the recognition that knowledge is only one of the multiple determinants of vaccine decision-making, as some vaccine-hesitant people delay or refuse vaccination after educational interventions (24). Pairing social capital interventions with a vaccine offer or immunization appointment scheduling at the end of the intervention may effectively increase uptake. For those with limited access to the healthcare system, school-based health outreach and partnerships with communities should be part of the strategy to build multisectoral delivery platforms for vaccination and to promote uptake following educational intervention (25).

Regarding secondary prevention, this review found that interventions improved several outcomes including knowledge on cervical cancer and screening procedures; understanding of perceived susceptibility to and severity of HPV infection and cervical cancer; benefits and intentions of cervical cancer screening; and emotional, instrumental, reciprocal and perceived social support. Among the four studies analyzing the uptake of cervical cancer screening, three found increased uptake. These three studies used the health belief model in the design of their interventions, which seeks to change an individual's beliefs, knowledge and perceived benefits and risks to positively influence their health behaviours (26). This finding may indicate the value of using a theoretical health behaviour change model alongside dimensions of social capital to guide cervical cancer screening interventions. While our findings do not allow us to infer how much contribution social capital made on cervical cancer screening uptake, they indicate that social capital plays a role and should be a component in screening interventions. Further research should consider the influences of other factors on participation in cervical cancer screening (e.g., limited access to sexual and reproductive healthcare programs).

Consistent with the current literature, this review's findings support the need for interventions to consider perceptions of social capital in different contexts and to reflect the multidimensional factors influencing people's decision-making on HPV immunization and cervical cancer screening (27). To create an environment conducive to positive HPV-related knowledge, intentions and behaviours, social capital interventions should address perceived social and structural barriers like affordability and accessibility of immunization and screening programs. Anticipating contextual barriers that jeopardize the success of social capital interventions for increasing uptake requires moving away from half measures such as charging for HPV vaccines or limiting vaccination appointments to work hours. The World Health Organization has called for actions to ensure affordability and expansion of HPV vaccination and cervical cancer screening coverage (28), including single dose for adolescents to reduce costs and burden to the healthcare system and incorporation of cervical cancer screening into state health insurance schemes to address social inequities in secondary prevention. The World Health Organization also recommends developing partnerships between the public health sector and public, private and non-profit organizations to roll out services and address constraints in HPV vaccine supply and devices for cervical cancer diagnostics (25,28).

Most studies in this review specified their HPV immunization target populations as "girls" and "women" and only one included mention of "boys." None of the studies focused on members of the Lesbian, Gay, Bisexual, Transgender, Queer and Questioning and Two-Spirit (LGBTQ2S+) community. This reflects an overlook of gender identity and sexual diversity in interventions utilizing social capital. Trends examining HPV immunization rates indicate a greater gap in HPV immunization

Table 4: Summary of equity considerations in the included studies

Social factors according to PROGRESS-Plus	Findings
Education, place of residence and socioeconomic status	• Knowledge, attitudes, intentions and behaviours related to HPV immunization and cervical cancer screening were improved by creating an enabling environment in low-income countries facing poor access to health services, long hospital wait times, lower education levels, lack of basic amenities (e.g., latrines and safe running water) and higher prevalence of risky sexual behaviours (Khani Jeihooni *et al.*, 2021; Olubodun *et al.*, 2022). • The majority of population groups studied received a high school education or less, which had implications on how the educational components of the intervention were designed (e.g., delivered verbally through lay health advisors, promoters, mixed marketing approach, PowerPoint) (Chu *et al.*, 2021; Khani Jeihooni *et al.*, 2021; Larkey *et al.*, 2012; Lee *et al.*, 2018; Ma *et al.*, 2022; McDonough *et al.*, 2016; Olubodun *et al.*, 2022). • Given the majority of the population groups were from low-income households or lived in poverty (Chu *et al.*, 2021; Khani Jeihooni *et al.*, 2021; Larkey *et al.*, 2012; Ma *et al.*, 2022; McDonough *et al.*, 2016; Olubodun *et al.*, 2022), provision of free Pap tests or referrals reduced cost barriers (especially for those who were uninsured) to receiving cervical cancer screening (McDonough *et al.*, 2016; Olubodun *et al.*, 2022).
Language	• Given language negatively affected knowledge and confidence in HPV-related decision-making, interventions provided multiple translated versions of their materials for their target population (Chu *et al.*, 2021; Larkey *et al.*, 2012; Lee *et al.*, 2018; Ma *et al.*, 2022; McDonough *et al.*, 2016; Olubodun *et al.*, 2022). • Participants preferred community classes delivered in the community's native language, which facilitated community dialogue and reduced mistrust of immunization and healthcare (Chu *et al.*, 2021).
Race, ethnicity, religion and culture	• Racial and ethnic minority groups in the United States have lower uptake of HPV immunization and cervical cancer screening due to limited awareness and lack of knowledge; language barriers; physical barriers (e.g., transportation and time to get to clinics); misperceptions about efficacy and safety regarding HPV immunization; mistrust of healthcare or immunization; lack of strong healthcare provider recommendations; healthcare costs (e.g., lack of insurance); and cultural beliefs, norms (e.g., restrictions around pork products) and stigma (e.g., association between getting the HPV vaccine and increasing sexual behaviours) (Chu *et al.*, 2021; Larkey *et al.*, 2012; Ma *et al.*, 2022). • Culturally appropriate interventions resulted in significant improvement in mothers' confidence, knowledge, beliefs and intentions to immunize their own children (Chu *et al.*, 2021). • Several studies utilized focus groups, stakeholder feedback and consultations with community leaders to inform their research design to create culturally relevant, community-based and audience-sensitive and specific content (Chu *et al.*, 2021; Larkey *et al.*, 2012; Lee *et al.*, 2018; Ma *et al.*, 2022; McDonough *et al.*, 2016). • Inviting community members and organizations to support HPV immunization initiatives (e.g., sharing the HPV immunization program with their communities) had a positive effect on participant recruitment among racial and ethnic groups (Chu *et al.*, 2021; Ma *et al.*, 2022). • Storytelling narratives effectively increased HPV immunization intentions (Lee *et al.*, 2018). • Delivery of an immunization information by co-ethnic research assistants was found to be successful in promoting behaviour changes in target populations (Chu *et al.*, 2021). • Trusted community members (e.g., lay health advisors, patient navigators) were found to have the ability to broker the relationships between healthcare providers and target population groups and act on their established social networks to diffuse information into the communities (Larkey *et al.*, 2012; McDonough *et al.*, 2016).
Gender and/or sex	• HPV immunization target populations were predominantly specified as girls and women (Chu *et al.*, 2021; Khani Jeihooni *et al.*, 2021; Larkey *et al.*, 2012; Lee *et al.*, 2018; Ma *et al.*, 2022; McDonough *et al.*, 2016; Olubodun *et al.*, 2022). • Barriers for women to seek a Pap test included the painful nature of the test; shame attributed to getting tested; inadequate knowledge; cultural and religious beliefs; and psychosocial causes (e.g., subjective norms, social pressures, embarrassment) (Khani Jeihooni *et al.*, 2021). • Women who had adequate knowledge of cervical cancer were more likely to recognize the risks, severity, susceptibility and benefits of cervical cancer screening (Khani Jeihooni *et al.*, 2021). • Subjective norms, such as support of family members and healthcare staff cooperation, impacted the intention and behaviour of women to seek cervical cancer screening (Khani Jeihooni *et al.*, 2021). • Findings were mixed regarding the influence of fathers and husbands on women receiving cervical cancer screening and children's decisions to receive HPV Immunization. One study indicated that Somali fathers had less influence than mothers on their decisions to immunize their children (Chu *et al.*, 2021). In some countries, husbands may need to consent before women are able to undergo cervical cancer screening. Thus, providing education sessions for husbands was recommended to reduce disapproval of screening (Olubodun *et al.*, 2022). • Overall, the reported preference to have a female sample collector for cervical cancer screening may indicate an opportunity to engage female physicians and nurses while reducing patients' shyness and shame (Olubodun *et al.*, 2022).

rates among males generally and that HPV-related cancer rates are predicted to rise among populations who do not have a cervix (29). This may be due to the prior focus of HPV vaccine promotions to prevent cervical cancer, which continues to act as a barrier for uptake of the newer nonavalent HPV vaccine that protects against oropharyngeal, anogenital and cervical cancer-causing strains of HPV. The LGBTQ2S+ community is more likely to experience an HPV infection and less likely to receive an HPV vaccine than heterosexual groups (30–32). Social support may support HPV vaccine uptake among LGBTQ2S+ people (33). As HPV infects both biological males and females and can lead to cancer in any person irrespective of their gender identity or

sexual orientation, future research should expand the evidence base concerning interventions utilizing social capital targeting LGBTQ2S+ populations and biological males.

Limitations

The strengths of this rapid review include the use of a systematic methodology for screening and data extraction and analysis, assessment of methodological quality and consideration of social factors. However, data synthesis was limited to a small sample of studies, which may reflect the heterogeneity of study designs and measures. As the included studies focused on interventions across the world, the generalizability, transferability and applicability of the review findings are context-dependent and the unique circumstances of each region and population should be considered. This creates opportunity for future research and implementation work focusing on the unique knowledge and awareness needs of each population, such that HPV immunization and cervical cancer screening is promoted as an autonomous, yet supported, culturally appropriate decision among disadvantaged populations.

Conclusion

This rapid review examined the evidence concerning the characteristics and impact of interventions utilizing social capital on HPV immunization and cervical cancer screening. It found limited and mixed results regarding the use of social capital as a mechanism to improve uptake of HPV immunization and cervical cancer screening. However, evidence suggests that interventions that consider and reflect the local context may increase the uptake of HPV immunization and cervical cancer screening. Given the strength of evidence from experiments and quasi-experiments, more research using those design studies are needed to understand the impacts of social capital interventions on HPV immunization and cervical cancer screening. Health researchers examining those programs should consider designing interventions that include social capital components that, for instance, enhance participants' trust of health practitioners and engage with religious leaders. Public health agencies should consider the promising results of culturally appropriate and tailored interventions containing components of social capital for creating positive change in HPV-related knowledge, attitudes, intentions and behaviours toward HPV immunization and cervical cancer screening. Further research must translate these psychological changes into HPV immunization and cervical cancer screening behaviours.

Authors' statement

CG — Writing–original draft, writing–review & editing
LKAS — Conceptualization, methodology, writing–review & editing
CIJN — Conceptualization, methodology, writing–review & editing
APB — Methodology, formal analysis, writing–review & editing, visualization
MOK — Formal analysis, writing–review & editing, visualization
BL — Formal analysis, writing–review & editing, visualization
LN — Methodology, writing–review & editing, project administration
KA — Conceptualization, methodology, writing–review & editing
EMO — Writing–review & editing

The content and view expressed in this article are those of the authors and do not necessarily reflect those of the Government of Canada.

Competing interests

None.

Acknowledgements

We are grateful to the Centre for Healthy Communities librarian for developing the search strategies and running the literature searches.

Funding

Funding provided, in whole or in part, by Alberta Health. Strategic direction and applied research support provided by the Alberta Health Services (AHS) Cancer Prevention and Screening Innovation (CPSI) team. Provision of funding by Alberta Health does not signify that this represents the policies or views of Alberta Health. The content and conclusions in this manuscript are those of the authors and do not necessarily reflect the official position of Alberta Health Services.

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Appendix

Table A1: Inclusion and exclusion criteria

Characteristics	Inclusion criteria	Exclusion criteria
Population	No limitation on population. All populations included. Populations can include, but are not limited to: • School aged, HPV immunization-eligible children. • Adults eligible for HPV immunization (18–26 years of age). • Women and people with a cervix eligible for cervical cancer screening. • Adults at risk for HPV-associated cancers (i.e., head, neck, anal, vaginal, vulvar, penile, oropharynx cancer), including high-risk populations (e.g., men who have sex with men).	None.
Intervention	Policy/program interventions related to social capital (primordial intervention); as a mechanism to, or in combination with interventions that improve HPV immunization AND/OR cervical cancer screening. • Interventions should be group or community-based. • Interventions aimed at increasing social capital should be at the upstream or midstream levels. • Interventions that aim to build trust in the healthcare system or build rapport within the population group (e.g., HPV immunization education program that increases social capital). • Knowledge and attitude interventions designed in a culturally relevant way to promote bonding within family, reliance on others, sense of community and trust (e.g., community-based programs creating opportunities for social interactions among participants). Interventions that do not explicitly outline that it is aimed at increasing or contain components of social capital (e.g., structural or cognitive social capital), BUT reports on social capital outcomes are included. • Social media as a platform for intervention (e.g., online interventions) is included if it specifies that it aims to increase social capital (e.g., trust, rapport, peer support, family support, online relationships or connections) OR it reports social capital outcomes. • Intervention focusing on improving knowledge and attitudes should have outcomes related to social capital (e.g., peer support, perceived social norms from family).	Interventions that ONLY focus on staff training or education, coping strategies related to needle phobias/medical procedures, traumas, anxiety, etc. delivered by professionals. • Interventions that are targeted to be delivered one-on-one or at individual-level. • Interventions that aim to change behaviours. General immunizations not related to HPV. Screening for cancers that are not cervical cancer. Interventions that do not explicitly outline that it aims to increase social capital or contains components of social capital AND does not report on social capital outcomes are excluded.
Comparator	None or any, as relevant.	None.
Outcomes	Impact/effectiveness outcomes MUST be related to HPV immunization AND/OR cervical cancer screening (e.g., HPV immunization uptake or participation, cervical cancer screening initiation in never screeners, incidence of HPV-associated cancers or outcomes, HPV vaccine acceptance, HPV immunization or cervical cancer screening intentions). Interventions that do not explicitly state that they aim to increase social capital must report on social capital outcomes to be included.	Studies that do not report on outcomes associated with HPV immunizations, cervical cancer screening, or HPV-associated cancers. Studies that do not measure or evaluate the impact or effectiveness of HPV immunization, cervical cancer screening, or HPV-associated cancers. Studies that only report changes in social capital or health inequities.
Setting	No limitation on settings. This includes, but is not limited to, healthcare settings, community-based settings and school-based settings. No limitation on geographical location. This includes, but is not limited to: • Urban locations • Rural locations • Suburban locations • Any country in the world	None.
Study design	Study is published in a peer-reviewed journal. Intervention studies: single group (pre-post), quasi-experimental (non-randomized interventions) and randomized controlled trials. Systematic reviews and meta-analyses that include any type of intervention studies as outlined above.	Primary research studies using qualitative methods and analysis. Observational studies, such as cohort, cross-sectional and case-control studies. Cost-effectiveness studies. Any other types of review, such as scoping reviews and narrative reviews. Descriptive studies and studies in the form of comments, editorials, letters to the editor, theoretical papers, books, book chapters, protocols, case studies, case reports, grey literature (e.g., magazine articles, dissertations, doctoral theses, conference papers, position statements, preprints). Systematic reviews and meta-analyses, including intervention studies (in inclusion criteria) and other types of study designs (outlined in exclusion criteria above), will be excluded, unless findings are reported separately for intervention studies.
Language	Full text is published in English.	Only abstract in English.
Date	Publication date between 2012 and 2022 (last 10 years).	Publication date prior to 2012.

Table A2: Quality of quantitative studies reviewed using the Effective Public Healthcare Panacea Project (EPHPP) quality assessment tool (n=7)

Study (in alphabetical order)	Selection bias	Study design	Confounding	Blinding	Data collection method	Withdrawal	Final rating
Khani Jeihooni *et al.*, 2021	Moderate	Strong	Strong	Moderate	Strong	Weak	Moderate
Chu *et al.*, 2021	Moderate	Moderate	Strong	Weak	Weak	Strong	Weak
Larkey *et al.*, 2012	Moderate	Strong	Strong	Moderate	Weak	Weak	Weak
Lee *et al.*, 2018	Weak	Strong	Weak	Moderate	Weak	Strong	Weak
Ma *et al.*, 2022	Weak	Moderate	Strong	Weak	Weak	Strong	Weak
McDonough *et al.*, 2016	Moderate	Moderate	Strong	Weak	Moderate	Weak	Weak
Olubodun *et al.*, 2022	Moderate	Strong	Weak	Moderate	Weak	Moderate	Weak

Congenital rubella syndrome, a case series

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Abstract

Rubella, or German measles, is a vaccine-preventable disease. Rubella infection is usually mild; however, infection in pregnancy is associated with severe outcomes for the baby, including pregnancy loss or a combination of developmental defects called congenital rubella syndrome. Within the last ten-year period, two cases of congenital rubella syndrome in Saskatchewan were reported to the provincial ministry and the Public Health Agency of Canada of the newborns of mothers who had recently arrived from Sub-Saharan Africa. Both infants had multiple health complications at birth consistent with congenital rubella and tested positive for the rubella virus. The article discusses the challenges encountered by the healthcare system in diagnosing, investigating, monitoring and managing cases of congenital rubella syndrome to prevent further sporadic transmission. The article emphasizes the need to provide additional support for cases and their households, especially new Canadians with less support to comply with public health advice and the importance of routine immunization to eliminate rubella globally.

Suggested citation: Medu OA, Mahajan P, Hennink M, Stang L, Anderson M, Tan B, Oyenubi A, Plamondon M, Salvadori MI, Franklin K, Primeau C, Hiebert J, Minion J, Diener T. Congenital rubella syndrome, a case series. Can Commun Dis Rep 2024;50(7/8):274–81. https://doi.org/10.14745/ccdr.v50i78a05

Keywords: congenital rubella syndrome, Canada, immigration, public health management, risk mitigation

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Introduction

Rubella, also known as German measles, is a vaccine-preventable disease of public health significance caused by the rubella virus. This disease typically presents in children and adults as a maculopapular rash, commonly preceded by a low-grade fever (1–3). While rubella infection is usually mild, infection in pregnancy is associated with severe outcomes for the baby, including pregnancy loss or a combination of developmental defects called congenital rubella syndrome (CRS). Congenital rubella syndrome can include low birth weight, heart, eye and hearing abnormalities, with or without microcephaly and other neurodevelopmental complications (2–4).

Prior to the introduction of rubella vaccines in the national immunization schedules, the disease would cause cyclic epidemics every three to 10 years (5). The last major rubella outbreak in the United States occurred from 1964 to 1965, causing 12.5 million infections, 20,000 cases of CRS, 11,000 pregnancy losses and approximately 2,000 neonatal deaths (6,7). In 2015, the Pan American Health Organization declared endemic rubella eliminated in the Americas, the first region to achieve this status (8,9). Rubella continues to transmit endemically globally, with prevalence highest in Africa, East Asia and South Asia (10).

The rubella vaccine was licensed in Canada in 1969. Soon after, the National Advisory Committee on Immunization endorsed a policy of mass immunization. Provinces readily initiated vaccination programs in the early 1970s, including Saskatchewan in 1971, leading to a significant decrease in the incidence of both rubella and CRS (9,11). The average incidence rate of rubella dropped from 37 cases per 100,000 people between 1969 and 1973 to fewer than one case per 100,000 people in 2005, the year rubella was eliminated in Canada (12,13). Since 2005, the rare cases of rubella or CRS diagnosed in Canada have been exclusively associated with virus importation (12).

Congenital rubella manifests either as congenital rubella infection or CRS. In congenital rubella infection, there is laboratory confirmation of infection in the absence of clinically compatible manifestations, while in CRS, there exists clinically compatible manifestations in addition to evidence of infection. The Canadian case definition requires the presence of any combination of the manifestations listed in **Table 1**.

Table 1: Congenital rubella syndrome clinically compatible manifestations

Column A	Column B
Cataracts or congenital glaucoma (either one or both count as one)	Purpura
Congenital heart defect	Hepatosplenomegaly
Sensorineural hearing loss	Microcephaly
Pigmentary retinopathy	Microphthalmia
	Developmental delay
	Meningoencephalitis
	Radiolucent bone disease
	Developmental or late-onset conditions such as diabetes and progressive panencephalitis and any other conditions possibly caused by rubella virus

Source: National case definition: Congenital rubella syndrome/infection

This article describes two recent cases of CRS in Canada, both acquired abroad. Given the relative rarity of these cases and lack of practical, updated guidelines regarding the public health management of CRS, we will also highlight public health management and risk mitigation approaches of sporadic rubella transmission.

Case reports

Case 1

The first case was born in the late 2010s from an immigrant mother, at a gestational age of 38 weeks and four days. At delivery, the baby was observed as small for gestational age, weighing 2.33 kg (i.e., less than the third percentile). The Apgar scores at birth were four and eight at one and five minutes, respectively. Clinical assessment of the infant in the immediate post-partum period revealed neonatal jaundice with an elevated total bilirubin of 307 µmol/L on admission to the neonatal intensive care unit. Further assessment revealed evidence of radiolucent bone disease, thrombocytopenia of 70×10^9 platelets/L and a patent ductus arteriosus.

Nasopharyngeal and throat swabs taken on day 25 after birth were positive for rubella virus by real-time reverse transcriptase-polymerase chain reaction (RT-PCR). A urine specimen was negative. Testing for inborn errors of metabolism was negative.

Upon review of the case, the mother and the family were found to have immigrated from Sub-Saharan Africa to Regina, Saskatchewan earlier in the calendar year. At the time, the mother was at approximately 12 weeks of gestation, but unaware of the pregnancy.

At the initial prenatal visit, the mother did not present written records of immunizations from her home country; however, she stated she was immunized as a child. Her serology showed a high rubella IgG titre, greater than 500 IU/ml. Titres for IgM were not performed, as the high-rubella titre values were thought to reflect immunity. The pregnancy was unremarkable and the mother did not recall any rash or flu-like illness. It is important to note that asymptomatic and subclinical rubella presentations do occur. Furthermore, the national immunization schedule in this patient's home country did not include rubella.

Over the next five years, the child was monitored by a paediatrician and developed a number of adverse sequelae consistent with congenital syndrome.

Case 2

A few years later, the public health office was alerted to a positive IgM rubella result in a two-day-old neonate, which was confirmed at the National Microbiology Laboratory by two additional independent methods. In this case, the mother had arrived in Regina, Saskatchewan from Sub-Saharan Africa at 29 weeks gestation. The baby was born to a 30-year-old mother via urgent caesarian section at 38 weeks and four days of gestation. Apgar scores at birth were four and eight at one and five minutes, respectively. The paediatrician noted microcephaly, with a head circumference of 31.5 cm (less than the third percentile) and dry, scaly, peeling skin. The rest of the newborn exam was unremarkable. A nasopharyngeal swab collected seven days after birth was positive for rubella virus by real-time RT-PCR (14). The urine specimen collected at the same time was inconclusive.

A case review revealed that an initial prenatal visit at 30 weeks showed an elevated rubella IgG titre of 256.6 IU/ml. As with the previous case, while the mother reported being vaccinated as a child, there were no written immunization records and the national immunization schedule of the country of origin did not include rubella vaccine.

Radiolucent bone disease was confirmed on X-rays done at two weeks of age and at the time of the writing of this report. Additional investigations are ongoing. Echocardiography showed a normal cardiac anatomy.

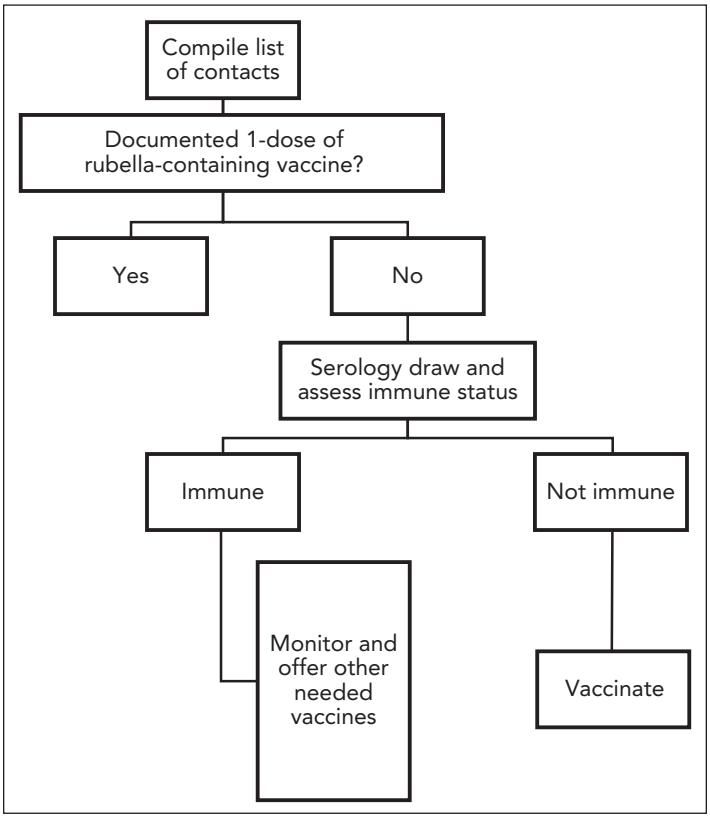
Public health management

This section highlights the public health response and the measures taken to mitigate the transmission risk from these cases.

Case notification and investigation

Following notification of the cases to local public health, investigations were initiated into the chronology of events to identify any possibility of in-country disease acquisition, as part of a risk assessment (**Figure 1**). Given the mothers' dates of arrival, dates of delivery and clinical histories, it was concluded that their rubella infections were unlikely to have been acquired within Canada and that only the infants were considered infectious.

Figure 1: Flowchart to determine public health action based on immunity



Transmission risk infection control

Children with CRS are considered to be infectious for the first year of life, unless repeated pharyngeal and urine testing (by RT-PCR and/or viral culture) are negative. In the home context, the risk is limited to non-immune contacts (especially susceptible pregnant visitors). Lessons learned from managing the first case were applied in the investigation and management of the second.

Dedicated staffing

As new immigrants are often less familiar with the Canadian healthcare system, dedicated staff were assigned to interface with the patients and their families. This helped to build trust and ensure consistency of practice, but also served to mitigate occupational risk exposures by limiting the number of people exposed to the case to a small number of professionals with confirmed rubella immunity.

Contact identification and management

To prevent further transmission within Canada, the focus was on the cases; immediate families, close contacts, healthcare contacts and the larger community.

The rubella immune status of immediate familial contacts was assessed. The National Advisory Committee on Immunization currently recommends a single dose of rubella vaccination to be considered immune, while two doses are required for immunity against measles, mumps and varicella (14). When no documented immunity or record of a rubella vaccine dose was available, a dose of rubella-containing vaccines (measles-mumps-rubella, or MMR) was provided. Where the measles vaccination record was also lacking, we offered a second dose of MMR to provide two-dose protection against measles. Additionally, for contacts with documented immunity but no documented evidence of receiving rubella vaccines, a similar catch-up schedule was offered, including rubella-containing vaccines (**Table 2**) (15).

Table 2: Summary table of public health actions

Individual/group	Public health actions
Mother	Had proof of immunity to rubella presumably from natural disease and offered catch-up vaccination
Newborn	Conducted ongoing clinical management for sequelae of CRS Practiced contact and droplet precautions while infectious Collected monthly nasopharyngeal swabs and urine samples for rubella RT-PCR
Household contacts	Verified rubella immunity status and offered catch-up vaccination
Healthcare providers	Practiced contact and droplet precautions for all encounters with the CRS case, as long as infectious Verified rubella immunity of exposed and potentially exposed healthcare provider(s)
Visitors to hospital and home	Monitored for symptoms among unvaccinated visitors prior to the case diagnosis until the end of the rubella incubation period; i.e., 12 to 23 days Subsequently restricted visitation to persons with documented immunity, with the appropriate contact and droplet precautions

Abbreviations: CRS, congenital rubella syndrome; RT-PCR, real-time reverse transcriptase-polymerase chain reaction

As these were new Canadians who often rely on support from persons from their country of origin (who might similarly not have rubella vaccination), lists of non-familial contacts were requested, assessed for immunity and provided vaccines where necessary. Recommendations were also provided that future contacts until the baby is no longer infectious be limited to rubella-immune individuals.

Social events

Cultural and religious events have significance for this population and we worked to ensure that these events were modified to limit the risk of transmission. Some of the activities identified include baby naming ceremonies, religious events and commemorative feasts. Modifications included smaller group sizes and only rubella-immune persons in attendance.

Healthcare-related infection control and environmental hygiene

The family was advised to maintain contact and droplet precautions, as well as ensuring a two-metre distance between baby and unimmunized persons where possible. Given that transmission is through nasopharyngeal secretions and urine, guidance was provided on dealing with potentially contaminated items.

With the expected increased frequency of healthcare visits, exposures in these settings were anticipated and the risk of transmission mitigated by appropriate infection control precautions. In the acute care component of the healthcare system, the patients were flagged using a similar process used for other medically important infections on the arrival electronic system. The mother-baby pair was flagged because the baby in most cases accompanied the mother. In addition, we proactively communicated with the facilities where visits were expected regarding infection control practices to mitigate exposure. We replicated this proactive communication with independent physician offices and the sample letter provided is shown in the **Appendix**.

Furthermore, clinical offices were advised to limit the pool of staff and patients with potential for contact with the infant. Similar to the measures taken by public health staff, documented proof of immunity was required for staff who provided care to the patient (Appendix).

Rubella is an enveloped virus, which makes it susceptible to the cleaning products used for low-level disinfection (2). Safety data sheet information notes that the virions are susceptible to either chloroform, formaldehyde, 1% sodium hypochlorite and 70% ethanol-based disinfectants (16). In practice, regular environmental cleaning supplies such as accelerated hydrogen peroxide wipes would provide sufficient disinfection. It is best to use products commonly used for disinfection in hospitals and households on a regular basis.

Laboratory testing

The public health staff conducted monthly home visits to assess the infant and collect nasopharyngeal swabs and a urine sample for rubella RT-PCR. Given the expected prolonged viral shedding in babies with CRS, two consecutive negative RT-PCR results one month apart would be required to medically clear the baby and conclude that the infant is no longer infectious, which is the same period required by the Pan American Health Organization to achieve adequate CRS surveillance in an elimination setting (17–20). Ultimately, we medically cleared our first case in the twelfth month of life.

For both CRS cases, both a nasopharyngeal swab and urine specimen were collected early after birth and only the nasopharyngeal swabs were RT-PCR positive. In the first case, the nasopharyngeal swab became negative at eight months of age. The urine became RT-PCR positive at three months of age and remained positive longer than the nasopharyngeal swab, still being positive at 10 months of age. For the second case, the urine returned a first negative at three months of age while the nasopharyngeal swab remained positive as of four months following the first swab. The laboratory manual developed by the World Health Organization (WHO)'s Global Measles and Rubella Laboratory Network notes that throat swabs are the preferred specimen for CRS confirmation by RT-PCR (21). The reduced sensitivity for rubella viral detection by RT-PCR seen in the urine specimen is likely related to the difficulty in obtaining urine specimens in adequate volume (more than 10 ml) from infants.

The use of RT-PCR testing could lead to a longer isolation period compared to that for a viral culture (22,23). This is because a viral culture detects only infectious virus, while RT-PCR can also detect neutralized or inactive virus.

Using WHO's standardized rubella genotyping methods, the first case was determined to be of genotype 2B and the second case of genotype 1G (24,25). Genotype 2B has a wide global distribution and has been noted to be endemic in African countries near the mother's country of origin (26). On the other hand, relatively few sequences of genotype 1G have been reported and none have been reported to the WHO Global Rubella sequence database in recent years (27). The detection of this imported 1G case likely reflects a lack of sufficient genotypic surveillance in areas with higher rubella virus circulation and highlights the importance of obtaining rubella genotypes in cases occurring in low prevalence rubella countries such as Canada.

Travel, transit, housing and other considerations

Both cases were new Canadians, with relative unfamiliarity with local services. We identified multiple challenges including transportation, housing, immigration documentation and childcare needs.

Our public health team provided transportation support to and from medical appointments until the infants were deemed no longer infectious. For other non-medical transportation within the city, our recommendation was the use of personal vehicles where available and possible, followed by single passenger transportation modes and finally public transit if needed. We provided guidance about contact and droplet precautions and this, in our assessment, mitigated transmission risks on public transportation. We recommended against air travel given the hypothetical infection risk to unvaccinated pregnant contacts during travel.

For childcare, we were explicit in informing the parents/caregivers of both cases that the cases could not attend regular daycares due to the possible presence of non-immune persons. Instead, public health encouraged the parents to identify immune persons who were able to provide needed childcare.

Housing and immigration documentation needs were outside of the mandate of the public health teams; however, we established connections with the respective agencies, both provincial and federal and advocated on behalf of our clients with varying levels of success.

Case reporting

Due to the rare nature of CRS in Canada, these case reports were highly scrutinized by provincial and national health agencies, requiring that local public health provide extensive case investigation details. Furthermore, Canada committed to the Pan American Health Organization's goal of rubella elimination in the Americas in 2005 and as part of Canada's commitment to the International Health Regulations, all cases of rubella must be reported to the WHO (12). These case reporting requirements are important to maintain global health security and contribute to global guidance on the management of public health communicable disease risks.

Public health learning points

Over the course of responding to and managing these cases, we identified several learning points.

First, a positive rubella IgG is generally assumed to represent vaccine-derived immunity in Canadian-born pregnant women. However, this should not be assumed for persons arriving from countries where rubella activity is still ongoing. In both of the cases described in this article, the mothers had significantly elevated rubella IgG titres, which were interpreted as reassurance of immunity when they would have benefitted from additional evaluation. Consequently, we suggest that during pregnancies in which positive rubella IgG with elevated titres is seen, clinicians consider requesting a rubella IgM test in pregnant women whose childhood immunization history is unclear and who have recently been in areas with endemic rubella (23). Rubella IgG avidity testing can further be used to differentiate a recent exposure (low avidity) from a past exposure (high avidity) (23,28).

Secondly, due to the reduced incidence of rubella disease in Canada, there is a limited pool of experience to inform the best public health management and surveillance practices (18,29–31). As with most public health questions, we ultimately balanced the benefits of our risk control and mitigation approach with any harms that may occur. As far as we are aware, no further transmission occurred from the first case. Therefore, it would be helpful to have national guidelines to inform the public health management of a case of congenital rubella infection and CRS.

Finally, it is important to note that recent immigrants may face additional challenges when complying with public health advice, due to their limited ties to the community and access to supportive resources. As such, it may be necessary to provide additional assistance to cases of congenital rubella infection and CRS to ensure they have the resources required to comply with recommendations to mitigate the spread of illness. We recommend that jurisdictions consider providing resources to support these cases until they are no longer contagious.

Conclusion

International travel in an increasingly global community impacts disease transmission dynamics and facilitates incident cases of imported communicable disease from high-incidence to low-incidence jurisdictions. It is expected that this will only increase as the impacts of the COVID-19 pandemic slowly come to light, including decreased routine childhood vaccine uptake coupled with "pent up" international travel demands (32). This emphasizes the critical importance of preventing and controlling vaccine-preventable diseases in both of these contexts.

As illustrated in these cases, not all countries offer childhood rubella immunization, which continues to impact global ability to eliminate this infection. Rubella elimination is achievable with routine immunization at the population-level. The WHO should be supported to facilitate the Expanded Programme on Immunization where it is needed most, in countries with high incidences of preventable conditions.

We describe the intensive resources at the local level required to manage two cases of CRS in a low-incidence, high-income country setting. Regardless of the immediate public health follow-up of infectious cases, these cases emphasize the very real risk of lifelong adverse outcomes among babies born with CRS. Our priority was ensuring sporadic transmission in Canada did not occur; however, the international public health community as a whole should be equally concerned with preventing and eliminating rubella globally. Rubella-containing vaccines have high efficacy, immunogenicity and safety; all children should have the opportunity to be immunized.

Authors' statement

OM — Conceptualization, methodology, writing–original draft, writing–review & editing
PM — Investigation, resources, writing–review
MH — Conceptualization, methodology, writing–original draft, writing–review & editing
LS — Investigation, resources, writing–review
MA — Methodology, writing–review & editing
BT — Investigation, resources, writing–review & editing, validation
AO — Investigation, clinical management, writing–review & editing
MP — Methodology, writing–review & editing
MIS — Methodology, writing–review & editing
KF — Methodology, writing–review & editing
CP — Methodology, writing–review & editing
JH — Investigation, writing–review & editing
JM — Conceptualization, methodology, investigation, writing–review & editing
TD — Conceptualization, methodology, writing–original draft, writing–review & editing

Competing interests

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. JM reports receiving grants from the Public Health Agency of Canada (PHAC), Saskatchewan Health Research Foundation (SHRF) and Canadian Institutes of Health Research (CIHR) paid to collaborating academic institutions.

Acknowledgements

Our thanks to the cases and families that we reported and the public health communicable diseases staff.

Funding

This study received no specific grant or funding.

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Appendix: Sample Letter to healthcare practitioners

Dear Provider,

Re: XXXXXXXXXXXXXX

We are writing to you concerning one of your patients who recently delivered a baby diagnosed with Congenital Rubella Syndrome (CRS). As cases of CRS potentially remain infectious for upwards of one year and because they, i.e., mother-baby pair, would require ongoing frequent clinical visits, we are advising of best infection control practices aimed at limiting exposure and, ultimately, transmission risk. Please note that the mother in this is no longer infectious.

The following are the recommended best practices:

Booking appointments at the end of the day is preferred.

Preferably, ensure no patients are in the waiting room.

Guide mother and baby directly into a private room.

The recommended precautions for PPE are contact and droplet.

Ensure any staff entering the room mother and baby are in are immune to rubella (either by vaccine or serology) and are not pregnant.

We would like to point out that rubella, being an enveloped virus, can be effectively eliminated by cleaning products meant for low-level disinfection. The Saskatchewan Health Authority currently uses such products, including Accel wipes. For additional IPAC-related information, please review the College of Physicians and Surgeons of Saskatchewan IPAC resource located here https://www.cps.sk.ca/iMIS/Documents/Legislation/Policies/GUIDELINE%20-%20IPAC%20Clinical%20Office%20Practice.pdf

Due to the nature of this case, and to protect the community from local transmission, public health is assisting the mother in transportation to and from appointments. We have a dedicated staff member for this who has other clients they need to assist with throughout the day. It would be greatly appreciated if appointment times could be minimized to reduce potential exposure times to staff and other patients.

Finally, due to organizational risk policy, staff cannot be alone with the baby, watch or care for the infant.

We appreciate your attention to this matter, and please reach out if you have any questions.

Sincerely,

Medical Health Officer

CCDR

CANADA COMMUNICABLE DISEASE REPORT

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Public Health Agency of Canada

Published by authority of the Minister of Health.

This publication is also available online at

https://www.canada.ca/ccdr

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