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OIAC Ontario Immunization Advisory Committee
CCOI Comité consultatif ontarien de l'immunisation

Recommendations for an Expanded Human Papillomavirus Immunization Program

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Overview

In July 2024, the National Advisory Committee on Immunization (NACI) updated its immunization guidance for human papillomavirus (HPV) vaccine.[1] In their updated guidance, NACI recommends that individuals 9 to 20 years of age should receive one dose of the nine-valent HPV vaccine (9vHPV), while individuals 21 to 26 years of age should receive two doses if not previously vaccinated. In Ontario, students in grade 7 (typically 12 to 13 years of age) currently receive two doses of 9vHPV through the routine school-based immunization program, with catch-up offered until the end of grade 12.[2] Males 9 to 26 years of age who identify as men who have sex with men (MSM) are also eligible for HPV vaccination under Ontario's high-risk program (see Note on Terminology).

These updated NACI guidelines provided an opportunity for Ontario to review its HPV immunization program and potentially expand eligibility to other age or risk groups. At the request of the Ministry of Health, the Ontario Immunization Advisory Committee (OIAC) considered potential options for HPV immunization program expansion. Over a series of three meetings held on October 23, November 13, and December 11, 2024, the OIAC reviewed and discussed scientific evidence supporting an age-based program expansion for all individuals up to and including age 26 and a risk-based program expansion for select high-risk groups up to and including age 45. These options were not mutually exclusive.

At the December 11th meeting, OIAC members voted unanimously to recommend an age-based program expansion to extend eligibility for the routine HPV immunization program from grade 12 (current) to age 26 inclusive. This recommendation was made assuming that Ontario will adopt NACI's updated schedule (one dose for individuals 9 to 20 years of age and two doses for individuals 21 to 26 years of age).

Recommendation: The Ontario Immunization Advisory Committee recommends extending the maximum age of eligibility for the routine publicly-funded HPV immunization program to age 26 inclusive.

Background

HPV is a highly prevalent sexually transmitted infection.[3,4] Without vaccination, it is estimated that more than 80% of people will have at least one HPV infection before age 45.[5] Most individuals acquire their first HPV infection within a few years of becoming sexually active.[6,7] These incident HPV infections will typically clear within six to 12 months without clinical disease;[8,9] however, persistent infection with oncogenic HPV types can cause cervical, vaginal/vulvar, anal, penile, and oropharyngeal cancers.[10] Despite screening, cervical cancer remains the most common HPV-related cancer in females.[11] More than 40% of all HPV-related cancers occur in males, with oropharyngeal cancer being the most common.[11] Certain populations, such as gay, bisexual and other MSM and people with HIV or other immunocompromising conditions, are at higher risk of HPV infection and/or disease progression.[3,4,12,13]

All Canadian provinces and territories, including Ontario, currently use 9vHPV for their publicly-funded immunization programs. This vaccine is authorized for use in Canada in individuals 9 to 45 years of age.[14] It protects against seven oncogenic (or high-risk) HPV types (16, 18, 31, 33, 45, 52 and 58), which cause up to 95% of HPV-related cancers,[15] and two low-risk HPV types (6 and 11), which are associated with anogenital warts.

Ontario's HPV Immunization Program

Since the 2007–08 school year, Ontario has provided publicly-funded HPV vaccine as part of its school-based program. Initially, the four-valent HPV vaccine (4vHPV) was offered only to female students in grade 8 according to a three-dose schedule but was changed to a two-dose schedule in 2015−16 and expanded to all students in grade 7 in 2016–17. In 2017−18, Ontario switched from 4vHPV to the newer 9vHPV. Thus, in Ontario, females born in 1994 and later and males born in 2004 and later have been eligible for the school-based HPV immunization program. These program and policy changes reflect evolving indications and recommendations for HPV vaccines over time.[16]

In Ontario, students in grade 7 are currently eligible for two doses of 9vHPV if they are younger than 15 years of age.[2] Three doses are offered to students who initiate their vaccine series at 15 years of age and older or are immunocompromised or living with HIV, regardless of age. Additionally, males 9 to 26 years of age who identify as MSM are eligible for two or three doses of 9vHPV, depending on age and immunocompetency status. Students who missed or declined doses remain eligible for catch-up immunization until the end of grade 12. Until August 2024, the Ministry of Health had temporarily extended eligibility for the catch-up program beyond grade 12 to students who graduated during the COVID-19 pandemic (2019–20 to 2022–23 school years) due to reduced availability of school-based immunization programs and missed opportunities for vaccinating affected cohorts during this period.

Updated Guidance for a Reduced-Dose HPV Immunization Schedule

In December 2022, the World Health Organization (WHO) released a position paper on HPV vaccines recommending a one- or two-dose schedule for girls and women 9 to 20 years of age and a two-dose schedule for women 21 years of age and older based on emerging evidence from randomized controlled trials and observational studies showing the efficacy and effectiveness of a single dose in younger populations.[17] This updated WHO guidance prompted several countries, including Canada, to review their HPV immunization schedules.

In July 2024, NACI released its updated recommendations for a reduced-dose HPV immunization schedule,[1] aligned with the WHO's position paper and publicly-funded immunization programs in other high-income countries, such as the United Kingdom and Australia.[18,19] Table 1 summarizes NACI's recommended immunization schedule for 9vHPV.

Table 1: NACI Recommended 9vHPV Immunization Schedule[1]

Group(s)	Number of Doses
Individuals 9 to 20 years of age	1 dose
Individuals 21 to 26 years of age	2 doses[a]
Individuals 27 years of age and older	2 doses[a]
Individuals 9 years of age and older who are immunocompromised or living with HIV	3 doses[b]

Notes: [a] Two doses should be administered at least 24 weeks (6 months) apart.
[b] The minimum interval between the first and second doses of vaccine is 4 weeks (1 month), the minimum interval between the second and third doses of vaccine is 12 weeks (3 months), and the minimum interval between the first and last doses is 24 weeks (6 months).

In their latest statement, NACI continues to recommend immunization with 9vHPV for all individuals 9 to 26 years of age (strong recommendation) and advises that individuals 27 years of age and older may receive 9vHPV based on individual-level shared decision making with a healthcare provider (discretionary recommendation).[1] NACI does not make any recommendations for specific high-risk groups, aside from recommending a three-dose schedule for individuals who are immunocompromised or living with HIV (Table 1).

Note on Terminology

The acronym "MSM" (men who have sex with men) has been used in this statement for consistency with the language in the current Ontario immunization schedule and literature cited in this statement; however, the OIAC acknowledges that "GBM" (gay, bisexual and other men who have sex with men) is the more inclusive terminology that may include cis- and transgender individuals who identify as men as well as two-spirit and non-binary people. The use of "female" and "male" and "women" and "man" descriptors in this statement reflects historic immunization policy in Ontario. The current Ontario immunization schedule refers to "students" without specifying sex or gender.

Evidence Summary for Age-Based Program Expansion

To inform its recommendation for an age-based program expansion, OIAC members reviewed evidence on the epidemiology and burden of HPV-related disease across the lifespan; immunogenicity and vaccine efficacy and effectiveness by age at vaccine initiation and in individuals with prior HPV exposure; school-based immunization coverage in Ontario; and cost-effectiveness of catch-up programs. As Ontario students in grades 7 to 12 (typically 12 to 18 years of age) are currently eligible for publicly-funded HPV vaccine, this evidence review focused on individuals 19 to 26 years of age. Additionally, OIAC members reviewed a jurisdictional scan of routine and high-risk HPV immunization programs in other Canadian provinces and territories and high-income countries with publicly-funded programs, along with ethics, equity, feasibility and acceptability (EEFA) considerations.

The following factors were influential in members' recommendation to expand eligibility for the routine program to age 26 inclusive:

- Considered to be more equitable, as it would encompass all high-risk groups, along with individuals who missed or declined HPV vaccine through school-based programs and newcomers to Canada
- Minimize stigma and discrimination associated with disclosing eligibility for the high-risk program
- Evidence that HPV vaccines are immunogenic and effective in individuals up to age 26, although protection declines with older age at vaccine initiation
- Would be more feasible to operationalize than a risk-based approach
- Would better align Ontario's HPV immunization program with NACI's universal recommendation for all individuals 9 to 26 years of age and eligibility in other provinces and territories

Epidemiology and Burden of Disease

Individuals remain at risk for HPV infection throughout their lifetime. New sexual partner acquisition typically peaks in the early 20s and is positively correlated with lifetime number of sexual partners in both males and females.[20-22] Incident HPV infection and reinfection with the same or a different type is associated with having new sexual partners, suggesting that immunity acquired from natural infection may be insufficient to protect against reinfection.[23,24] In mid-adult women (25 to 65 years of age), most incident HPV detections are attributable to changing sexual behaviours, rather than reactivation of latent infections, but this attributable risk proportion declines with older age.[25]

In females without HIV, prevalence of high-risk HPV types at cervical (6–30%) and anal (8–18%) sites is highest in young women in their late teens and early 20s,[4] corresponding to the peak age of new partner acquisition.[20] Conversely, in females with HIV, prevalence remains high for both cervical (34–47%) and anal (39–53%) infection across the lifespan.[4] In males, anal HPV prevalence increases during adolescence and early adulthood but remains constant in all adult age groups,[3] in contrast to females where prevalence declines with increasing age.[4] These differences may reflect lower natural immunity, higher reactivation rates or different sexual behaviours in males.[26] MSM with HIV have the highest anal prevalence of high-risk HPV types (58–79%), followed by MSM without HIV (24–49%) and heterosexual males with HIV (14–31%).[3]

Immunogenicity

Although a correlate of protection has not been established, HPV vaccines are immunogenic in both males and females up to age 45 based on clinical trials,[27,28] and immune responses are sustained up to 14-years post-immunization.[29-31] HPV vaccines have greater immunogenicity and higher levels of antibody persistence over time when given at younger ages.[32-34] However, despite immune responses being inversely proportional to age, antibody titres following vaccination remain above seropositivity thresholds in older age groups, including those vaccinated in their 20s, 30s or 40s.[35] In immunobridging studies, antibody titres in females 9 to 14 years of age who received two doses were non-inferior to females 16 to 26 years of age who received three doses,[32,33] including in long-term follow-up studies.[36,37]

Vaccine Efficacy/Effectiveness

The pivotal efficacy trials of HPV vaccine were conducted in individuals 16 to 26 years of age.[38-41] In females who received all three doses and had no prior history of HPV infection or disease (per-protocol efficacy population), vaccine efficacy against high-grade cervical lesions exceeded 94%, including in those vaccinated at 21 years of age and older.[42] Conversely, vaccine efficacy declined from 69% in those vaccinated at 17 years of age and younger to 31% in those vaccinated at 21 years of age and older in females who received at least one dose and may have been previously exposed to HPV (intention-to-treat population). In subsequent trials, HPV vaccine was significantly protective, with efficacy exceeding 82% in all age groups, against persistent HPV infection, cervical lesions and anogenital warts in previously uninfected females 24 to 45 years of age,[43] consistent with data in younger women.[38,39,44,45]

Currently authorized HPV vaccines are prophylactic and have no evidence of a therapeutic effect against active infection or disease progression.[38,39,46] HPV vaccines are thus most effective in people who are vaccinated at younger ages before sexual exposure. However, HPV vaccines can protect against new infection in those with prior exposure to different HPV types,[47] and against reinfection or reactivation with the same HPV type.[48-50] In a meta-analysis of eight randomized clinical trials, vaccine efficacy exceeded 80% in seropositive but HPV DNA-negative women, representing women who have evidence of prior exposure but not an active infection.[50]

In observational studies, vaccine effectiveness declines with older age at vaccination.[51] Despite this trend, statistically significant vaccine effectiveness has been observed in individuals who initiated vaccination in their late teens or 20s in real-world settings,[51] including against cervical cancer outcomes,[52-54] and in those who received one or two doses.[55] These observational studies have a moderate-to-high risk of bias due to the inclusion of prevalent cases at the time of vaccination, since prophylactic HPV vaccines would have no effect against active infection with prevalent types, and outcome misclassification.[51] These findings suggest that the lower vaccine efficacy and effectiveness observed at older ages is likely due to prior HPV exposure, rather than a true age effect.

Immunization Coverage

Up-to-date HPV immunization coverage in Ontario's school-based program has lagged behind other adolescent vaccines, with significant additional impacts observed during the COVID-19 pandemic. Two-dose coverage of HPV vaccine among grade 7 students fell to 52% and 46% during the 2019−20 and 2020−21 school years (representing the 2007 and 2008 birth cohorts, respectively) that were most impacted by the COVID-19 pandemic.[56] Even before the COVID-19 pandemic, two-dose coverage was around 60% for the 2013–14 to 2018–19 school years, representing the birth cohorts of young adults who are turning 19 to 25 years of age in 2025–26.[56] In the 2023–24 school year, just over half of Ontario grade 7 students had received two doses of 9vHPV, while 68% had received at least one dose.[56]

Population-Level Impacts and Cost Effectiveness

In a meta-analysis of HPV immunization programs globally, significant population impacts were observed in female cohorts targeted for HPV vaccination up to eight years post-implementation, with herd immunity effects seen in non-targeted cohorts.[57] Countries that implemented multi-cohort HPV immunization programs and achieved coverage exceeding 50% saw the greatest impacts.[57]

Studies on the cost-effectiveness of HPV catch-up programs in Canada are not available. Prior modelling studies in the United States found that catch-up immunization of females through age 26 and males through age 21 (which was the current recommendation in the United States at the time) was cost-saving compared with no vaccination or vaccination of adults up to 45 years of age.[58,59] Incremental cost-effectiveness ratios ranged from $830,000 USD to $1,843,000 USD for vaccinating cohorts less than or equal to 30, 40 or 45 years of age compared with the current recommendation.[58] These findings may have limited relevance to a Canadian setting due to differences in vaccine price, health care costs and other modelling assumptions.

Jurisdictional Scan of HPV Immunization Programs in Other Provinces and Territories and Countries

All 13 Canadian provinces and territories have school-based HPV immunization programs, with most jurisdictions offering two doses of 9vHPV in grade 6 or 7 as of September 2024. (Quebec and Yukon have already transitioned to a one-dose program for the 2024–25 school year.) Nine provinces and territories have publicly-funded catch-up programs for young adults outside of their school-based program: one to age 20, six to age 26 and two define eligibility based on birth year (Table 2). Additionally, nine provinces and territories, including Ontario, have a high-risk HPV immunization program, with some jurisdictions offering HPV vaccine to select high-risk groups up to age 45. As in Ontario, these HPV immunization programs are under review following the release of the updated NACI recommendations in July 2024.[1]

Age-based programs are also in place in several other countries, including the United Kingdom and Australia, which offer publicly-funded HPV vaccine to all individuals 11 to 24 years of age and 9 to 25 years of age, respectively.[18,19] In the United Kingdom, gay, bisexual and other MSM 45 years of age and younger who attend sexual health or HIV clinics are also eligible for HPV vaccine under their national publicly-funded program.[18]

Table 2: Jurisdictional Scan of HPV Immunization Programs in Canadian Provinces and Territories as of September 2024

Province/Territory	School-Based Program	Catch-Up Program	High-Risk Program: MSM and/or Transgender	High-Risk Program: People with HIV	High-Risk Program: Immunocompromised	High-Risk Program: Other
Ontario	Grade 7 (2 doses)	Until end of grade 12	9–26 years old	No	No	No
British Columbia	Grade 6 (2 doses)	Until age 18	19–26 years old[a]	9–26 years old	No	Street-involved cisgender males 19–26 years old
Alberta	Grade 6 (2 doses)	Until age 26	No	No	9–45 years old[b]	No
Saskatchewan	Grade 6 (2 doses)	Until age 26	No	9–26 years old	9–26 years old[c]	No
Manitoba	Grade 6 (2 doses)	1997 and later birth cohorts (females) or 2002 and later birth cohorts (males)	9–26 years old[d]	9–45 years old (females) or 9–26 years old (males)	9–45 years old (females) or 9–26 years old (males)[e]	Select groups[f]
Quebec	Grade 4 (1 dose)	Until age 20	≤26 years old[g]	21–45 years old	21–45 years old	No
New Brunswick	Grade 7 (2 doses)	Until age 26	No	No	No	No
Nova Scotia	Grade 7 (2 doses)	Until age 18	≤45 years old	≤45 years old	No	No
Prince Edward Island	Grade 6 (2 doses)	2007 and later birth cohorts (females) or 2012 and later birth cohorts (males)	No age limit	No age limit	No	Select groups[h]
Newfoundland	Grade 6 (2 doses)	No	No	No	No	No
Yukon	Grade 6 (1 dose)	Until age 26	No	9–45 years old	9–26 years old	No
Northwest Territories	Grade 6 (2 doses)	Until age 26	No	No	No	No
Nunavut	Grade 6 (2 doses)	Until age 26	No	No	No	No

Notes: [a] Includes individuals not yet sexually active but questioning their sexual orientation and those who identify as two-spirit, transgender, or non-binary
[b] Includes solid organ transplant, stem cell transplant or chimeric antigen receptor (CAR) T-cell therapy
[c] Includes individuals with acquired compliment deficiency, congenital immunodeficiency, or immunocompromised due to disease or treatment
[d] Includes males who identify as gay or bisexual and trans men and trans women
[e] Includes individuals who have congenital immune deficiencies, acquired immune deficiencies or CAR T-cell therapy and patients who have malignant neoplasms or are hypo- or asplenic under the care of a haematologist or oncologist
[f] Includes males ≥18 years of age who have ever been incarcerated; individuals with recurrent respiratory papillomatosis; females 9 to 45 years of age who have a newly diagnosed high-grade abnormal cervical/Pap smear result; females 9 to 45 years of age and males 9 to 26 years of age who are victims of sexual assault
[g] Includes men who have or plan to have sex with men
[h] Includes males 18 to 26 years of age who have unprotected sex with multiple partners or a history of genital warts and females 18 to 45 years of age who have unprotected sex with multiple partners, a history of genital warts, or an abnormal Pap test

Ethics, Equity, Acceptability and Feasibility (EEFA) Considerations

OIAC members considered a universal, age-based program expansion to be more ethical and equitable than a risk-based approach. An age-based approach would encompass all high-risk groups, including those not under consideration for risk-based program expansion, while minimizing stigma and discrimination associated with having to disclose sexual behaviours or risk factors (e.g., HIV status, sexual orientation) to be eligible for the high-risk program.[60-62] Certain equity-deserving populations, such as recent immigrants and refugees and people who identify as Indigenous or live in rural, remote or Northern Ontario regions, may experience intersecting socioeconomic, cultural and structural determinants of health that result in barriers to access and uptake of preventive health care services, such as HPV immunization and cervical cancer screening.[63-69] As a result, these groups may be at increased risk of HPV infection and/or disease progression, if exposed.

Given changes to Ontario's HPV vaccine eligibility over time, a harmonized, age-based approach would enable persons of all genders up to and including age 26 who missed or declined HPV vaccine through school-based programs to benefit from HPV vaccination, without requesting parental consent, along with recent newcomers to Canada. Publicly-funded, universal programs have been shown to reduce access barriers and improve uptake, including among high-risk groups.[70-72] In a Canadian systematic review, HPV vaccine uptake was found to be higher in school-based versus community-based programs and when vaccines were publicly-funded versus requiring individuals to pay out-of-pocket.[72]

An age-based approach was considered more feasible to operationalize than a risk-based approach in primary care settings outside of school-based programs. It would also remove the onus being placed on individuals or their health care provider to be aware of and interpret high-risk program eligibility.

Additional Considerations

- Within an age-based program expansion, the OIAC encourages the Ministry of Health to implement targeted strategies to promote vaccine confidence, access and uptake for eligible populations who may have limited engagement with the health system. These targeted strategies will be particularly important for individuals who are at increased risk of HPV infection and/or disease progression and/or have historically had suboptimal coverage of HPV vaccine or low rates of cervical cancer screening due to intersecting socioeconomic, cultural and structural determinants of health.
- The OIAC also suggests that the Ministry of Health facilitate enhanced data collection and research to evaluate the HPV immunization program over time, including studies to monitor and evaluate vaccine coverage, vaccine effectiveness, and population-level impacts, particularly for equity-deserving groups who may face greater barriers to accessing preventive health care services and/or have historically been excluded from research studies.
- The OIAC continues to recommend that Ontario develop and implement a comprehensive electronic immunization registry to provide real-time, individual-level immunization data to facilitate program monitoring, evaluation and research.[73] Immunization providers could use such a registry to identify individuals 26 years of age and younger who are not up-to-date for immunization and offer HPV vaccination in health care settings outside of school-based programs.

Evidence Summary for Risk-based Program Expansion

OIAC members also considered a risk-based program expansion for select high-risk groups up to and including age 45. The OIAC secretariat identified these groups under consideration for high-risk program expansion in consultation with the Ministry of Health. These groups included populations having a high burden of HPV-related infection and/or disease based on published literature. Certain equity-deserving groups, such as recent immigrants and refugees and Indigenous populations, which were specifically mentioned in the recent NACI statement on HPV immunization as groups having historically low uptake of HPV vaccine or cervical cancer screening, were also included.[1]

Select groups under consideration for high-risk program expansion

- Gay, bisexual, and other men who have sex with men
- People with HIV
- People who are immunocompromised due to disease or therapy
- People with a history of anogenital warts or HPV-related pre-cancers or cancer
- People with a history of sexual violence
- People who identify as Indigenous or who live in rural, remote or Northern Ontario regions
- Recent immigrants or refugees

To inform discussions on risk-based program expansion, OIAC members reviewed scientific evidence on the epidemiology, burden of disease, safety, immunogenicity, vaccine efficacy and effectiveness, vaccine uptake and cervical cancer screening rates in these select high-risk groups and cost-effectiveness of routine versus targeted immunization strategies. Table 3 summarizes the evidence supporting expanded risk-based eligibility for select high-risk groups under consideration for program expansion.

Given members' recommendation to expand eligibility to age 26 inclusive, the evidence review for the risk-based expansion focused on individuals 27 to 45 years of age. However, members did not reach a consensus on which high-risk groups, if any, should be recommended within this older age range.

The following factors were influential in members' discussion of high-risk program expansion:

- Balance of evidence with certain groups at higher risk of HPV acquisition and disease progression (e.g., people with HIV or other immunocompromising conditions) also potentially having lower immunogenicity and efficacy in response to HPV vaccination
- Lack of high-quality evidence and cost-effectiveness data for certain high-risk groups and persons 27 to 45 years of age, especially given lower expected immunogenicity and/or efficacy
- Equity concerns with certain high-risk groups tending to have lower access to and uptake of HPV prevention services due to intersecting socioeconomic, cultural and structural factors
- Heterogeneity of risk within groups and challenges with defining eligibility for certain high-risk groups (e.g., those who reside in rural, remote or Northern regions)
- Rationale for not considering other groups at increased risk of HPV infection (e.g., sex workers, individuals with a recent sexually transmitted infection) for potential program expansion
- Consideration for eligibility based on sexual behaviours, such as having new or ongoing sexual exposure risk, rather than membership in select high-risk groups

Table 3: Summary of Evidence Supporting Expanded Risk-Based Eligibility for Select High-Risk Groups

Group	Epidemiology and Burden of Disease	Safety and Immunogenicity	Vaccine Efficacy/Effectiveness	Vaccine Uptake and Cervical Cancer Screening
Gay, bisexual, and other men who have sex with men (MSM)	• MSM, particularly those with HIV, experience a disproportionate burden of HPV-related disease[3,13,74] • MSM with HIV have the highest incidence of anal HPV infection and longest time to clearance[9] • Anal prevalence of high-risk HPV types >60% in MSM with HIV and >40% in MSM without HIV across the lifespan[3]	• HPV vaccines are safe and immunogenic in MSM up to age 45[28]	• Vaccine efficacy (3 doses) of 78% against anal HPV-related disease in MSM age 16–26[41] • Vaccine effectiveness of 20−40% against prevalent/incident infection in MSM up to age 45[75-78] • Higher vaccine effectiveness in MSM vaccinated at younger ages before HPV exposure or soon after sexual debut, as in the general population[75-79]	• MSM 9 to 26 years of age are currently eligible for HPV vaccine under Ontario's publicly-funded high-risk program[2] • Within 1–3 years of program implementation, 33% of age-eligible MSM had received ≥1 dose, while 21% had completed the 3-dose series[80]
People with HIV	• Women with HIV have 6x higher rates of cervical cancer (vs. women without HIV); MSM with HIV have 80x higher rates of anal cancer (vs. heterosexual males without HIV)[12,13] • Evidence of a synergistic relationship between HIV and HPV infection[81] • HIV-associated immune impairment can increase the risk of HPV acquisition, reduce the ability to clear HPV infections, and accelerate disease progression[9,12,13]	• HPV vaccines are safe and immunogenic in people with HIV[82-84] • Lower immunogenicity is seen in those with poorly controlled HIV infection (low CD4 counts, no HIV viral suppression)[82,83]	• HPV vaccines are not effective against anal HPV-related disease in people with HIV ≥27 years of age with a high baseline prevalence of HPV infection/disease[85-87] • Some evidence that HPV vaccines may be protective in people with HIV, especially if HPV naïve, but likely less effective than in people without HIV[79,83,88,89] • Data are inconclusive and suffer from methodological biases and limitations[79,83]	• Low HPV vaccine uptake (≥1 dose) in a clinical HIV cohort of males (7%, 2016–2017) and females (13%, 2017–2020) engaged in HIV care in Ontario[90,91]

Group	Epidemiology and Burden of Disease	Safety and Immunogenicity	Vaccine Efficacy/Effectiveness	Vaccine Uptake and Cervical Cancer Screening
People who are immunocompromised due to disease or therapy	• People with certain non-HIV immunosuppressive conditions, such as transplant recipients and people with autoimmune disorders, experience a greater burden of HPV-related disease[13,84,92,93]	• HPV vaccines are safe and well-tolerated and do not exacerbate underlying disease in people with immunocompromising conditions[84] • Immune responses in transplant recipients and women with autoimmune disorders (e.g., lupus, rheumatoid arthritis) are suboptimal compared with healthy controls[94-100]	• Limited data on vaccine efficacy/effectiveness[84,101]	Not available
People with a history of anogenital warts or HPV-related pre-cancers or cancer	• Individuals with a history of HPV-related disease are at higher risk of subsequent disease at the same or other anatomical sites[13,102-104] • Risk of cervical and other anogenital cancers is 2–10x higher in women with prior cervical lesions or cancer following treatment[102,103]	• HPV vaccines generate a memory response in seropositive individuals[48,49]	• HPV vaccines are effective against reinfection or reactivation,[49,50] and recurrent cervical disease in women with prior HPV infection or disease[79,105,106] • HPV vaccines can protect against infection with other HPV vaccine types in women previously infected with a different HPV type[47] • Vaccine efficacy >50% against recurrent high-grade cervical lesions if vaccinated before or after treatment[105] • Inconclusive data for recurrent anal dysplasia and anogenital warts[79,107-109]	Not available

Group	Epidemiology and Burden of Disease	Safety and Immunogenicity	Vaccine Efficacy/Effectiveness	Vaccine Uptake and Cervical Cancer Screening
Recent immigrants or refugees	• Cervical cancer risk varies by age, country of birth and time since immigration[110] • Risk of HPV exposure may decrease after arriving in Canada relative to their country of origin, depending on age and other risk factors	• Same as general population, unless living with HIV or other immunocompromising condition	• Same as general population, unless living with HIV or other immunocompromising condition	• Immigrant and refugee women have lower uptake of regular cervical cancer screening than women born in Canada[65,111-113] • Access to HPV vaccines in many countries is limited[114] • Within Canada, HPV vaccine uptake tends to be lower in areas with a higher proportion of immigrants[115,116]
People who identify as Indigenous and/or live in rural, remote or Northern Ontario regions	• Incidence of cervical cancer has historically been higher among First Nations vs. non-First Nations women[117]	• Same as general population, unless living with HIV or other immunocompromising condition	• Same as general population, unless living with HIV or other immunocompromising condition	• Regional variation in cervical cancer screening, with some studies noting similar rates between Indigenous vs. non-Indigenous women and others showing lower participation among Indigenous populations[69,118-121] • Little published data on HPV vaccine coverage among Indigenous populations;[69,72,122] national estimates as low as 40% in First Nations girls[69] • Rural, remote or Northern regions pose challenges to delivering preventative HPV care, but impact on vaccine uptake and cervical cancer screening is unclear[112,121-123]
People with a history of sexual violence	• Women and girls who report a history of sexual violence have a greater risk of HPV infection and disease[124-129] • Risk of cervical cancer increases with duration and frequency of physical and sexual violence[124] • More long-term data is needed to assess outcomes of HPV infection in children with a history of sexual violence	• Same as general population, unless living with HIV or other immunocompromising condition	• Same as general population, unless living with HIV or other immunocompromising condition	Not available

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About the Ontario Immunization Advisory Committee

The Ontario Immunization Advisory Committee (OIAC) was established in August 2021 at the request of the Chief Medical Officer of Health. The Committee provides scientific and technical advice to Public Health Ontario on vaccines and immunization matters, including program implementation in Ontario, priority populations, clinical guidance, and vaccine safety and effectiveness.

OIAC's work focuses 'on publicly funded vaccines and immunization programs in Ontario, and those under consideration for new programming. The OIAC provides advice by applying scientific knowledge and the best available evidence, in addition to feasibility, acceptability and other implementation considerations.

For more information about the OIAC and its members contact secretariat@oahpp.ca.

About Public Health Ontario

Public Health Ontario is an agency of the Government of Ontario dedicated to protecting and promoting the health of all Ontarians and reducing inequities in health. Public Health Ontario links public health practitioners, front-line health workers and researchers to the best scientific intelligence and knowledge from around the world. For more information about PHO, visit publichealthontario.ca.

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OIAC Members

Dr. Jessica Hopkins, co-chair
Vice President and Chief, Communicable Disease Control
Public Health Ontario

Dr. Jeffrey Pernica, co-chair
Associate Professor, Infectious Disease
Department of Pediatrics
McMaster University

Dr. Vinita Dubey
Associate Medical Officer of Health
Toronto Public Health

Dr. Julie Emili
Associate Medical Officer of Health
Region of Waterloo

Dr. Sherilyn Houle
Associate Professor, School of Pharmacy
University of Waterloo

Dr. Ava John-Baptiste
Associate Professor, Schulich School of Medicine and Dentistry
Western University

Dr. Deepali Kumar
Director, Ajmera Transplant Centre
University Health Network

Dr. Allison McGeer
Professor, Laboratory Medicine and Pathobiology
University of Toronto
Dalla Lana School of Public Health

Dr. Matthew Miller
Director, Michael G. DeGroote Institute for Infectious Disease Research
McMaster University

Dr. Justin Presseau
Senior Scientist
Ottawa Hospital Research Institute

Dr. Maurianne Reade
Family Physician; Associate Professor
Northern Ontario School of Medicine

Dr. Marina Richardson
Associate Director, Health Technology Assessment (HTA) Methods and Health Economics
Institute for Clinical and Economic Review (ICER)

Richard San Cartier
Clinical Team Lead
N'Mninoeyaa Aboriginal Health Access Centre

Fairleigh Seaton
Director, Infectious Disease Prevention and Environmental Health
Kingston, Frontenac and Lennox & Addington Public Health

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