

CADTH Horizon Scan

Self-Sampling Devices for HPV Testing

Authors: Michelle Clark, Jennifer Horton

ISSN: 2563-6596

Disclaimer: The information in this document is intended to help Canadian health care decision-makers, health care professionals, health systems leaders, and policy-makers make well-informed decisions and thereby improve the quality of health care services. While patients and others may access this document, the document is made available for informational purposes only and no representations or warranties are made with respect to its fitness for any particular purpose. The information in this document should not be used as a substitute for professional medical advice or as a substitute for the application of clinical judgment in respect of the care of a particular patient or other professional judgment in any decision-making process. The Canadian Agency for Drugs and Technologies in Health (CADTH) does not endorse any information, drugs, therapies, treatments, products, processes, or services.

While care has been taken to ensure that the information prepared by CADTH in this document is accurate, complete, and up-to-date as at the applicable date the material was first published by CADTH, CADTH does not make any guarantees to that effect. CADTH does not guarantee and is not responsible for the quality, currency, propriety, accuracy, or reasonableness of any statements, information, or conclusions contained in any third-party materials used in preparing this document. The views and opinions of third parties published in this document do not necessarily state or reflect those of CADTH.

CADTH is not responsible for any errors, omissions, injury, loss, or damage arising from or relating to the use (or misuse) of any information, statements, or conclusions contained in or implied by the contents of this document or any of the source materials.

This document may contain links to third-party websites. CADTH does not have control over the content of such sites. Use of third-party sites is governed by the third-party website owners' own terms and conditions set out for such sites. CADTH does not make any guarantee with respect to any information contained on such third-party sites and CADTH is not responsible for any injury, loss, or damage suffered as a result of using such third-party sites. CADTH has no responsibility for the collection, use, and disclosure of personal information by third-party sites.

Subject to the aforementioned limitations, the views expressed herein are those of CADTH and do not necessarily represent the views of Canada's federal, provincial, or territorial governments or any third-party supplier of information.

This document is prepared and intended for use in the context of the Canadian health care system. The use of this document outside of Canada is done so at the user's own risk.

This disclaimer and any questions or matters of any nature arising from or relating to the content or use (or misuse) of this document will be governed by and interpreted in accordance with the laws of the Province of Ontario and the laws of Canada applicable therein, and all proceedings shall be subject to the exclusive jurisdiction of the courts of the Province of Ontario, Canada.

The copyright and other intellectual property rights in this document are owned by CADTH and its licensors. These rights are protected by the Canadian *Copyright Act* and other national and international laws and agreements. Users are permitted to make copies of this document for non-commercial purposes only, provided it is not modified when reproduced and appropriate credit is given to CADTH and its licensors.

About CADTH: CADTH is an independent, not-for-profit organization responsible for providing Canada's health care decision-makers with objective evidence to help make informed decisions about the optimal use of drugs, medical devices, diagnostics, and procedures in our health care system.

Funding: CADTH receives funding from Canada's federal, provincial, and territorial governments, with the exception of Quebec.

Questions or requests for information about this report can be directed to Requests@CADTH.ca

Table of Contents

Key Messages	5
Purpose	5
Methods	5
Peer Review.....	5
Background	6
The Technology	6
Availability	7
Cost	7
Who Might Benefit?	8
Current Practice	8
Technical Considerations	8
Concurrent Developments	9
Summary of the Evidence	9
Results.....	9
Safety	13
Cost-Effectiveness	13
Perspectives and Experiences.....	13
Barriers and Facilitators to Cervical Cancer Screening.....	17
Interventions to Improve Screening Uptake.....	19
Operational Considerations	21
Rural and Remote Communities.....	21
COVID-19 Pandemic.....	21
Final Remarks	22
References	24

List of Tables

Table 1: Characteristics of the Trials 10

Table 2: Results of the Trials 12

Key Messages

- This Horizon Scan summarized the available information regarding the use of self-sampling devices for HPV testing as part of cervical cancer screening programs.
- HPV testing for primary cervical cancer screening is not currently a part of any Canadian screening programs. However, several provinces are in the process of implementation and some pilot testing.
- Self-sampling is generally as accurate as clinician-collected sampling for HPV testing.
- Self-sampling devices for HPV testing could likely be used to increase participation in cervical cancer screening programs.
- Self-sampling for primary HPV screening was highly acceptable to study participants.
- Culturally appropriate care, appropriate educational materials, and providing people with choice in the screening process may contribute to increased uptake of cervical cancer screening.
- Health care providers identified self-sampling as an area where they might benefit from increased knowledge and training.

Purpose

The purpose of this Horizon Scan is to present health care stakeholders in Canada with an overview of information related to self-sampling devices for HPV testing used for primary cervical cancer screening, a description of some of the published studies, and a summary of some important considerations related to the potential implementation of the technology. This report is not a systematic review, does not involve critical appraisal, and does not include a detailed summary of study findings. It is not intended to provide recommendations for or against the use of the technology.

Methods

One author screened the literature search results and reviewed the full text of all potentially relevant studies. Studies were considered for inclusion if the intervention was a device used for HPV self-sampling, cervical cancer screening programs that used self-sampling devices, information regarding user and provider preferences and experiences with HPV self-sampling devices, and the use of HPV self-sampling devices as a way to improve access to underserved populations. Conference abstracts and grey literature were included when they provided additional information to that available in the published studies.

Peer Review

A draft version of this bulletin was reviewed by 1 clinical expert with expertise in gynecological pathology, HPV testing, and cervical screening. The manufacturers of a number of self-sampling devices were contacted with an opportunity to provide information and review the draft. No manufacturer information was received.

Background

Approximately 1,300 people in Canada are diagnosed with cervical cancer each year.¹ Organized cervical cancer screening programs operate in most jurisdictions in Canada and all jurisdictions offer opportunistic screening. The current practice in Canada is to use cytology-based testing (Pap testing) for primary screening, which detects signs of abnormal cells in the cervix that could become cancerous. Large reductions (more than 70%) in the incidence and mortality of cervical cancer have been attributed to the uptake of cytology-based tests.²

HPV is a common infection of the reproductive tract and most different genotypes or strains of HPV pose little risk to human health. However, 97% of cervical cancer is attributed to 12 strains of HPV and 70% of cervical cancer cases across the world are attributed to 2 specific strains of the virus (HPV 16 and 18), referred to as high-risk HPV.¹ Vaccines for HPV, which protect a variety of strains of HPV (including high-risk strains), are part of immunization programs in all Canadian jurisdictions as part of school-based immunization programs for children between the ages of 9 and 13.³ Immunization rates indicate that between 57% and 91% of eligible children receive the full course of HPV vaccines (3 doses).³

The strong association between HPV infection and cervical cancer has given rise to HPV genetic tests as a possible screening tool. These tests aim to detect the presence of HPV DNA or RNA, with some focused on detecting the presence of high-risk strains. Unlike cytology-based tests, which require a trained health care professional to collect samples from a person during a pelvic exam, HPV testing can allow for the end-user to collect their own samples with a kit. HPV self-sampling tests require a sampling kit (provided to the end-user) and a sampling analyzer (PCR-based platform or other genomic assay). These self-sampling tests may help to improve accessibility and acceptability of cervical cancer screening in certain populations.¹

Several jurisdictions in Canada are aiming to initiate pilot programs to evaluate the role of HPV self-sampling tests as part of screening programs into 2022. A pilot study from Manitoba showed improved screening participation with self-sampling tests.⁴ While the technology behind HPV self-sampling has existed for many years, no jurisdictions in Canada offer primary HPV testing for cervical cancer screening or self-sampling as part of routine screening programs. The Canadian Partnership Against Cancer has committed to an action plan for the elimination of cervical cancer by 2040 through increased vaccination, a shift to HPV testing as the primary mode of cervical cancer screening, and improved follow-up care.³

To support jurisdictions in selecting which tests to use or test as part of their pilot programs, this Horizon Scan aims to provide an overview of the technology behind different types of tests and sampling kits available and authorized in Canada, the evidence about their clinical and cost-effectiveness, and operational considerations and lessons learned from other similar jurisdictions.

The Technology

HPV testing for cervical cancer screening involves 2 steps. The first step is the collection of a sample of cells collected from the vagina or cervix. This sample can be taken using a variety of methods including lavage (fluid is used to wash the inside of the cervix and cells are taken

from the collected fluid), tampons, or flocked or cotton swabs. Swab samples can be left dry and sent to a lab for analysis as is or stored in a liquid or solid transport medium. In the second step, the sample is analyzed using a genomic assay or PCR-based platform to detect the presence of high-risk strains of HPV. The devices required for each step in the testing pathway are regulated separately.

Currently, most screening programs — whether HPV- or Pap smear-based — require sample collection by a health care provider. The nature of HPV testing allows for the tests to be run on clinician- or self-collected samples. Kits that allow for self-collection of cervical cell samples may play an important role in expanding participation in cervical cancer screening programs by more easily reaching populations under-represented in screening participation and decreasing the embarrassment, discomfort, or trauma sometimes associated with cervical sample collection by a clinician. Self-collection of samples can be done in a variety of settings including a clinician's office or the person's home.

Availability

Devices used for self-collection of samples for HPV testing and authorized for clinical use in Canada include the Rovers Evalyn Brush and Copan Self Vaginal FLOQSwabs.⁵ Other self-collection devices available internationally include the Viba-Brush (a lower-cost version of Rovers' Evalyn Brush),⁶ Qvintip by Aprovix,⁷ Mia by XytoTest,⁸ and the Eve Medical HerSwab. In clinical studies, other types of cotton and flocked swabs typically used for cervical sample collection by clinicians have also been used for self-collection.

A variety of analysis platforms are available for HPV testing in Canada including the Abbott RealTime High Risk HPV assay, Aptima HPV assay, BD Onclarity HPV Assay, cobas 4800 HPV amplification/detection kit, *digene* HC2 High-Risk HPV DNA Test, Roche Linear Array HPV detection kit, and the Cepheid Xpert HPV.⁵

Cost

Information regarding the Canadian pricing of individual self-collection devices was not available. Information about other relevant health care costs are discussed in the section on Cost-Effectiveness.

In the US, at-home HPV self-sampling kits are available for purchase on the internet. The Nurx kit costs US\$49 to US\$79, plus a \$15 consultation fee.⁹ The Everlywell kit costs US\$24.99 to \$49.¹⁰ Both sampling kits are sent directly to one's home and the self-collected samples are returned to a lab for analysis via a prepaid envelope.

Who Might Benefit?

Self-sampling is seen as a way to engage underscreened or never-screened individuals in participating in cervical cancer screening by increasing the convenience and autonomy of sample collection. Self-sampling for HPV testing may also be beneficial for individuals who face barriers in accessing traditional cytology screening such as lack of access to a primary care provider, a history of trauma, distance, lack of access to transportation, paid time off, and childcare. Further details are provided in this scan in the sections on Perspectives and Experiences and Barriers and Facilitators to Cervical Cancer Screening.

Current Practice

The most recent Canadian guidelines for cervical cancer screening were published in 2013 by the Canadian Task Force on Preventive Health Care.³ These guidelines recommend cervical cytology (Pap testing) for cervical cancer screening every 3 years starting at the age of 25.³ Screening can end after the age of 70, as long as the previous 3 screening tests produced normal results.³ These guidelines recommend against HPV testing for cervical cancer screening; however, the evidence regarding HPV testing has evolved since these recommendations were produced and the existing guidelines are in the process of being updated.³

The American Cancer Society now recommends HPV testing as the primary modality of cervical cancer screening for people over the age of 25 years.¹¹ HPV primary testing for cervical cancer screening has been implemented in Australia, the Netherlands, Finland, and the UK.¹ A number of Canadian provinces are currently planning to implement HPV testing within their cervical cancer screening programs.¹

Technical Considerations

Samples for HPV testing can be collected using different combinations of collection devices and transport media. These range from dry cotton swabs to flocked swabs in liquid media. Samples also require transportation to a lab from the place of collection. These samples are often returned through the mail, which raises questions about the stability of the samples in different temperatures, shipping conditions, and time periods. Samples returned in liquid media may need special handling to ensure mail system safety protocols are met and this can result in more expensive postage.

Viviano and colleagues (2018)¹² compared cotton and flocked swabs in a PreservCyt vial for sample self-collection in a group of women referred for colposcopy. The swabs were analyzed using the Anyplex II HPV HR Detection assay.¹² Although there was substantial agreement between the 2 sampling methods, the total HPV prevalence detected with the flocked swab was statistically significantly greater than that detected with the cotton swab (38.1% versus 29.7%; $P = 0.006$).¹² The mean number of cells collected was also significantly higher with the flocked swab.

Self-collected samples using a dry, cone-shaped flocculated swab and a FLOQSwab with transport medium were compared with clinician-collected samples for HPV DNA testing in Korea.¹³ The samples were tested on both the Roche cobas 4800 HPV and Abbot RealTime High Risk HPV tests.¹³ Both the Roche and Abbott tests performed similarly on the wet and dry cervical samples, with no statistically significant differences in agreement observed. Diagnostic test accuracy was high on each test for both swab types.¹³

Researchers in Denmark assessed the analytical stability of using the dry Evalyn self-sampling brush analyzed using the BD Onclarity HPV Assay.¹⁴ HPV detection was steady among time points from baseline to 32 weeks after sample collection.¹⁴ Storage temperatures ranging from 4 °C (refrigeration) to room temperature to 30 °C were also stable. The use of dry samples removed the issues related to the use of liquid medium such as spillage, skin irritation, or accidental consumption.¹⁴ Any spillage of the liquid media, by the user or in the lab, can affect the analytical volume for analysis and may impact the accuracy of results.¹⁴ Dry samples can be mailed directly to the lab without any other major considerations and at a lower cost, as compared to a liquid sample.¹⁴

Du et al. evaluated filter paper card solid transport media for self-collected samples.¹⁵ Solid media was compared with self-collected samples and clinician-collected samples in the ThinPrep media. All samples were tested with cobas 4800 and SeqHPV NGS assay for high risk HPV and found similar sensitivities and HPV positivity for both types of media used for the self-samples.¹⁵ The filter paper cards were easier to transport and store than liquid media.¹⁵

Concurrent Developments

Urine testing for high-risk HPV screening has been under development for some time as an alternative non-invasive method of sample collection. Despite good agreement observed between urine sample and clinician-collected cervical sampling results and good acceptability from screening participant and health care providers, urine sampling for this purpose has not yet been implemented as an alternative method of sample collection for high-risk HPV testing.¹⁶

Self-sampling for the purpose of cancer screening is not limited to cervical cancer. The fecal immunochemical test (FIT) has been introduced into colorectal cancer screening programs to allow people at average risk for colorectal cancer to collect a fecal sample for screening within the comfort of their homes.¹⁷ The introduction of the FIT into screening programs has increased screening completion rates.¹⁷ As of 2021, every province and territory in Canada offers self-collection of samples for colorectal cancer screening.

Summary of the Evidence

Results

In 2019, CADTH conducted a health technology assessment¹⁸ on HPV testing for primary cervical cancer screening, accompanied by recommendations from the Health Technology

Expert Review Panel (HTERP);¹⁹ however, self-sampling methods were not included in the original report. A separate report was completed evaluating the diagnostic test accuracy and agreement between self-collected samples for high-risk HPV testing for primary cervical cancer screening and clinician-collected samples for HPV testing or cytology in asymptomatic people.²⁰ The review found that self-sampled HPV tests based on PCR for the detection of cervical intraepithelial neoplasia (CIN) grade 2 or more severe were shown to have sensitivity or specificity that was not statistically significantly different when compared with clinician-sampled tests.²⁰ However, self-sampled HPV tests based on signal amplification were not as accurate for the detection of CIN2+.²⁰ Moderate to excellent agreement between self- and clinician-sampled HPV tests was reported in primary studies.²⁰ Various HPV tests were evaluated in different health care settings. However, it was unclear whether the differences in the agreement were associated with the types of HPV tests due to heterogeneity between the included studies. The impact on the diagnostic accuracy or agreement of self- and clinician-sampled HPV tests was unclear.²⁰

A second update to this report, that did not include critical appraisal of the included studies, was conducted in 2021 and identified 10 non-randomized studies for inclusion.²¹ These studies mostly included participants who were referred to colposcopy clinics for the treatment of cervical abnormalities.²¹ Overall, self-collected samples for HPV testing were comparable to clinician-collected samples; however, the results did vary based on the type of test that was used.²¹ Self-sampling did not appear to be as accurate as clinician sampling when the HC2 test was used.²¹

The results of further studies published since 2018, including participants who were due or overdue for cervical cancer screening and did not have a previously diagnosed cervical abnormality, are summarized in Table 1 and Table 2. Self- and clinician-collected HPV samples did not produce significantly different results in HPV prevalence²²⁻²⁴ or histologically important results.²³ When randomized to self-collection for HPV testing or clinician collection for cytology testing (Pap test), significantly more participants completed screening in the self-collection group.²⁵ Regarding diagnostic sensitivity of self-collected samples for cytology testing, rather than for HPV testing, authors of 1 study concluded that physician-collected samples were statistically significantly superior to self-collected samples.²⁶

Table 1: Characteristics of the Trials

Author, year, country	Study design, study duration, sample size	Population	Intervention, comparator(s)	Outcomes
Aarnio et al. (2021) ²³ Sweden	RCT 18 months N = 11,951 invited Self-sampling = 2,466 Clinician-collected = 1,519	Women aged 30 to 60 years undergoing high-risk HPV, primary cervical cancer screening, with no prior screening for 1 year before study entry	Vaginal self-sampling for HPV testing (Rovers Viba-Brush) returned by mail Clinician-collected vaginal sampling for HPV testing (cytobrush) at a midwife clinic	<ul style="list-style-type: none"> Prevalence of HPV Detection of CIN2+ or CIN3+

Author, year, country	Study design, study duration, sample size	Population	Intervention, comparator(s)	Outcomes
Aranda Flores et al. (2021)²² Norway	Non-randomized observational study 12 months N = 505 (1,010 samples)	Sexually active women aged 30 to 65 years attending cervical cancer screening and health professionals at the oncology clinic	Vaginal self-sampling for HPV testing (XytoTest medical device in PreservCyt Solution) Clinician-collected vaginal sampling for HPV testing (Cervex-Brush in PreservCyt Solution) Samples were collected on the same day using each method in alternating order for each participant and analyzed using Abbott RealTime High Risk HPV assay	<ul style="list-style-type: none"> • Prevalence of HPV • Level of discomfort • Level of difficulty
Reques et al. (2021)²⁵ France	RCT 22 months N = 687	Women aged 25 to 60 years experiencing socioeconomic difficulties and who had not had a Pap smear in the past 3 years	Vaginal self-sampling for HPV testing collected in clinic or at home. Samples were analyzed using Abbott RealTime High Risk HPV test Pap smear (LBC)	<ul style="list-style-type: none"> • Screening completion rate • Cytological abnormalities (ASC-US, LSIL, HSIL)
Satake et al. (2020)²⁶ Japan	Non-randomized observational study N = 300	Women visiting clinics in private hospitals had 2 samples taken at the same visit (self- and clinician-collected) and both samples underwent high-risk HPV and cytology testing	Vaginal self-sampling for HPV and cytology testing collected in clinic (home smear set) Clinician-collected vaginal sampling for HPV and cytology testing collected in clinic (Cervex-Brush + SurePath vial) High-risk HPV testing was done using Roche cobas 4800 HPV kit Cytology smears were prepared using the SurePath (clinician-collected) or Cyto-Tek (self-collected) systems	<ul style="list-style-type: none"> • HPV prevalence • Agreement between high-risk HPV testing and cytology • Cytological abnormalities (ASCUS or greater)
McLarty et al. (2019)²⁴ US	RCT N = 174	Women visiting a clinic for regularly scheduled routine Pap test and pelvic examination	Vaginal self-sampling for HPV testing collected at home and returned by mail (tampon worn for 2 hours or Eve Medical HerSwab) Clinician-collected vaginal sampling for HPV testing High-risk HPV testing was done using Roche cobas 4800 HPV kit	<ul style="list-style-type: none"> • Percentage of women compliant with testing • Validation of HPV results with paired clinician-collected sample • Results of tampon vs. HerSwab • Participant satisfaction

ASCUS = atypical squamous cells of undetermined significance; CIN = cervical intraepithelial neoplasia; HSIL = high-grade squamous intraepithelial lesion; LBC = liquid-based cytology; LSIL = low-grade squamous intraepithelial lesion; RCT = randomized controlled trials; vs. = versus.

Table 2: Results of the Trials

Author, year, country	Screening completion rate	Test agreement	HPV prevalence	Cytology or histology findings	Patient-reported outcomes
Aarnio et al. (2021)²³ Sweden	Significantly higher in the self-sampling group (44.3% vs. 26.5%; P < 0.001)	NR	Not significantly different between groups (6.8% vs. 7.8%; P = 0.26)	Not significantly different between groups CIN2+ 48 vs. 35; P = 0.49 CIN3+ 40 vs. 25; P = 1.00	NR
Aranda Flores et al. (2021)²² Mexico	100% of enrolled participants completed the study	Agreement between self- and clinician collection was fair for HPV DNA testing (concordance rate = 78.2%, k = 0.34, 95% CI, 0.24 to 0.44; P < 0.001)	Not significantly different between groups (22.8% vs. 19.2%; P = 0.19)	NR	<ul style="list-style-type: none"> • 96.8% of participants were confident with self-collection • 88.8% of participants reported no discomfort associated with self-collection
Reques et al. (2021)²⁵ France	Significantly more participants completed screening in the self-sampling group (71.3% vs. 39.5%; P < 0.001)	NR	NR	No significant differences in cytological abnormalities were observed between groups (2.3% vs. 2.0%; P = 0.74)	NR
Satake et al. (2020)²⁶ Japan	Clinicians collected samples from all 300 individuals enrolled in the study	Overall concordance rate for high-risk HPV = 96.3% Overall concordance rate for cytology = 90.7%	Positive rate for high-risk HPV was not significantly different between groups (13.7% physician-collected vs. 14.7% self-sampled; P = 0.37)	Positive rate for physician sampling was significantly greater than that of self-sampling (12.3% vs. 5.3%; P < 0.0001)	NR
McLarty et al. (2019)²⁴ US	66% of self-collected samples were returned for analysis. No significant difference was measured between groups	Overall agreement for HPV 18 (HerSwab) = 100% (P < 0.0001) Overall agreement for other high-risk HPV types = 93.1% (P < 0.001)	There was a high failure rate for the tampon collection method and performance was not compared. 10.3% samples collected with HerSwab were positive for HPV. One sample was positive for high-risk HPV	NR	Respondents said the self-collection procedure was fast, not painful, easy to do, and the majority would prefer to collect the sample themselves vs. clinician collection

CIN = cervical intraepithelial neoplasia; NR = not reported; RCT = randomized controlled trial.

Safety

No safety issues related to the use of self-sampling devices for HPV testing were reported in the reviewed clinical studies.

Cost-Effectiveness

The authors of a 2020 systematic review examined cost-effectiveness modelling studies of HPV self-sampling from the societal or payer perspectives.²⁷ The results of 14 of the 16 studies included in the analysis suggested that self-sampling for HPV testing could be a cost-effective screening strategy.²⁷ Six of the 16 included studies targeted enrolment of women who were under screened for cervical cancer and 11 of the 16 studies were set in high-income countries. In addition to conclusions regarding cost-effectiveness, the authors concluded that the effect of widespread vaccination against HPV in higher income countries could be explored further in future research.²⁷

A randomized controlled trial conducted in Sweden compared the cost-effectiveness of repeated at-home self-sampling for HPV testing versus midwife-collected samples for Pap testing from the health care provider perspective.²⁸ Self-sampling resulted in a higher participation rate and greater detection of histologically important cytology at a lower cost than midwife-collected samples for cytology testing (€ 229,446 versus € 782,772).²⁸ The analysis was undertaken from the health care provider perspective.²⁸ Sensitivity analyses altering participation rate, screening test cost, sampling kit cost, and appointment cost did not affect the results of the analysis.²⁸

Perspectives and Experiences

Much research has been done examining participants' experiences with, and attitudes toward, cervical cancer screening. When considering the implementation of self-collection, both participants' and health care providers' perspectives are important to inform optimal approaches to screening.

Screening Participants

Nishimura et al. (2021)²⁹ conducted a systematic review of values and preferences related to HPV self-sampling for cervical cancer screening and Camara et al. (2021)³⁰ conducted a meta-synthesis of qualitative studies related to the self-collection of HPV samples. The self-collection of samples for HPV testing was generally found to be a highly acceptable method of screening.²⁹ The high level of acceptability is consistent across varying age and income groups, and countries of residence.²⁹ The ease of use, convenience, privacy, and emotional and physical comfort of self-sampling have been found to be acceptable to users.²⁹ The aspects of confidentiality and privacy associated with self-collection were preferred by both participants and health care workers.³⁰ Self-collection was also found to be associated with less pain, discomfort, and embarrassment for the participant.³⁰

In some cases, screening participants prefer to have a clinician collect their cervical samples. Accuracy of the sample was the most common concern related to self-collection, particularly among participants who were familiar with other methods of cervical cancer screening.³⁰ Step-by-step-instructions and clear illustrations in the appropriate language were helpful to reassure participants that they were collecting their samples properly.²⁹ Safety and sterility of the swab were also noted.³⁰ The size of the device used for sample collection was associated with differences in participants' perceptions: The smaller the swab, the more

comfortable participants were with its use.³⁰ Participants in some studies were reluctant to perform self-collection because of discomfort or shyness related to their bodies.³⁰ Some of this reluctance was associated with cultural barriers that prevent women from being familiar or comfortable with their bodies.³⁰ In contrast, other studies concluded that self-collection provided participants with an opportunity to learn more about their bodies and empowered them to contribute to their own care.³⁰

Communication with one's partner was noted as an important consideration in some studies.³⁰ In some situations, the insertion of the swab could be interpreted similarly to intimate relations with another person and could feel in conflict with an individual's cultural beliefs.³⁰ Participants felt more comfortable with self-collection when their partner was informed and supportive of the procedure. Participants' relationships with their peers were also important contributors to screening.³⁰ Undergoing testing together and being able to talk freely with peers about concerns and fears, and ask questions of those who had already undergone screening, were facilitators to screening.³⁰

Culturally sensitive and appropriate health education materials are an important factor in the uptake of sample self-collection.³⁰ Based on the responses of study participants, the authors concluded that educational materials should be matched to participants' needs (e.g., language, literacy levels, cultural requirements).³⁰ Participants trusted the results of their self-collected tests more when they felt they had received adequate instructions before testing. Instructions that included a verbal, as well as written, component and images were the most helpful.³⁰

The results of a few studies highlighted concerns about self-collection for participants with physical mobility limitations.³⁰ Dexterity issues and difficulties with mobility might lessen a participant's confidence in their ability to self-sample. The self-collection devices might also be difficult to use because of the packaging involved, such as screw-top vials for sample delivery.³⁰

Generally, home-based sampling was preferred over self-sampling in a clinic setting, regardless of the country or geographical location of the clinic.^{29,31} More than half of participants in 1 survey indicated they did not want any support while collecting their samples.³¹ Benefits of testing at home included the convenience of choosing when to perform the test, removing the time required to travel to a clinic, and not having to take time off work.³⁰ Drawbacks to at-home testing were identified by some participants, such as living in a home with others that lacked the necessary privacy to take their sample or the lack of a clean space in which to take the sample.³⁰ Access to clinics was a major barrier to in-clinic screening.³⁰

In high-income countries, samples were most often returned for analysis by mail. In low- to middle-income countries, samples were generally collected from people's homes by a community health worker and then sent for analysis in batches.²⁹ A cervical swab was the most commonly used and most accepted device used for self-sampling.²⁹ Other sampling devices identified in the systematic review that were used in clinical studies included the cervical brush, lavage, tampons, and labial padette.²⁹ Self-collection for cervical cancer screening is a relatively new option. Therefore, both participants and health care workers felt a need for standardized guidelines for the use and availability of self-collection devices.³⁰

Surveys conducted among Canadian cervical cancer screening participants show a preference for self-sampling as an option for cervical cancer screening.^{32,33} In 1 study, 93% of those surveyed indicated they had no prior knowledge of HPV self-sampling, suggesting

that the majority of those eligible for cervical cancer screening in Canada are unaware that self-sampling may be an option in the screening pathway.³³

Indigenous Populations

Indigenous people in Canada, Australia, New Zealand, and the US have a higher incidence of cervical cancer morbidity and mortality than non-Indigenous people.³⁴ Zehbe and colleagues (2017)³⁵ examined the preferences of First Nations women in Canada who participated in the Anishinaabek Cervical Cancer Screening Study, which compared clinician- and self-collected sampling for cervical cancer screening. Participants in the study had a strong preference for self-collected HPV sampling as compared with clinician-collected Pap testing.³⁵ Participants who were able to collect their own samples experienced greater accessibility to screening. Additionally, they experienced less physical and emotional discomfort, and had fewer concerns about privacy and test results.³⁵ The authors concluded that future program implementation could be enhanced by including more culturally sensitive education addressed to all community members, clarifying that HPV causes cervical cancer and normalizing the roles of people of all genders in the spread of HPV to avoid placing blame on 1 group over the other.³⁵

Indigenous women in New South Wales were surveyed after the implementation of HPV testing for primary cervical cancer screening in Australia.³⁶ Participants in the study were generally not familiar with the changes to the screening program or the role of screening in cervical cancer prevention.³⁶ Most of the participants expressed a negative attitude toward cervical cancer screening. Participants who had more understanding of cervical cancer prevention had a better perception of screening and felt they had a responsibility to get tested and take care of their health.³⁶

Most of the Australian study participants who were eligible for self-collection had not previously been offered the option.³⁶ Additionally, the majority were not willing to do it because they were afraid they would do it incorrectly, injure themselves, or have to return for a more invasive test despite self-sampling.³⁶ Although they were not keen to use it themselves, the participants did think that self-collection should be offered as an option to increase autonomy for those who desire it.³⁶ Embarrassment or a dislike of speaking about private topics — like illness, private parts of the body, and sex — contributed to participants not discussing the topic with family, friends, or community leaders.³⁶ Barriers to screening uptake identified in this study included lack of support or guidance from health care providers and not having access to appropriate specialist services, especially in more remote areas where there may only be 1 health care provider who is male.³⁶

Transgender or Non-Binary Individuals

Connolly and colleagues³⁷ undertook a systematic review of barriers and facilitators to cervical cancer screening among transgender men and non-binary individuals assigned female at birth.³⁷ In some screening programs, only those marked as “female” on their medical records are invited for screening, thereby potentially missing an entire group of people eligible for cervical cancer screening.³⁷ Generally, gender minority patients assigned female at birth are less likely to be up-to-date with their cervical cancer screening than cisgender patients.³⁷ Authors concluded that there may be inadequate resources and a lack of appropriate guidance aimed at this population.³⁷

Gender dysphoria associated with cervical cancer screening can vary among individuals. In a qualitative study included in the systematic review, some individuals reported in interviews

that the focus on a female part of their body was extremely upsetting, while others were not bothered and cited their general lack of genital dysmorphia as contributing to their response.³⁷ Some individuals will face barriers through insurance not allowing coverage for procedures labelled or coded as “female” once they have registered a change in gender.³⁷ Concerns associated with self-collection included a reluctance to engage with parts of their anatomy that they no longer identify with, lack of comfort with the accuracy of the self-swab, and unease with the lack of visual examination of the cervix by a health care provider.³⁷ There is a high prevalence of prior emotional and/or sexual trauma among these individuals that may also contribute to a reluctance to participate in screening.³⁸ Additionally, there is a general lack of appropriate educational materials directed toward these groups.³⁸

Androgen therapy has been associated with increased odds of a failed cervical sample. Studies in the UK have reported that androgen-induced changes to cervical and vaginal tissue can make sample collection more painful and cervical examination can potentially lead to gender dysphoria for transgender men and non-binary people with a cervix.^{37,39}

Older Screening Participants

In a study evaluating the experiences of self-testing at home in older participants (60 to 75 years of age) in Sweden, the majority of participants found self-sampling to be easy or very easy to perform and preferred self-sampling over clinician-collected sampling.⁴⁰ The authors found that participants who had more understanding about HPV infection and its relationship to cervical cancer were more concerned about receiving a positive HPV test result.⁴⁰ Other studies have found generational differences and report that self-sampling is generally more acceptable to younger individuals.^{33,41}

Medically Underserved Populations

In the US, lower screening rates have been documented in a number of groups including Hispanic, Asian, and American Indian/Alaskan Native people.⁴² New immigrants and people without a usual source of health care are also often underscreened.⁴² In non-focus group studies included in a systematic review, percentages of people who preferred self-testing to Pap testing ranged from 10% to more than 90%.⁴² People in low-income populations and those staying in domestic violence shelters preferred the HPV self-test less than other groups.⁴² The majority of rural residents preferred the self-test option.⁴²

In focus group studies with low-income participants who belonged to ethnic minority groups, there was a preference for the health care provider to collect the HPV sample because of a fear of not doing it correctly themselves.⁴² The majority of low-income and minority participants cited privacy and convenience as factors that contributed to their preference for self-collection. Study participant variables that were most associated with a preference for HPV self-collection over Pap testing included more education, older age, less frequent screening history, and self-reported avoidance of preventive care because of discrimination or cost.⁴²

Health Care Providers

HPV testing has been incorporated into the national cervical cancer screening program in Australia since December of 2017.⁴³ Self-sampling in a health care setting is an option for eligible underscreened or never-screened participants. A survey conducted in late 2018 among rural general practitioners (GPs) found that they had limited experience with facilitating self-sampling. Their capacity to offer self-sampling was limited by inadequate provision of provider education, difficulty accessing testing kits, poor availability of accredited

labs, and unclear compensation guidelines.⁴³ They also reported uncertainty around patient eligibility and the quality of self-collected samples. The providers indicated that, although the provision of self-collection could increase uptake of cervical cancer screening among some participants, the limitation of only being able to self-collect the sample in a GP's office would not remove many of the limitations that keep people from accessing screening.⁴³ Although many GPs did not have extensive experience with self-collected sampling, they did show optimism with the potential for the practice to increase rates of cervical cancer screening. To facilitate their ability to offer this option to patients, GPs indicated a requirement for a clearer view of the details of the program, and eligibility and guidance as to how they can incorporate self-collected samples into their daily practices.⁴³ Further support was also required at a systems level to enable easier access to labs, test kits, billing, and appropriate guidance.⁴³

Surveys conducted after 2 years of experience with the Australian HPV screening program found that most health care providers were comfortable with the extension of screening intervals to 5 years from 2 years, the increased age of recommended first screening, and the type of test used (all of which were part of the changes to HPV screening from cytology testing).⁴⁴ The majority of providers agreed that self-collection is a reasonable alternative to Pap for underscreened individuals⁴⁵ and were comfortable offering self-collection to those who declined practitioner-collected sampling.⁴⁴ Some discomfort was expressed regarding the length of time between screenings being up to 7 years for participants to be defined as underscreened.⁴⁴ The clinicians surveyed were in favour of a broadened definition of eligibility for self-sampling.⁴⁴ Providers reported barriers to implementation such as a poor publicity campaign, long waits to access self-collection, and confusion among practitioners, and confusion and disappointment from women about the limited eligibility for self-collection.⁴⁵ The authors did find that further supports for health care providers — such as additional education for providers, handouts for patients, and information appropriately targeted to Aboriginal and Torres Strait Islander women — would be useful to improve the implementation of self-collection of samples.^{44,45}

Barriers and Facilitators to Cervical Cancer Screening

Barriers

A wide variety of barriers to accessing cervical cancer screening have been identified. Barriers generally fall within broad categories such as logistical, structural, procedural, personal, and knowledge-based.

Logistical and structural barriers to cervical cancer screening include:

- no access to a primary care physician or screening clinic^{32,36}
- inconvenient clinic hours⁴¹
- a lack of time due to competing priorities, such as work or parenting⁴¹
- a lack of child or elder care⁴¹
- hidden costs, such as child care, transportation, or parking³¹
- not wanting to be screened by a male clinician^{36,41}
- a desire for bodily autonomy^{31,35,46}
- a lack of appropriate or empathetic screening services³¹
- overall difficulty navigating the health care system.³¹

Procedural barriers to cervical cancer screening include:

- a fear of test-related emotional or physical discomfort^{31,32,35,41}
- embarrassment or shyness^{31,32,36,41,47}
- a dislike of Pap testing³²
- a potential lack of privacy in small towns or crowded housing.^{41,47}

Knowledge-based and personal barriers to cervical cancer screening include:

- a fear of self-injury while collecting the sample⁴⁸
- feeling unqualified to take an adequate or reliable sample themselves^{36,41,48}
- a distrust of health care providers⁴⁷
- a lack of understanding of the need for regular cervical cancer screening³²
- a lack of understanding of HPV test reliability⁴¹
- a lack of understanding of the relationship between HPV infection and cervical cancer^{31,49}
- perceptions of low cancer risk and high screening barriers⁴²
- fear of receiving a positive HPV test result³¹
- not receiving enough information alongside a positive HPV test result³¹
- a misalignment between cultural beliefs and understanding of cervical cancer screening⁵⁰
- recent immigration status.⁵⁰

Self-sampling alone would not be able to remove all of the barriers to cervical cancer screening; however, many of the logistical and structural barriers could potentially be removed or reduced with the implementation of sample self-collection. Knowledge-based barriers may require additional interventions, such as education and increasing awareness of HPV infection and cervical cancer screening, as the introduction of self-sampling alone would likely not alleviate these barriers.

Facilitators

A variety of barriers to accessing cervical cancer screening have been identified. They include:

- providing self-collection kits with return postage to enable easy return of the sample to the lab⁵¹
- flexibility over where and when sample collection takes place (e.g., at home or at a clinic while attending another appointment)^{41,46}
- providing screening participants with a choice regarding which method of sample collection they would prefer⁴⁹
- access to a female health care provider⁴¹
- a personal recommendation from a trusted health care provider to take part in cervical cancer screening^{41,49,51}
- relationship building between providers and communities^{31,51}
- availability of culturally sensitive and appropriate screening approaches and educational materials^{35,47,51}
- within Indigenous and other cultural contexts, reaffirming women's traditional caregiving and educational roles within the community.⁴⁷

Interventions to Improve Screening Uptake

The authors of a 2021 Cochrane systematic review and meta-analysis⁵² examined different interventions aimed at increasing the uptake of cervical cancer screening. They found moderate-certainty evidence that invitations to screening increased uptake compared to control.⁵² Invitations that were personalized to the recipient were more successful and there was moderate-certainty evidence that sending a letter with a fixed appointment date was more successful than a letter with an invitation to make an appointment at the recipient's convenience.⁵² The use of educational materials and lay health worker involvement among ethnic minorities to increase screening uptake were supported by low-certainty evidence.⁵² It was not clear from the evidence which kinds of educational materials would be the most effective.

Other interventions that were identified, but were less widely reported, included counselling, risk factor assessment, access to a health promotion nurse, photo comic book, intensive recruitment, and message framing.⁵² The authors were unable to draw clear conclusions regarding the effectiveness of these interventions because of the lack of data; however, attempts at intensive recruitment and access to a health promotion nurse may have contributed to increased screening uptake.⁵² The self-collection of samples for cervical cancer screening as a means to increase uptake was not covered in this review but will be the subject of future work.⁵²

Indigenous Populations

Canada

Dick and colleagues (2021)⁵¹ studied community-driven approaches to increase ownership of cervical cancer screening in rural and remote Indigenous communities in Northern British Columbia. CervixCheck North is a pilot project of self-collection for HPV screening conducted on the traditional, unceded, and occupied territories of the Carrier Sekani Nations in collaboration with Carrier Sekani Family Services (CSFS), an Indigenous health and wellness organization.⁵¹ Distribution of self-collection kits started in February 2019 at community health centres by physicians and nurses to persons with a cervix who met the eligibility criteria and each community provided at least 2 information sessions and provided educational materials.⁵¹

As part of the project, the Indigenous partners were invited to define how the process would be shared with the community in a culturally informed and collaborative way.⁵¹ The research team completed cultural competency training before beginning the study. Steps were taken to ensure the language and project materials used reflected the knowledge of the existing health team and that the holistic health model that guided care in their communities informed the project development and rollout.⁵¹

The authors stated that a primary driver of community-specific culturally sensitive programming was the prioritization of community engagement.⁵¹ The local CSFS teams were involved in the creation and distribution of the study materials and the cultural protocols used throughout the project.⁵¹ The partnerships of trust, communication, project promotion by community health advocates, and building on an existing base of local health care services were strengths of the project.⁵¹

In Nunavik, Quebec, key community stakeholders formed an advisory committee to direct discussions with 27 Inuit women to identify the best ways to implement HPV self-sampling as a way of increasing access to routine screening in the community.⁴⁹ They found that the most

influential factor in the use of health services was the cultural awareness of the provider.⁴⁹ Lack of access to medical information was a major barrier to screening. The participants in the study generally expressed a desire to access screening after learning more about the medical facts about cervical cancer and screening.⁴⁹ The participants highlighted the importance of individual choice in the method of screening that they prefer to engage in.⁴⁹ Visual communication between the provider and the patient was most likely to influence other factors in screening acceptance and participation.⁴⁹

A study published by Wakewich and colleagues (2016)⁴⁷ examined colonial legacy and the experience of First Nations women in cervical cancer screening in Northwestern Ontario. The colonial legacy and influence contributed to a list of barriers to screening access including strong sense of body shyness, shame related to sexuality and sexually transmitted infections, concerns about confidentiality in clinical interactions, and distrust or caution around health care providers.⁴⁷ In contrast, facilitators to screening uptake included reaffirming women's traditional caregiving and educational roles, enhancing mother and daughter communication, improving cultural sensitivity in health care and education, and the adoption of self-sampling to increase privacy and control of the screening experience.⁴⁷

International

Six primary care clinics were randomized in a community-based cluster randomized controlled trial comparing HPV self-collection versus standard Pap tests to reach underscreened or never-screened Indigenous people in New Zealand.³⁴ Participants in the intervention arm were offered a self-collection kit (completed at home, at the clinic, or at a community centre) but were also able to choose a provider-collected HPV test or Pap test if that was their preference. Fifty-nine percent of Māori women were screened in the self-collection arm and 21.8% were screened in the Pap testing arm.³⁴ More than 90% of Māori women who accepted the HPV self-test took their own swabs and the majority of samples (73.6%) were taken at the clinic.³⁴ Māori women in the intervention group were 2.8 times more likely to be screened than those offered traditional cervical cancer screening. The authors suggested that their results could be generalizable to benefit Indigenous peoples facing similar barriers to screening in other high-income countries like Canada.³⁴

Underscreened or Never-Screened Populations

In underscreened or never-screened populations, direct mail strategies have been shown to result in higher screening uptake, enabling access to people who have not engaged with the health care system in some time.⁵³ Sending self-testing kits to individuals' homes via direct mail can be more cost-effective than opt-in strategies, where individuals have to seek out testing themselves, although with higher overall costs.²⁷

In a systematic review of interventions to improve the uptake of cervical cancer screening among lower socioeconomic groups, population screening programs were, as a whole, unlikely to remove the barriers and socioeconomic inequalities that prevent many underscreened people from participating.⁵⁰ More targeted interventions were more successful at increasing uptake.⁵⁰ Two studies from rural Mexico (self-sampling kits delivered by nurses to people's homes) and France (self-sampling kit sent to people who had not attended screening) that provided people with HPV self-sampling kits were identified. The results of both studies showed a significant increase in screening uptake when HPV self-sampling kits were delivered directly to non-attending individuals.⁵⁰

Transgender Men or Non-Binary Individuals

A number of facilitators exist that could improve cervical cancer screening access by transgender men or non-binary individuals with a cervix. Findings in the literature suggest that providers should explore the individual's preferences around screening, while avoiding assumptions about their feelings toward the process.³⁷ Providers can become familiar with examination techniques that minimize the potential for gender dysphoria or pain, while maintaining patient autonomy.³⁷ Self-collection for HPV screening may provide a more acceptable alternative to Pap smears for this group of patients. More localized research may be needed to inform specific policy changes.³⁷ As with other minority groups, cultural competency in care was cited as a facilitator to screening uptake.³⁷ Both self- and provider-collected HPV swabs were preferred over Pap testing.³⁷ Those who preferred self-collection indicated that it provided a greater sense of bodily autonomy.³⁷ HPV tests were less emotionally invasive and dysphoria inducing, and more comfortable.

In a before-and-after study of rates of cervical cancer screening among transmasculine or non-binary patients in New York City, providers offered a self-swab to patients who declined a speculum exam.⁵⁴ Prior to the introduction of self-collection, 25% of 121 identified transmasculine patients had cervical cancer screening documented on their records. After the switch to self-collection for high-risk HPV testing, there was a significant increase (51% of 193; $P < 0.001$) in patients who had a screening test documented in their medical record.⁵⁵ The screening rate of cisgender women at this health care facility was 76% during the same time period.⁵⁵

Operational Considerations

Rural and Remote Communities

As part of the CervixCheck program in Northern British Columbia, test kits were initially sent home with study participants for completion, but the researchers found that none of them were returned for analysis.⁵¹ The participants indicated that there were confidentiality concerns related to self-collection of samples within crowded living arrangements and the locations of the sample drop-off sites within the small towns.⁵¹ The protocol was changed to allow for self-collection kits to be completed at the community health centres and mailed to the lab for analysis by the health centre staff. With this change, the completion rate increased to 100% (78 returned test kits).⁵¹ Additionally, rollout of the program was slowed due to the start of the COVID-19 pandemic and health care centre closures.⁵¹

In rural and remote communities, follow-up care (cytology tests or colposcopy) is most often accessed outside of the community. This can cause limitations based on when the health care providers are physically present in the community and when travel to other centres is able to happen dependent on travel access because of finances, time required to travel, or weather.⁵¹

COVID-19 Pandemic

Currently, self-sampling options for cervical cancer screening are especially important considering the COVID-19 pandemic and its impacts on health care services. The detection of both HPV and severe acute respiratory syndrome coronavirus 2, or SARS-CoV-2, involve

the use of PCR testing and some common reagents and consumable items.⁵⁶ In Canada, common screening and lab resources were diverted to COVID-19 testing. This resulted in the delay of HPV-based screening in some provinces.⁵⁶

The self-collection of samples for cervical cancer screening can allow people to maintain physical distance and provide access to vital health care screening when much of in-person health care has been paused.⁵⁷ In Ontario, cervical cytology screening decreased by 63.8% in the first 6 months of the pandemic as compared to the same time period in 2019.⁵⁸ Reaching underscreened populations will remain a challenge as the pandemic continues to exacerbate the issues that create and compound health inequality.^{57,59}

Common barriers from before the pandemic may now be worsened including embarrassment, physical discomfort, fear of the possibility of cancer, judgment, inconvenience, physical disability, trauma, female genital mutilation, lack of familiarity with the person taking the sample, and lack of understanding of the procedure.⁵⁹ Fears about safety (e.g., visiting a doctor's office or riding public transportation in a pandemic, risk of transmission to loved ones) have contributed to reluctance to attend screening during the pandemic.⁵⁹

Based on the available literature, ways that access to in-person screening programs could be improved while the pandemic continues include more guidance and appointment reminders, and information about what to expect regarding hygiene and safety procedures in place at the appointment site.⁵⁹ Self-sampling could also aid in lessening the backlog of patients who will remain when the pandemic ends by allowing people to sample themselves in the convenience of their homes rather than taking up time and resources at in-person clinics.⁵⁷ The Netherlands has highlighted the option for HPV self-collection in screening invitation letters since November 2020.⁵⁶

Final Remarks

The identification of high-risk HPV infection through screening is an important step on the path to the elimination of cervical cancer in Canada. Although the research surrounding the use of HPV testing using self-collection of samples for primary cervical cancer screening appears to be robust, there has not been widespread uptake of this technology in Canada. The implementation of self-collected sampling for HPV testing may provide an accurate and more convenient option to increase participation in cervical cancer screening and reach populations that have historically been less likely to participate in traditional cytology-based screening.

Self-collected samples appear to be as accurate as clinician-collected samples for the identification of high-risk HPV infection. The introduction of self-collection into screening programs can help increase the personal autonomy of the individual being screened by providing them with another option to facilitate convenient and comfortable participation in screening programs. Allowing people to make a choice regarding the type of sample used to screen (e.g., self- or clinician-collected) and also the location of sample collection (e.g., at home or in a clinic) can increase their comfort levels and confidence in the screening process. Taking steps to target and accommodate the needs of different populations who have historically been less likely to participate in cervical cancer screening, such as providing

culturally sensitive care and educational information in a variety of languages, are important to improve uptake regardless of the testing modality used.

References

1. Cervical Cancer: Hpv Primary Screening And Abnormal Screen Follow-Up Environmental Scan. Toronto (ON): Canadian Partnership Against Cancer; 2021: <https://s22457.pcdn.co/wp-content/uploads/2021/03/HPV-primary-screening-escan-EN.pdf>. Accessed 26 Oct 2021.
2. Dickinson JA SA, Popadiuk C, Pogany L, Onysko J, Miller AB. Reduced cervical cancer incidence and mortality in Canada: national data from 1932 to 2006. *BMC Public Health*. 2012;12:992. [PubMed](#)
3. Action plan for the elimination of cervical cancer in Canada, 2020–2030. Toronto (ON): Canadian Partnership Against Cancer; 2020: <https://www.partnershipagainstcancer.ca/topics/elimination-cervical-cancer-action-plan/>. Accessed 26 Oct 2021.
4. Jalili F, O'Connell C, Templeton K, et al. Assessing the impact of mailing self-sampling kits for human papillomavirus testing to unscreened non-responder women in Manitoba. *Current Oncology*. 2019;26(3):167-172. [PubMed](#)
5. Medical devices active license search. 2021; <https://health-products.canada.ca/mdall-himh/prepareSearch-preparerRecherche.do>. Accessed 25 Oct 2021.
6. Viba-Brush. 2021; <https://www.roversmedicaldevices.com/cell-sampling-devices/viba-brush/>. Accessed 28 Oct 2021.
7. QVINTIP - Validated for primary HPV screening 2021; <https://www.aprovix.com/home>. Accessed 28 Oct 2021.
8. Mia by XytoTest. 2021; <https://www.mel-montmedical.com/products/mia/>. Accessed 28 Oct 2021.
9. At Home HPV Testing. 2021; <https://www.nurx.com/hpv-screening/>. Accessed 29 Oct 2021.
10. Screen for HPV - HPV Testing. 2021; <https://www.everlywell.com/products/hpv-test-female/>. Accessed 29 Oct 2021.
11. Fontham ETH WA, Church TR, Etzioni R, Flowers CR, Herzig A, Guerra C. Cervical cancer screening for individuals at average risk: 2020 guideline update from the American Cancer Society. *CA Cancer J Clin*. 2020;70(5):321-346. [PubMed](#)
12. Viviano M, Willame A, Cohen M, et al. A comparison of cotton and flocked swabs for vaginal self-sample collection. *Int J Women Health*. 2018;10:229-236. [PubMed](#)
13. Jun JK, Lim MC, Hwang SH, et al. Comparison of DRY and WET vaginal swabs with cervical specimens in Roche Cobas 4800 HPV and Abbott RealTime High Risk HPV tests. *J Clin Virol*. 2016;79:80-84. [PubMed](#)
14. Ejegod DM, Pedersen H, Alzua GP, Pedersen C, Bonde J. Time and temperature dependent analytical stability of dry-collected Evalyn HPV self-sampling brush for cervical cancer screening. *Papillomavirus Research*. 2018;5:192-200. [PubMed](#)
15. Du H, Duan X, Liu Y, et al. An evaluation of solid versus liquid transport media for high-risk HPV detection and cervical cancer screening on self-collected specimens. *Infect Agent Cancer*. 2020;15(1):72. [PubMed](#)
16. Hernandez-Lopez R, Hermosillo L, Leon-Maldonado L, et al. Performance of an affordable urine self-sampling method for human papillomavirus detection in Mexican women. *PLoS ONE*. 2021;16(7):e0254946. [PubMed](#)
17. Liles EG PN, Rosales AG, Feldstein AC, Smith DH, Mosen DM, Schneider JL. Change to Fecal Immunochemical Testing Increased Colorectal Cancer Screening Rates: Evaluation of a Screening Outreach Program in the United States. *Am J Manag Care*. 2012;18(10):588-595. [PubMed](#)
18. HPV Testing for Primary Cervical Cancer Screening: A Health Technology Assessment. Ottawa (ON): CADTH; 2019: <https://cadth.ca/sites/default/files/ou-tr/op0530-hpv-testing-for-pcc-report.pdf>. Accessed 20 Oct 2021.
19. HPV Testing for Primary Cervical Cancer Screening: Recommendations Report. Ottawa (ON): CADTH; 2019: <https://www.cadth.ca/sites/default/files/ou-tr/op0530-hpv-testing-for-pcc-recommendations.pdf>. Accessed 14 Dec 2021.
20. HPV Self-Sampling for Primary Cervical Cancer Screening: A Review of Diagnostic Test Accuracy and Clinical Evidence – An Update. Ottawa (ON): CADTH; 2019: <https://www.cadth.ca/sites/default/files/pdf/htis/2019/RC1124%20HPV%20Self-Sampling%20Update%20Final.pdf>. Accessed 10 Oct 2021.
21. HPV Self-Sampling for Primary Cervical Cancer Screening: A 2021 Update. Ottawa (ON): CADTH; 2021: <https://www.cadth.ca/sites/default/files/pdf/htis/2021/RB1588%20HPV%20Self%20sampling%20Final.pdf>. Accessed 10 Oct 21.
22. Aranda Flores CE, Gomez Gutierrez G, Ortiz Leon JM, Cruz Rodriguez D, Sorbye SW. Self-collected versus clinician-collected cervical samples for the detection of HPV infections by 14-type DNA and 7-type mRNA tests. *BMC Infectious Diseases*. 2021;21(1):504. [PubMed](#)
23. Aarnio R, Isacson I, Sanner K, Gustavsson I, Gyllensten U, Olovsson M. Comparison of vaginal self-sampling and cervical sampling by medical professionals for the detection of HPV and CIN2+: A randomized study. *Int J Cancer*. 2021;148(12):3051-3059. [PubMed](#)
24. McLarty JW, Williams DL, Loyd S, Hagensee ME. Cervical Human Papillomavirus Testing With Two Home Self-Collection Methods Compared With a Standard Clinically Collected Sampling Method. *Sexually Transmitted Diseases*. 2019;46(10):670-675. [PubMed](#)
25. Reques L, Rolland C, Lallemand A, et al. Comparison of cervical cancer screening by self-sampling papillomavirus test versus pap-smear in underprivileged women in France. *BMC Womens Health*. 2021;21(1):221. [PubMed](#)
26. Satake H, Inaba N, Kanno K, et al. Comparison Study of Self-Sampled and Physician-Sampled Specimens for High-Risk Human Papillomavirus Test and Cytology. *Acta Cytologica*. 2020;64(5):433-441. [PubMed](#)
27. Malone C, Barnabas RV, Buist DSM, Tiro JA, Winer RL. Cost-effectiveness studies of HPV self-sampling: A systematic review. *Prev Med*. 2020;132:105953. [PubMed](#)

28. Aarnio R, Ostensson E, Olovsson M, Gustavsson I, Gyllensten U. Cost-effectiveness analysis of repeated self-sampling for HPV testing in primary cervical screening: a randomized study. *BMC Cancer*. 2020;20(1):645. [PubMed](#)
29. Nishimura H, Yeh PT, Oguntade H, Kennedy CE, Narasimhan M. HPV self-sampling for cervical cancer screening: a systematic review of values and preferences. *BMJ glob*. 2021;6(5):05.
30. Camara H, Zhang Y, Lafferty L, Vallely AJ, Guy R, Kelly-Hanku A. Self-collection for HPV-based cervical screening: a qualitative evidence meta-synthesis. *BMC Public Health*. 2021;21(1):1503. [PubMed](#)
31. Adcock A, Cram F, Lawton B, et al. Acceptability of self-taken vaginal HPV sample for cervical screening among an under-screened Indigenous population. *Aust N Z J Obstet Gynaecol*. 2019;59(2):301-307. [PubMed](#)
32. Datta GD, Mayrand MH, Qureshi S, Ferre N, Gauvin L. HPV sampling options for cervical cancer screening: preferences of urban-dwelling Canadians in a changing paradigm. *Current Oncology*. 2020;27(2):e171-e181. [PubMed](#)
33. Kraut RY, Manca D, Lofters A, et al. Attitudes Toward Human Papillomavirus Self-Sampling in Regularly Screened Women in Edmonton, Canada: A Cross-Sectional Study. *Journal of Lower Genital Tract Disease*. 2021;25(3):199-204. [PubMed](#)
34. MacDonald EJ, Geller S, Sibanda N, et al. Reaching under-screened/never-screened indigenous peoples with human papilloma virus self-testing: A community-based cluster randomised controlled trial. *Aust N Z J Obstet Gynaecol*. 2021;61(1):135-141. [PubMed](#)
35. Zehbe I, Wakewich P, King AD, Morrisseau K, Tuck C. Self-administered versus provider-directed sampling in the Anishinaabek Cervical Cancer Screening Study (ACSS): a qualitative investigation with Canadian First Nations women. *BMJ Open*. 2017;7(8):e017384. [PubMed](#)
36. Moxham R, Moylan P, Duniec L, et al. Knowledge, attitudes, beliefs, intentions and behaviours of Australian Indigenous women from NSW in response to the National Cervical Screening Program changes: a qualitative study. *Lancet Reg Health West Pac*. 2021;13:100195. [PubMed](#)
37. Connolly D, Hughes X, Berner A. Barriers and facilitators to cervical cancer screening among transgender men and non-binary people with a cervix: A systematic narrative review. *Prev Med*. 2020;135:106071. [PubMed](#)
38. Weyers S, Garland SM, Cruickshank M, Kyrgiou M, Arbyn M. Cervical cancer prevention in transgender men: a review. *Bjog*. 2021;128(5):822-826. [PubMed](#)
39. Berner AM, Connolly DJ, Pinnell I, et al. Attitudes of transgender men and non-binary people to cervical screening: a cross-sectional mixed-methods study in the UK. *Br J Gen Pract*. 2021;71(709):e614-e625. [PubMed](#)
40. Hermansson RS, Olovsson M, Gustavsson C, Lindstrom AK. Elderly women's experiences of self-sampling for HPV testing. *BMC Cancer*. 2020;20(1):473. [PubMed](#)
41. Racey CS, Gesink DC. Barriers and Facilitators to Cervical Cancer Screening Among Women in Rural Ontario, Canada: The Role of Self-Collected HPV Testing. *J Rural Health*. 2016;32(2):136-145. [PubMed](#)
42. Biddell CB, O'Leary MC, Wheeler SB, Spees LP. Variation in Cervical Cancer Screening Preferences among Medically Underserved Individuals in the United States: A Systematic Review. *Cancer Epidemiol Biomarkers Prev*. 2020;29(8):1535-1548. [PubMed](#)
43. Foo YM, Goswami P, Grogin J, et al. Incorporation of human papillomavirus self-sampling into the revised National Cervical Screening Program: a qualitative study of GP experiences and attitudes in rural New South Wales. *Australian Journal of Primary Health*. 2021;27(4):284-290. [PubMed](#)
44. Obermair HM, Bennett KF, Brotherton JML, Smith MA, McCaffery KJ, Dodd RH. Australian National Cervical Screening Program renewal: Attitudes and experiences of general practitioners, and obstetricians and gynaecologists. *Aust N Z J Obstet Gynaecol*. 2021;61(3):416-423. [PubMed](#)
45. Sultana F, Roeske L, Malloy MJ, McDermott TL, Saville M, Brotherton JML. Implementation of Australia's renewed cervical screening program: Preparedness of general practitioners and nurses. *PLoS ONE*. 2020;15(1):e0228042. [PubMed](#)
46. Adcock A, Stevenson K, Cram F, et al. He Tapu Te Whare Tangata (sacred house of humanity): Under-screened Maori women talk about HPV self-testing cervical screening clinical pathways. *Int J Gynaecol Obstet*. 2021;11:11. [PubMed](#)
47. Wakewich P, Wood B, Davey C, Laframboise A, Zehbe I. Colonial legacy and the experience of First Nations women in cervical cancer screening: a Canadian multi-community study. *Crit*. 2016;26(4):368-380. [PubMed](#)
48. Possati-Resende JC, Vazquez FDL, Pantano NDP, Fregnani JHTG, Mauad EC, Longatto-Filho A. Implementation of a Cervical Cancer Screening Strategy Using HPV Self-Sampling for Women Living in Rural Areas. *Acta Cytologica*. 2020;64(1-2):7-15.
49. Tratt E, Sarmiento I, Gamelin R, Nayoumealuk J, Andersson N, Brassard P. Fuzzy cognitive mapping with Inuit women: what needs to change to improve cervical cancer screening in Nunavik, northern Quebec? *BMC Health Serv Res*. 2020;20(1):529. [PubMed](#)
50. Rees I, Jones D, Chen H, Macleod U. Interventions to improve the uptake of cervical cancer screening among lower socioeconomic groups: A systematic review. *Prev Med*. 2018;111:323-335. [PubMed](#)
51. Dick A, Holyk T, Taylor D, et al. Highlighting strengths and resources that increase ownership of cervical cancer screening for Indigenous communities in Northern British Columbia: Community-driven approaches. *Int J Gynaecol Obstet*. 2021;08:08.
52. Staley H SA, Shreeve N, Bryant A, Martin-Hirsch PPL, Gajjar K. Interventions targeted at women to encourage the uptake of cervical screening. *Cochrane Database Syst Rev*. 2021(9).
53. Malone C, Tiro JA, Buist DS, et al. Reactions of women underscreened for cervical cancer who received unsolicited human papillomavirus self-sampling kits. *J Med Screen*. 2020;27(3):146-156. [PubMed](#)

54. Goldstein A, Lei Y, Goldstein L, et al. A rapid, high-volume cervical screening project using self-sampling and isothermal PCR HPV testing. *Infect Agent Cancer*. 2020;15:64. [PubMed](#)
55. Goldstein Z, Martinson T, Ramachandran S, Lindner R, Safer JD. Improved Rates of Cervical Cancer Screening Among Transmasculine Patients Through Self-Collected Swabs for High-Risk Human Papillomavirus DNA Testing. *Transgend Health*. 2020;5(1):10-17. [PubMed](#)
56. Castanon A RM, Burger EA, de Kok I, Smith MA, Hanley SJ, Carozzi FM, Peacock S, O'Mahony JF. Cervical screening during the COVID-19 pandemic: optimising recovery strategies. *Lancet Public Health*. 2021;6:e522-e527. [PubMed](#)
57. Wentzensen N, Clarke MA, Perkins RB. Impact of COVID-19 on cervical cancer screening: Challenges and opportunities to improving resilience and reduce disparities. *Prev Med*. 2021;151:106596. [PubMed](#)
58. Meggetto O JN, Gao J, Walker MJ, Rey M, Rabeneck L, Murphy KJ, Kupets R. The impact of the COVID-19 pandemic on the Ontario Cervical Screening Program, colposcopy and treatment services in Ontario, Canada: a population-based study. *Bjog*. 2021;128(9):1503-1510. [PubMed](#)
59. Masson H. Cervical pap smears and pandemics: The effect of COVID-19 on screening uptake & opportunities to improve. *Womens Health (Lond Engl)*. 2021;17. [PubMed](#)