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AI-SUPPORTED HPV SELF-SAMPLING AND DIGITAL FOLLOW-UP PATHWAYS IN CERVICAL CANCER PREVENTION: EQUITY, ACCEPTABILITY, AND IMPLEMENTATION CHALLENGES IN HPV-VACCINATED POPULATIONS (2022-2026): A NARRATIVE REVIEW

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ABSTRACT

Background: Cervical Cancer Prevention has undergone a tremendous transformation over the years as a result of Primary HPV Testing, HPV Vaccination, Self-Sampling, Digital Follow-Up and New Artificial Intelligence Tools. As such these changes will be relevant socially and clinically in regards to Equity, Acceptability, Implementation and Governance.

Objectives: To summarize peer reviewed articles that have been written about HPV Self Sampling, Digital Support for Follow Up and AI enabled Pathways for Cervical Cancer Prevention since January 1st 2022- through March 31st 2026, specifically looking at Underserved Populations, Under Screened Populations, Vaccinated Populations.

Methodology: A Structured Narrative Search of Peer Reviewed Articles was conducted using Pubmed MEDLINE, Scopus and Google Scholar. When identifying Evidence related to Self Sampling, Digital Communication, Triage/Workflow supported by AI and Program Equity we prioritized Guidelines and Reports focused on Implementation.

Results: Recent Literature indicated that HPV Self Sampling could increase Access and Participation among the Under Screened Population. However, it's success would depend on successful Linkage to Follow-Up. Digital Technologies could potentially Improve Communication, Provide Navigation Through Screening Programs and Strengthen Coordination. However, They could Reproduce Exclusion if there is Limited Access to Technology and/or Digital Literacy. AI is currently in the earliest stages of development for Image Based Support and Workflow Optimization. There is Very Limited Evidence Available regarding Routine Use of AI for Pathway Level Screening. Vaccinated Populations will likely need More Adaptive Risk Informed Screening Protocols then Less Screening.

Conclusions: HPV Self Sampling, Digital Follow-Up and Selective Applications of AI can Enhance Cervical Cancer Prevention if Equitable Care Pathways exist and are Well Governed.

KEYWORDS

Cervical Cancer Prevention; HPV Self-sampling; Artificial Intelligence; Digital Follow-up; Health Equity; HPV-vaccinated Populations

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Introduction

Cervical cancer is among the most preventable cancers in women's health but remains a global health problem. Screening, treatment, and vaccination have improved significantly for many years, however, cervical cancer remains an important contributor to cancer incidence and death, particularly in areas where there are barriers to organized prevention. The World Health Organization describes cervical cancer elimination through the simultaneous scale up of Human Papillomavirus (HPV) vaccination, screening, and the appropriate treatment of precancerous lesions. According to the World Health Organization, all of these elements will need to work together, rather than independently. Therefore, screening will remain an important component in the detection of high-risk HPV infection and precancerous lesions prior to development into invasive cancer. (World Health Organization 2021; World Health Organization, n.d.)

Historically, in most parts of the world, programs using cytology (smear) have been the predominant cervical cancer screening model. However, as more research emerged supporting that primary HPV testing is significantly more sensitive to clinically relevant cervical cancer and provides a strong degree of reassurance to patients with a negative test, guidelines around screening strategies began changing. The preference for primary HPV testing has now become the standard for screening in most locations, and this shift has changed screening frequency, how screening results are managed, and ultimately the overall paradigm of preventing cervical cancer. The literature also reflects the increasing trend towards risk-based and personalized screening practices driven by vaccination coverage and digital technology. (Galani et al. 2025; Wentzensen et al. 2025)

Self-collection using HPV testing has become an innovation that will be key to secondary prevention. In areas with national programs for HPV testing, self-collection may provide an opportunity to increase screening participation and potentially assist countries in meeting the World Health Organization's goal of at least 70% participation in screening. Women may prefer to collect their own sample compared to having a clinician collect a sample because of perceived embarrassment, lack of time, fear of a pelvic exam, distance to service providers, or previous negative experiences. The direction of public policy regarding self-collection of samples has been supported by the emerging public health agenda related to cervical cancer. This agenda now includes self-collection as a potential way to expand the reach of cervical cancer prevention while still providing an HPV-based prevention strategy. (World Health Organization 2023a; World Health Organization 2023b; Gomes et al. 2025)

Policy support has been increasing with the development of guidelines and implementation plans. Clinician-collected cervical specimens remain recommended for women in surveillance (after prior abnormality, colposcopy, or treatment), while self-collected vaginal specimens can be used for primary HPV screening in asymptomatic, low risk women who have access to approved testing pathways. Importantly, these guidelines do not indicate that self-sampling should replace other components of the cancer prevention pathway but instead, that self-sampling can serve as an entry point to a larger, triage/recall/referral/ongoing screening process. (National Cancer Institute 2025; Wentzensen et al. 2025)

This distinction is vital. To achieve the public health value of self-sampling, it is important for the individual to not only collect a specimen, but to have the ability to connect themselves to appropriate follow-up care. A poor screening experience at the follow-up stage can negate the advantage gained from an increased number of individuals taking the first step in screening. Specifically, self-collected vaginal specimens may necessitate further clinical evaluation if the test result shows the presence of HPV. Consequently, self-sampling must be viewed as part of a continuum of a process, rather than as simply a separate act of screening. (Gomes et al. 2025; Smith et al. 2024)

Digital health tools (e.g. reminder systems, online registration, patient portals, app-enabled communication, electronic delivery of results, etc.) will likely play a major role in preventing cervical cancer. Digital health tools can support continuous care by supporting continuity for patients from kit ordering through follow-up attendance. Initial studies indicate that digital followup pathways may be an effective way to create clinical continuity after screening participation, particularly in areas with low screening rates and poor coordination of access to care. (Smith et al. 2024; Gomes et al. 2025)

AI adds yet another level of transformation. In the cervical cancer area, AI has become an additional topic of discussion regarding how AI can be used as a more general decision-support system to help with triage, risk stratification, workflow prioritization and pathway optimization; in addition to its role in AI-assisted image-based detection (cytology, colposcopy). Recent literature supports that AI may aid in developing more adaptable, data-driven prevention models. This literature also discusses the challenges associated with implementing AI on an ethical, legal and practical basis, which include the risk of overstating the advantages of AI prior to demonstrating that it has proven to be effective in practice, fair, transparent, and governed by adequate data practices. (Wang et al. 2024; Linder et al. 2025)

These types of issues will be even more important as we continue to expand HPV vaccination. The way cervical disease is spread will likely change as a result of expanded vaccination. Screening models for vaccinated individuals cannot be conceptualized as static programs that are used similarly in all groups. Therefore, they will likely need to be more adaptable and personalized. They will also likely be more dependent on technology. This is especially true when you consider how the absolute risk of developing cervical cancer has changed as well as how the trade-off between sensitivity, test interval length, patient acceptance, and resources needed will be affected by this new landscape. (Galani et al. 2025; Department of Health and Social Care 2025b)

Digital cervical cancer prevention can reinforce the same inequality issues that exist with clinician-based screening (and possibly even exacerbate them) if barriers such as language, technology, varying levels of health literacy, trust in systems/clinicians, and lack of coordination of services aren't addressed at the program level. Innovation on its own will not address inequity; how an innovation is implemented is what will determine whether it increases equitable access to cervical cancer screening or simply provides benefits to those who are already well-served. (Gomes et al. 2025; Vahabi et al. 2025)

This research will give a comprehensive view of the rapid development in the application of AI-aided self sampling for HPV (Human Papillomavirus) and Digital Follow Up in Cervical Cancer Prevention; especially focusing on acceptability, health equity, and implementation barriers in HPV vaccinated populations from 2022 through 2026." "the paper discusses how current findings inform the integration of self sampling, digital continuity of care tools, and AI informed pathways into modern disease prevention systems. It also discusses the limitations of these technologies that are dependent upon the integrated, equitable, and evidence based nature of the overall pathway design. Finally, this paper views cervical screening as both a clinical pathway and as a technology-and-society issue influenced by context including institutional, communication, trust and implementation issues. (Galani et al. 2025; Gomes et al. 2025)

Methodology

The main objective of this research is to provide an overall thematic review of the present published studies related to the use of AI-based methods for conducting HPV self-sampling followed by the digital follow-up as part of cervical cancer screening. The review emphasized themes including; Patient Acceptability, Health Inequity Implications, Barriers to Implementation, and the Impact of Increasing HPV Vaccination Coverage on Screening Strategy. (Gomes et al. 2025; Galani et al. 2025)

A comprehensive literature search was conducted in PubMed/MEDLINE, Scopus, and Google Scholar. Institutional and guideline references from international organizations, including the World Health Organization, were also reviewed. When multiple sources addressed the same issue, peer-reviewed articles and formal guidance documents were prioritized over news-style summaries. (Wentzensen et al. 2025; National Cancer Institute 2025)

The search focused on English-language publications published between January 1, 2022 and March 23, 2026. The selected timeframe was chosen to reflect the most recent phase of cervical cancer prevention research, including developments in HPV self-sampling, digital screening pathways, artificial intelligence applications, and the implications of increasing HPV vaccination coverage. (Department of Health and Social Care 2025a; Department of Health and Social Care 2025b)

A search strategy that utilized a combination of terms for cervical cancer screening, HPV self-sampling, digital health, follow-up adherence, AI and vaccine-eligible populations were employed. Narrative Reviews and Systematic Reviews were prioritized as well as Observational Studies, Implementation Studies, Pilot Programs, Clinical Workflow Papers and Major Guidelines/Consensus Documents. Additionally, citation tracking of key references was employed to further expand upon the relevant literature identified. (Smith et al. 2024; Wang et al. 2024)

Articles had to include at least one of the following: (1) The use of HPV Self-Sampling for Cervical Cancer Prevention; (2) Digital Methods to Support Post-Test Follow-Up, Recall, Referral, and/or Triage; (3) Use of Artificial Intelligence for Applications Related to Cervical Screening, Cytology, Colposcopy, Risk Assessment, and/or Workflow Support; (4) Equity and Acceptability Issues Associated with Self-Sampling and Digital Pathways; (5) Adaptations for Screening Populations Who Have Been Vaccinated Against HPV. Articles were ineligible if they were not in English language; were published beyond the defined timeframe; or dealt with Laboratory Techniques that are Unrelated to Cervical Cancer Prevention Pathways. (Parker et al. 2024; Montealegre et al. 2025; Vahabi et al. 2025)

The final database consisted of 14 references. The final evidence was analyzed with a qualitative (narrative) synthesis as quantitative analysis was impossible due to variability in design, setting, and outcome. Thematic areas that were selected based on conceptual relevance and potential heterogeneity among studies included: Rationale for self-collection; Acceptability of self-collection by population type; Digital Pathways for Follow-Up Post-Self-Collection; Artificial Intelligence supported preventive tools; Implications of Vaccination on Screening Logic; and Equity and Implementation Challenges

Results

Clinical and Public Health Rationale for HPV Self-Sampling

The idea of self sampling corresponds to the move from cytological screening to hvp screening. Primary HPV screening has greater sensitivity than cytology in identifying clinically important cervical pre-cancers; as such it creates new options for collecting samples that are valid in non-clinical environments. Therefore, as primary HPV screening increases in usage there will be an increase in the amount of time patients can collect their own specimens due to a shift from morphological based preventive methods towards virological. (World Health Organization 2021; Wentzensen et al. 2025)

The self-sampling concept fits well into an evolutionary transition from cytological screening to screening based upon HPV. Cytological screening does have a higher sensitivity rate than cytology when it comes to detecting clinically significant cervical pathology; as such, the use of primary HPV testing has created the opportunity for collection of viable samples in non-traditional (non-clinic) environments. The increasing utilization of primary HPV screening will continue to create opportunities for self-sampling as an essential component of the broader shift toward a virological versus morphologically based prevention model. (World Health Organization 2021; Wentzensen et al. 2025)

Many people that are unable to visit the doctor for screening do not actually refuse screening — many have barriers (e.g. embarrassment, fear/discomfort with the pelvic exam, no time, long wait times to see their doctor, difficulty getting to an appointment, child-care responsibilities, previous poor health care experience, etc.) that prevent them from being able to get screened. Self sampling is addressing most of those barriers at once — providing a more private experience, easier, and more control over when you screen. (Gomes et al. 2025; Vahabi et al. 2025)

Recent literature focused on the application of self-sampling approaches, has provided support for the notion that self-sampling represents an innovative approach for increasing equity among underserved populations who are at increased risk of developing HPV infection; and are less likely to engage with traditional screening services. Self-sampling innovations may represent viable solutions in addressing disparities related to access, convenience and trust within the context of innovative screening models. These studies collectively reinforce the concept of self-sampling being not only a technological innovation but a population health intervention which can assist in expanding program reach. (Gomes et al. 2025)

In addition to increasing access to screening through organized screening programs; self-sampling will also support screening through opportunistic screening programs as well, though its integration within different types of systems may vary. For example, in organized programs self-sampling can either replace traditional screening methods (e.g., mailed kits), or be used in conjunction with traditional screening methods to encourage those who have failed to attend screening appointments to come back. Self-sampling provides another avenue of entry into cancer prevention pathways for individuals in communities where there are few formalized prevention structures. (Smith et al. 2024; Department of Health and Social Care 2025a)

The role of self-sampling for cervical cancer screening has been overestimated with respect to improving the way screening can eliminate inequities in screening. While it does help improve the number of individuals entering the screening system, especially for those difficult to reach by traditional clinical systems, whether an

increase in screening participation results in a decrease in overall morbidity will depend upon how well laboratory testing is performed; when test results are communicated to patients; what triage mechanisms are used to evaluate abnormal findings; and how well screened women are linked to follow-up care. (Gomes et al. 2025; Wentzensen et al. 2025)

The advantage of self-sampling in a public health context lies in its alignment with an increasingly common trend of utilizing person-centred and self care-based approaches to provide health services. The ultimate goal for successful cervical cancer screening, which requires continuous participation by the same individuals over a prolonged period of time, will be achieved through interventions that remove barriers to participation and enhance participant's ability to make their own decisions. (World Health Organization 2023a)

Overall, the 2022-2026 literature provides evidence of a strong public health and clinical justification for use of HPV self-sampling. Its potential to provide improved access to screening and increased screening among under-screened populations supports its value in promoting a shift towards an HPV based prevention program. The effectiveness of self-sampling will be best demonstrated by how well it can be used as part of an overall pathway of care that includes timely follow-up with appropriate triage and the appropriate infrastructure to support the screening process. (Wentzensen et al. 2025; Gomes et al. 2025)

Acceptability of HPV Self-Sampling Across Different Populations

Many individuals are finding that they view their own collection of HPV samples to be more acceptable than having a healthcare provider collect a sample. Acceptance by individuals will greatly determine if an HPV testing initiative is successful. In addition to other perceived benefits (such as being faster, less invasive and/or providing more autonomy), many individuals have reported to feel safer collecting an HPV sample because they avoid the unpleasantness of pelvic exams. (Parker et al. 2024; Vahabi et al. 2025)

Evidence from the safety-net's under-screened populations is particularly valuable. Mailed HPV self-sampling kits were tested with under-screened patients in safety-net health care systems and had a relatively high level of acceptance. The participants often noted that the mail-in kit was easy to use and completed faster than the traditional clinic based screening. The above mentioned studies targeted the exact segments of the U.S. population where many programs have failed to reach; therefore, the results provide evidence for how much "access" is tied to "acceptance": An intervention will be effective at reducing inequities only if it is perceived by its target audience to be reasonable (practical), understandable, and worthwhile. (Parker et al. 2024)

Randomized trials have also provided evidence for self-sampling in resource poor countries. Mailed self-collection kits increased participation in cervical cancer screening in a number of U.S. Safety Net Health Systems. These studies demonstrated additional gains by incorporating patient navigation into the self-collection process. While the primary outcome measure for most of these studies was the rate at which screenings were completed, rather than solely acceptability; the findings support an overarching implementation strategy that self collection is especially useful when used in conjunction with systems that provide support to users as they navigate their care pathway and maintain contact with their provider. (Montealegre et al. 2025)

In addition to privacy and body autonomy, the main reasons individuals prefer self-sampling is the reduction of embarrassment in relation to a pelvic exam and shifting of control over their screening from healthcare providers to themselves. Self-sampling will likely be especially useful for those who experienced sexual assault; have a cultural aversion to personal examinations (intimate); have had poor experiences at other health care settings; or experience anxiety due to an inability to establish trust in healthcare professionals. (Parker et al. 2024; Vahabi et al. 2025)

Qualitative and implementation-oriented studies have also demonstrated that fear of doing the test incorrectly, anxiety about positive results, and confusion regarding follow-up remain important barriers for some participants. Acceptability is not universally uncomplicated at the same time. Some individuals are uncertain whether they can collect the sample correctly, whether the test is as accurate as clinician-based sampling, or what a positive HPV result would mean. (Parker et al. 2024; Smith et al. 2024)

Acceptability will vary based on the person's social environment and their past experience with screening. For example; if someone has experienced regular screening and has minimal obstacles attending a medical office, then self-sampling can be viewed as a convenient option. However, for those persons who are underscreened; of lower income; living in a rural setting; migrant; or minority groups, it could be viewed as a completely new way to make screening a realistic possibility for them after many years. (Parker et al. 2024)

The user journey for remote self-screening applications can significantly influence the acceptability of screening. User journeys include online registration, a sample kit being mailed to the individual, receiving test result notifications via email or other communication methods (e.g. SMS) as well as receipt of follow-up recommendations. Therefore, while the privacy and convenience of self-screening are important factors; they are not the sole factor for determining whether an individual finds self-screening acceptable. The overall user journey also plays a significant role in determining if the screening process will be viewed as both understandable and accessible by users. (Smith et al. 2024)

Self-sampling's acceptability will be difficult to measure based on just one use of the device. Acceptability may be better defined through an individual's willingness to use self-sampling again; their ability to recommend it to other women who are eligible for cervical cancer screening; and their continued engagement with future follow-ups as required. These criteria take into account that cervical screening is a continuous and longitudinal process. (Parker et al. 2024; Smith et al. 2024)

Another problem in the area of acceptability and health literacy relates to how much people know about their own knowledge of HPV, what a positive test means to them, and what the differences are between finding HPV, and having cancer. Consequently, policy assessments and review on implementation emphasize the necessity for understandable, culture sensitive, and literacy appropriate information, especially as self-sampling becomes more widespread. Thus, self-sampling will likely increase the number of women that come into screening programs but may also leave those same women with uncertainty, anxiety and confusion during the triage process. (Vahabi et al. 2025; Smith et al. 2024)

Recent research has supported the idea that self-sampling for HPV is generally well accepted among different groups of individuals. It appears especially useful for those individuals who have some type of barrier to obtaining cervical cancer screening at a clinical site. The reasons why self-sampling for HPV is generally well accepted appear to include convenience, privacy, autonomy, and lessened embarrassment; however, these factors are also influenced by how confident one feels about collecting their own sample, how clearly the sampling instructions were given, how much they understood about the process (health literacy), and how much they believed in the quality of the system that will follow-up with them. (Parker et al. 2024; Montealegre et al. 2025; Vahabi et al. 2025)

Digital Follow-Up Pathways After Self-Sampling

The clinical value of self-sampling will depend on whether women can be successfully linked to follow-up care after they have received their results. Linking is very important since most self-collected positive HPV results may need additional triage (e.g., clinician collected sampling), a referral for colposcopy examination or other specific follow-up by the public health system; as such, recent guidelines emphasize that self-collecting is primarily an entrance point into the healthcare delivery system rather than a completely separate method for preventing cervical cancer. (Wentzensen et al. 2025; National Cancer Institute 2025)

Digital follow-up pathways contain digital alternatives for each of the traditional steps in a pathway (online portal for registering, e-consent system, SMS reminder, app, platform for delivering test results, telehealth support, digitally-coordinated patient navigator) to help prevent attrition at several of the critical junctures in the pathway: kit ordering; returning the sample; receiving the test results; attending the subsequent clinic visit(s); and being referred to a specialist if required. These tools have particular appeal as an aid to implementation since self-collection provides only part of the solution to the participation problem. (Smith et al. 2024; Gomes et al. 2025)

Real-world data indicate that Digital Infrastructure (DI) can provide for both the initiation of testing AND the continuation of necessary follow-up care to be provided to individuals tested for conditions where there has historically been less screening performed by those groups. For example, in a geographic area within British Columbia, Canada, use of an online (digital) platform for self-screening was found to have favorable levels of acceptability, satisfactory levels of completed screening, and high follow-up examination rates among participants who were positive for Human Papillomavirus (HPV). (Smith et al. 2024; Department of Health and Social Care 2025a)

The value of digital follow-up is not limited to logistics alone. Results communication for HPV based screening has both psychological and behavioral complexity as there are many differences that exist between having an HPV positive result, having a precancerous lesion or being diagnosed with invasive cervical cancer. Therefore communication strategies will need to address participant's emotional reactions to their results; clarify what they should expect after receiving their results; and ultimately encourage participants to continue with further evaluation rather than just convey test results. (Gomes et al. 2025)

Digital tools could be particularly useful in helping those who have been under-screened as well as individuals with limited access to healthcare. The above factors can prevent individuals from completing the screening process; therefore, digital reminders, online results and navigation models for patients can make it easier for them to complete their screening process. Additionally, these technologies will allow for quicker communication with the individual regarding additional testing and/or treatment needed. (Montealegre et al. 2025; Vahabi et al. 2025)

At the same time, as it appears from the existing research there is a need for caution when implementing digital follow-up systems. Programs in which a large degree of dependency exists on Internet access, digital literacy, or consistent use of personal devices can disadvantage some of the very people that self-testing programs intend to serve. Consequently, it seems probable that hybrid models, which provide both convenience via the Internet and human assistance through detailed instruction and alternative access methods will ultimately be more equitable and long-term. (Vahabi et al. 2025; Gomes et al. 2025)

Another aspect is program integration. It will likely be difficult for a digital reminder or an internet based platform to achieve its goals when laboratories, cancer screening registries, primary care, and referral services lack cohesion. The success of the digital follow-up process will thus depend both on the user facing design of the tool and how well these different organizations coordinate with one another. The best models integrate all the elements that make up a complete continuum of care (self-sampling, managing results, recalling patients, referring) instead of adding them as separate pilot projects. (Department of Health and Social Care 2025a; Wentzensen et al. 2025)

In an increasingly immunized population, digital follow-up will be more important for screened individuals to track the changes that are occurring with screening modalities as we move from static to more dynamic/risk-based models. The need for a sophisticated and adapted approach to communicating about risk, screening intervals and what it means when you test positive for high-risk strains of HPV in a low risk population will grow as immunized cohorts come into screening age. (Galani et al. 2025; Department of Health and Social Care 2025b)

Overall, studies (2022-2026) support that digital follow-up pathways represent an important component to HPV self-sampling. The primary advantage of these pathways is in maintaining the continuum of care following the collection of samples through improved communication, follow-up for the screening process, adherence to triage, and coordination throughout the entire prevention pathway. However, there is much more involved with successful digital systems than just technology; programmatic integration of digital systems along with equitable design, and access to effective communication will be required for them to convert screening participation into preventive benefits. (Smith et al. 2024; Gomes et al. 2025)

AI-Supported Tools in Cervical Cancer Prevention Pathways

Artificial Intelligence (AI) has emerged in various studies concerning cervical cancer prevention pathways, from enhancing the efficiency of workflows by providing decision-making support to triaging patients. The potential applications of AI extend well beyond its ability to classify images, whether those are cytological or colposcopic. The current research is moving toward an era of adaptive screening with AI being used to make better use of digital information. Therefore, the relevance of this study is high because the use of Self-Sampling and Digital Follow-Up will produce new pathway data that could be applied to more personalized prevention strategies. (Galani et al. 2025; Linder et al. 2025)

One of the strongest bodies of evidence for maturity of AI comes from studies on how well AI can assist with cytology (the examination of cells) and provide a basis for image-based screening support. A number of recent studies describe the design and testing/evaluation/validation of artificial intelligence systems to grade cervical cytology using large-scale retrospective, prospective, and randomized observational data. The studies found that these AI systems had high levels of diagnostic performance, and indicated that use of AI as an aid helped improve the sensitivity of cytopathologists, and supported standardization of the interpretation. (Wang et al. 2024)

The applications of artificial intelligence (AI) go beyond cytology, and are currently being investigated for image analysis during colposcopy, multi-modal screening approaches, as well as patient-specific risk assessments. More recent reviews have indicated an increasing number of studies developing AI-based methods combining cytological findings, colposcopic findings, HPV test results and other forms of medical imaging. Ultimately, such a combination of data may allow for better triage through identification of those patients at greater immediate risk of clinically significant disease; thereby potentially aiding in prioritizing the intensity of follow-up examinations. (Galani et al. 2025)

An additional area where AI has potential is in improving the efficiency of work flow. The major problem with prevention pathways isn't a lack of understanding about the biological aspects of disease; it's an inability on the part of the health system to manage how to recall patients, triage them appropriately, refer them to specialists as needed, and monitor their progress over time. AI-based systems may ultimately assist in identifying individuals at the highest risk of being lost to follow-up, prioritizing abnormal test results to be reviewed, and facilitating more efficient use of limited specialist resources. (Linder et al. 2025)

This larger preventative role is particularly important when considering the use of HPV self-sampling. Because self-sampling has potential to expand program coverage, there is an increased need for effective triage and follow-up coordination on a case-by-case basis as a positive HPV test result alone will determine disease severity. These tools have the theoretical ability to assist in determining the level of risk associated with a positive HPV case based upon patterns that are commonly associated with significant clinical risks, as well as providing decision-making support for recalling or referring patients through increasingly digital screening systems. (Galani et al. 2025; Linder et al. 2025)

At the same time as this literature has been pointing out these limitations to avoid overstating the readiness of artificial intelligence (AI) for common use in practice, many studies on AI have focused on cervical prevention have a number of limitations including: many are based on retrospective designs; selected data sets; insufficiently validated externally; and too few or too narrow outcome measures to completely capture all possible effects along a pathway. (Linder et al. 2025; Wang et al. 2024)

AI systems can be used to increase equity of care in cervical cancer screening but there are many issues with using AI for this purpose. There is a concern that current AI systems will perpetuate inequities by performing differently based on race/ethnicity (as shown in other studies) and/or geographic area. There is also a concern about equity regarding the technology itself. Self-collection kits are being increasingly recommended as a method of improving cervical screening access in low-income communities. (Linder et al. 2025; Gomes et al. 2025)

An additional drawback is the fact that nearly all of the current body of research concerning artificial intelligence (AI) focus upon diagnostic precision and/or classification effectiveness as opposed to patient-based outcomes. The relative amount of data available regarding whether the implementation of AI results in enhanced long-term follow-up (adherence), reduced wait times for colposcopy, diminished disparities, increased programmatic efficiency in large-scale settings, or improved cancer-related outcomes within actual practice are also relatively limited. (Linder et al. 2025)

Overall, the literature from 2022 through 2026 supports cautious optimism regarding the use of AI in cervical cancer prevention. The most advanced role that AI has developed so far is in image-based support for clinical tasks, particularly cytology interpretation. Additionally, while the use of AI for triage, pathway development, and risk-informed preventive care is developing it is still an emerging area. AI may help improve both the prioritization, personalization and workflow organization for self-sampling and digital follow-up pathways. This could be particularly useful as vaccination rates increase. It will also require real world implementation with evidence, fairness and integration into existing health systems rather than just relying on enthusiasm for technology. (Wang et al. 2024; Linder et al. 2025; Galani et al. 2025)

HPV-Vaccinated Populations and Evolving Screening Logic

As vaccination against HPV becomes more widespread, it will become inappropriate to continue to think about cervical screening solely as an application of a single, static model that applies equally to all cohorts. In fact, because the increased use of prophylactic vaccinations is beginning to alter the epidemiology of cervical diseases by decreasing the prevalence of infections with HPV types targeted by vaccines and thus reducing the population-specific risk of these infections at the time when those individuals enter screening age, this shift will have significant implications for how screening programs are developed and communicated over the next few years. (Galani et al. 2025; Department of Health and Social Care 2025b)

This developing philosophy is strongly connected to a larger movement toward moving away from using cytological screening in favor of first-generation HPV based screening. The HPV based screening is inherently better-suited for risk-stratification due to its ability to detect viral risk much sooner and with greater sensitivity than cytology alone. In vaccinated populations, when the rate of high-grade lesion development could potentially decrease, and therefore the risk distribution could become more non-uniform, there would be even greater reason to implement individualized screening interval and triaging. (Wentzensen et al. 2025; Galani et al. 2025)

Vaccination will not replace screening, but changes the environment within which screening is done. This is an important consideration since successful vaccination may give the impression that screening is less necessary when in reality there should be intelligent readjustment of prevention measures (not withdrawal). While lower average risk levels may allow for adjustment of screening interval, triage threshold, or post-screening follow-up protocols, this can occur only as long as the overall program remains based on evidence, understandable and acceptable to those who are screened. (Galani et al. 2025)

This transition will also increase the value of self-sampling and digital pathways for supporting participants. For example, in lower risk, vaccinated populations, a prevention program could be significantly more reliant upon effective participant engagement; clearly communicated expectations regarding follow-up (and how follow-up is tailored); as well as reducing the reliance on universally applied frequent visits. The reduction of "barriers" to initiating self-sampling, along with maintaining long term recall, reinforcing an understanding of interval based prevention and providing support for navigating post-positive test results are all possible ways that digital systems could provide similar benefits. (Smith et al. 2024; Department of Health and Social Care 2025b)

At the same time, changing screening criteria for vaccinated people poses other forms of communication problems. Vaccinated individuals are likely to be confused about why screening would continue to be recommended after receiving vaccines; conversely, unvaccinated individuals that receive a positive HPV test may be confused as well, because it will contradict their belief that the vaccine will completely prevent HPV infection. Therefore, there is an urgent need for clear information on residual risk, on what types of infections vaccines do offer protection against (i.e., vaccine scope), on screening interval, and on the appropriate follow-up actions. (Galani et al. 2025; World Health Organization, n.d.)

Another reason why vaccinated populations should receive particular consideration when implementing screening is because vaccination levels will vary across countries and among populations. The level at which individuals are vaccinated also varies geographically, socioeconomically, and based on how their local health system is organized, as well as with respect to public trust. These differences indicate that there will be an increasing trend for screening pathways to be used in communities where both vaccinated and under-vaccinated individuals exist together. (Gomes et al. 2025; Department of Health and Social Care 2025b)

Risk stratification could have an advantage in terms of both the efficiency of testing (i.e., better use of resources) and reducing disparities among high-risk vs. lower risk populations. However, the success of these strategies will depend on having the right technology to support them; and appropriate guidance from government; and adequate education/communication with patients about their risks and what they should do based upon those assessments. (Department of Health and Social Care 2025b; Galani et al. 2025)

Overall, data from 2022 to 2026 show that vaccinated HPV populations require not less (cervical) screening, but more flexible cervical screening. It appears that prevention routes will have to evolve toward a risk-orientation, digital coordination of prevention activities and an orientation towards changing epidemiology. In such a context, self-sampling and subsequent digital follow-ups could be used with increasing frequency as tools for supporting user engagement and continuous participation; AI can possibly play a role in the future on route customization. (Galani et al. 2025; Department of Health and Social Care 2025b)

Equity and Implementation Challenges

Self-Sampling and Digitally Supported Prevention Pathways Have Potential for Increasing Inequality If They Are Implemented Without Equity in Mind.

Equity is an essential part of the rationale behind self-sampling and digital health innovations due to the fact that they are typically marketed toward individuals who are at high-risk of being under-screened, underserved, or excluded from conventional screening at clinics. The potential of digital health innovations to address disparities will be realized only if there is intentional design to address barriers to access, building trust, and navigating services. (Gomes et al. 2025; Vahabi et al. 2025)

One of the most obvious barriers is that created by the digital divide. The use of follow-up systems may enhance reminder function, communication and coordination between participants and clinics but they also disadvantage those with limited internet access, unstable phone access, low levels of digital literacy or reduced confidence in navigating online systems. This issue has high relevance because the populations which are most likely to benefit from self-sampling will also probably be those least well served by purely digital solutions. Convenience for some users may result in exclusion of others if alternative pathways do not continue to be available. (Smith et al. 2024; Vahabi et al. 2025)

Language and health literacy barriers are equally important. Even though self-sampling is acceptable in principle participants may not understand how to perform the test what an HPV positive result means why additional triage (screening) is necessary or how vaccination status changes but does not eliminate the need for screening. Reviews and policy analysis have consistently identified that targeted culturally sensitive and literacy sensitive communication must be provided if self-sampling programs are to improve outcomes equitably. (Vahabi et al. 2025; World Health Organization 2023a)

Structural marginalization, as well as prior experience (e.g., stigma) of structural marginalization can also lead to relational and institutional barriers when receiving an intervention based on self care and/or using technology. Therefore, implementing a new, more technologically simple diagnostic tool does not inherently overcome these existing relational and institutional barriers. Thus, cultural acceptance/trust in addition to other factors will contribute to successful implementation of a new diagnostic tool. (Vahabi et al. 2025)

A significant limitation of self-sampling for improving screening access is that it could potentially only move some of the disparity in screening to later stages in the screening process. When a woman receives a positive HPV result she will need follow-up care by her doctor. If women have difficulty getting an appointment with their doctor, receiving test results, or navigating through the system there may be no improvement in the overall disparity. Therefore, as emphasized in this review, evaluating the total path of screening (not just at the time of sample collection) is important. (Wentzensen et al. 2025; Gomes et al. 2025)

Challenges to implementing new technologies arise from both the capacities and resources available in health systems as well. For example, self-sampling is an appealing alternative for many women in low-resource or fragmented health care delivery systems since they expand screening options that do not rely on a visit to a health care provider. If however, laboratory testing, registry tracking, and follow-up with and referrals to appropriate treatment centers are poorly linked within a system there will be reduced benefit from such programs. (Gomes et al. 2025; Department of Health and Social Care 2025a)

Another layer of complication is added through regulatory/ethical/governance issues. Secure data handling, transparency/oversight, and accountability are necessary for digital communication of screening results, remote management of screening pathway, and AI-informed triage system. However, concerns exist around privacy, secondary use of data, bias in algorithmic systems and unequal performance across population. Therefore, technological modernization should occur with fairness, explainability, legal protections and context sensitive governance. (Linder et al. 2025; Department of Health and Social Care 2025a)

A further critical aspect of implementing this new technology relates to how well it has been tested in different settings. Most of the research published on these new technologies has come from pilots; high income countries (such as the UK); and specific populations rather than all. Furthermore, there are few studies evaluating the long term effects of repeated screening behavior and the effect on a system wide level. (Gomes et al. 2025; Galani et al. 2025)

These obstacles don't diminish the worth of self-testing and digital pathway development. They simply help us understand when we will see success with this technology. The most prevalent finding from recent studies has been that for equitable use there needs to be a hybrid model (human assisted where needed, and digital as appropriate) and flexible in order to respond to linguistic, cultural, geographic and socio-economic differences. (Gomes et al. 2025; Vahabi et al. 2025)

The evidence from the past five years indicates that barriers to both equity and implementation are not secondary issues in determining whether the public health benefits of self-sampling, digital follow-ups, and AI supported prevention programs will emerge. The most effective approaches will need to marry innovation (in technology) with strong communication; with hybrid access pathways; with culturally responsive delivery methods; and with a unified governance strategy for all stages of screening. (Gomes et al. 2025; Vahabi et al. 2025; Department of Health and Social Care 2025a)

Discussion

Self-collection by means of a HPV sampling device represents an opportunity for a larger number of people to participate in cervical cancer prevention programs. Most of the research published recently, along with various government policies, indicate that the value of self collection does not simply lie in changing the person collecting the sample; rather, it may have an impact on access to the screening program as a whole. The main advantage of self-collection lies in its ability to reduce "friction" or obstacles to screening at the time the individual decides to be screened, by virtue of increased privacy, convenience, autonomy, and acceptability. However, gaining entrance into screening is just one part of a process which must be both clinically and operationally coherent in order to produce meaningful preventive benefits. (Montealegre et al. 2025; Parker et al. 2024)

The most important thing about the information included in this study is that it suggests HPV self-testing by itself will not be effective. As exciting as many are with the idea of self-testing (and there are some benefits) — especially for increasing participation rates — just collecting samples isn't enough to reduce the burden of cervical cancer. Screening can only prevent cervical cancer if each step after collecting a sample occurs effectively; laboratory procedures to analyze samples occur correctly, results are communicated clearly to individuals receiving them, referrals occur quickly when they're needed and appropriate follow-up care occurs in a timely manner. (Wentzensen et al. 2025; Gomes et al. 2025)

Why Digital Follow-Up Is Such an Important Theme. Although this review of the literature shows that digital support could be at its most valuable in maintaining links between screening phases, it does not mean to replace clinical contact. There are many ways digital solutions can help preserve these connections; e.g., reminder systems, patient-held electronic records through web-based portals, apps which allow patients to communicate with their health service providers and digital navigation (pathway) models to avoid loss at all points along the chain from test kit distribution through to sample return, receipt of results, booking into triage clinics and then onto onward referral. (Smith et al. 2024; Gomes et al. 2025)

The article also states that "digital" does not mean "simpler." In fact, digital preventive pathways could bring about a greater amount of complexity while reducing the logistics barrier. An individual's positive test result for HPV can be very confusing to an individual especially when the individual has varying levels of health literacy or may have confused their HPV infection with cancer. A faster and easier route via digital means will not produce empowered behavior if it lacks clear and contextualized communication. Therefore, both the technical functioning of the digital pathway and the communication design of the pathway will determine the effectiveness of the digital follow-up. (Vahabi et al. 2025; Department of Health and Social Care 2025a)

AI has the potential to be the most forward-thinking part of this pathway; however, it has the greatest opportunity to be mis-stated. While there is a wealth of data showing that AI can perform with high accuracy on tasks using images (such as cytology support and other classification), in some limited screening environments, we are seeing evidence that these technologies can provide improvements in sensitivity, standardization and/or efficiencies in workflows. A number of broader claims about AI - including its ability to effectively manage pathways, prioritize triage and implement personalized prevention - while they represent technological promise, at present, are largely aspirational versus operational in many real world practice settings. (Wang et al. 2024; Linder et al. 2025)

This difference in what the two types of AI are intended for is significant due to the fact that cervical cancer prevention is an ongoing health process for the population and requires acceptance, recall, trust, and continuation over time, along with coordination within systems. Therefore, even though there may be high performance in retrospect using data sets from images, a new AI technology will likely not contribute to actual prevention pathways until it improves how many patients are followed up on after screening, when they get their results back (timely), and whether or not all populations have equal access to the same benefits. (Gomes et al. 2025; Vahabi et al. 2025)

One of the primary findings in this study is that as vaccination increases among populations, it will be essential to develop new screening strategies based on the epidemiology of cervical disease. The development of new screening strategies may include a combination of risk-based, digitally-coordinated and personalized screening programs. Traditional fixed-interval screening models will likely no longer remain applicable to the same degree, particularly in the area of optimizing the trade-off between the length of time between screenings (interval), the proportion of positive tests which are triaged for further testing, and programmatic efficiency. (Galani et al. 2025; Department of Health and Social Care 2025b)

At the same time, however, there are several communication and programmatic challenges associated with the vaccine-protected population. For example, the fact that many in the vaccinated population will believe it is not necessary to be screened for diseases; likewise, those designing or implementing prevention programs have an obligation to provide rationale as to why prevention continues to matter even though average-risk levels among the vaccinated population are significantly decreased. The above illustrates the reason why technical approaches to prevent disease often fail when sufficient support exists for successful implementation through the development of good communication frameworks. (Galani et al. 2025; World Health Organization, n.d.)

In order to determine whether innovations of this type are justifiable, equity is a key element. While nearly all benefits associated with self-sampling, digital follow-up and artificial intelligence (AI) supported pathways depend on improvements to access among underserved populations; the literature also demonstrates how inequities can easily be shifted from one point along the pathway to another. For example, while self-sampling overcomes embarrassment or logistically-based barriers to accessing screening tests, it does not necessarily address issues such as interpretation of test results, unequal digital access to test information, lack of language support for patients who require assistance or fragmentation of referral systems. Therefore, innovation must be evaluated based upon differential effects within population groups instead of merely by assessing overall program convenience. (Gomes et al. 2025; Vahabi et al. 2025)

This has led to an expanded definition of implementation: the success of innovation in preventing cervical cancer is very likely going to depend on hybrid (as opposed to pure technology) approaches. While digital tools can provide increased ease and convenience, human intervention will continue to be important for helping individuals navigate these new technologies as well as building confidence through explanation and providing assurance – especially among marginalized populations. Self-collection devices could potentially increase screening rates — however this approach would work best if placed into multi-route access systems rather than being built around one method or tool. Therefore the most effective programs will probably be those with flexibility which incorporate both self-care options, digital communication systems, and clinical support based upon individual needs. (Smith et al. 2024; Gomes et al. 2025)

The current body of literature possesses many positive aspects. First, the subject matter is contemporary, and the time frame from 2022-2026 represents an era of self-sampling policy, digital pathways for experimentation, use of artificial intelligence (AI) as well as vaccination based cohort thinking. Second, there are multiple disciplines in the data providing the opportunity for synthesizing concepts in public health, implementation science, screening policy, digital health and AI-enabled diagnostics. Third, this literature also contains sufficient conceptual agreement to allow for a definitive interpretation that the future utility of self-sampling will depend less on how specimens are collected than how the surrounding pathway is constructed. (Galani et al. 2025; Wang et al. 2024)

Although the reviewed research was informative, it had many significant shortcomings. The majority of reviewed studies were pilot-based, site-based or addressed intermediate (i.e., uptake, acceptability, or diagnostic performance) instead of long-term pathway outcomes. There are few data regarding adherence over a period of years, repeat attendance through subsequent screening rounds, time-to-colposcopy/treatment, impacts on equitable access to screening at scale, and relative effectiveness among different healthcare systems. AI research has been particularly strong with regard to technical activities vs. those related to patients and programs. Therefore, although the field of research into AI for cervical screening appears to be developing rapidly, the body of evidence does not support conclusions regarding an imminent "transformation. (Linder et al. 2025; Montealegre et al. 2025)

From an implementation standpoint, the study's results provide some direction. Screening programs (and particularly those using self-testing) need to develop their own follow-up process as part of the initial program planning process; not wait until later. Programs utilizing digital platforms should evaluate how efficient they are in addition to evaluating how accessible, comprehensible, and fair they are. Forward-thinking design for screened populations (e.g., vaccinated) should include them but also ensure that people understand that screening is still important. The use of AI tools should be incremental and emphasize both external validation and transparency related to fairness and quantifiable pathways. Overall, when implementing new programs or technologies, they should be evaluated based upon their ability to increase continuity, understanding and equality. (Department of Health and Social Care 2025a; Department of Health and Social Care 2025b)

In summary, the literature reviewed here supports a coherent overarching interpretation: HPV self-sampling is an important innovation for cervical cancer prevention but its true public health value will be realized when it is used as part of digitally coordinated equity-sensitive and clinically-integrated pathways.

Future application of AI to these pathways may enhance them particularly if screening moves towards risk-based practices in vaccinated populations, however this will depend on responsible implementation of technology instead of merely exuberant use of technology. Thus, the future of cervical cancer prevention will not be defined by any single tool; rather it will be how well self-sampling, digital follow-up, AI, and screening policy are weaved into prevention systems that are both scientifically sound and socially just. (Gomes et al. 2025; Galani et al. 2025)

Conclusions

The advancement represented by HPV self-sampling for contemporary cervical cancer prevention is significant for healthcare systems seeking to increase participation from under-screened populations while adjusting existing screening pathways to accommodate the HPV vaccine. Between 2022 and 2026, there has been consistent evidence that self-sampling will eliminate many of the identified barriers associated with privacy, convenience, autonomy, and accessibility; ultimately enhancing the opportunity for individuals to participate in cervical cancer prevention. However, although research indicates that the public health value of self-sampling exists post-collection (e.g., communicating results, adhering to triage procedures, referring patients promptly through established or semi-established pathways), it is contingent upon several factors. (Wentzensen et al. 2025; Gomes et al. 2025)

Digital tracking programs can be an important support for self-collecting samples rather than simply a secondary process. Tracking methods such as reminder systems, online portal systems, and digitally integrated tracking systems have the potential to develop screenings into meaningful ongoing care, particularly for those who use traditional pathway systems less frequently due to their fragmentation. It is apparent from current research that the effective use of technology in this area will depend upon; a) clear communication, b) health system wide integration, c) a commitment to preserve hybrid (digital & non-digital), accessible (to all) models for accessing these systems. (Smith et al. 2024; Montealegre et al. 2025)

AI may also support cervical cancer prevention pathways through patient-flow management, workflow prioritization, risk-based strategies, and triage. The current evidence is far more developed for image-based and technical applications than it is for longer term patient focused and programmatic outcomes. Therefore AI has great potential as part of cervical cancer prevention however it needs to be viewed as developing technology that has the need for robust evaluation, transparency, equity and thoughtful inclusion within the existing screening processes. (Wang et al. 2024; Linder et al. 2025)

The logic of screening in HPV vaccinated populations appears to be increasingly adaptable and risk based. Thus, while future prevention models may rely heavily on innovative technologies such as self-sampling; digital follow-up; and AI supported management, they may do so within pathways that remain clinically relevant; accessible to patients; and equitably distributed among diverse populations. Therefore, the most compelling interpretation of current data suggests that self-sampling is not an independent solution for cervical cancer prevention, but can provide significant access enhancing contributions when integrated with evidence based, digitally coordinated, and sensitive to inequity systems of care. (Galani et al. 2025; Department of Health and Social Care 2025b)

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