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Strengths, Weaknesses, Opportunities and Threats (SWOT) Analysis for the Implementation of Public Health Policies for Human Papillomavirus (HPV)-based cervical cancer screening in Brazil

Análise de Forças, Oportunidades, Fraquezas, e Ameaças (FOFA) para a Implementação de Políticas de Saúde Pública para o Rastreamento do Câncer do Colo Uterino Baseado na detecção do Papilomavirus Humano (HPV) no Brasil

Análisis de Fortalezas, Debilidades, Oportunidades y Amenazas (FODA) para la implementación de políticas de salud pública para la detección del cáncer de cuello uterino basado en el Virus del Papiloma Humano (VPH) en Brasil

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Abstract
In Brazil, cervical cancer incidence and mortality persist at high levels, disproportionately affecting most vulnerable women. This article aims to present and discuss factors that facilitate or hinder the implementation of HPV-based screening, which is important for achieving cervical cancer global elimination targets by 2030. A SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis assessed internal and external factors affecting the nationwide adoption of HPV-based cervical cancer screening. The analysis was informed by official national documents, international guidelines, and peer-reviewed published literature, complemented by insights from researchers, health managers, and civil society actors. The SWOT analysis identified strong enabling factors—including a unified public health system, existing laboratory capacity, and availability of World Health Organization (WHO)-recommended HPV tests—alongside major weaknesses, such as low screening coverage, lack of an organized call–recall system, and regional inequities. Opportunities include global support for cervical cancer elimination, expansion of molecular diagnostics, and the potential of self-collection to reach underserved populations. Threats include supply chain vulnerabilities, long-term financial sustainability, and uncertainties in follow-up pathways for women with HPV-detected. The analysis highlights strategic priorities for strengthening the implementation of HPV-based screening in Brazil, with actionable recommendations to increase coverage, improve diagnostic quality, and enhance follow-up and treatment. These findings can guide planning and support efforts to meet the Global cervical cancer elimination targets.
Keywords: Human Papillomavirus; Cervical Cancer Screening; Public Health; Women's Health; Molecular Diagnostics.

Resumo
No Brasil, a incidência e mortalidade por câncer de colo úterino persistem em níveis elevados, afetando desproporcionalmente mulheres em situacao de vulnerabilidade. Este artigo tem como objetivo apresentar e discutir os fatores que facilitam ou dificultam a implementação do rastreamento baseado no HPV, fundamental para alcançar as

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metas globais de eliminação do câncer de colo úterino até 2030. Uma análise FOFA avaliou fatores internos e externos que afetam a adoção nacional do rastreamento do câncer de colo uterino baseado no HPV. A análise considerou documentos oficiais nacionais, diretrizes internacionais e literatura científica, complementada por contribuições de pesquisadores, gestores de saúde e membros da sociedade civil. A análise identificou fatores facilitadores — incluindo um sistema unico de saúde pública, capacidade laboratorial existente e disponibilidade de testes de HPV recomendados pela Organização Mundial da Saúde (OMS) — juntamente com importantes fragilidades, como baixa cobertura de rastreio, ausência de um sistema organizado de convocação e acompanhamento, e desigualdades regionais. Oportunidades incluem o apoio global à eliminação do cancer, expansão do diagnóstico molecular e potencial da autocoleta para alcançar populações carentes. As ameaças incluem vulnerabilidades na cadeia de suprimentos, sustentabilidade financeira e incertezas no tratamento de mulheres com HPV detectado. A análise destaca prioridades estratégicas para fortalecer a implementação do rastreio por HPV no Brasil, com recomendações práticas para aumentar a cobertura, melhorar a qualidade do diagnóstico e aprimorar o acompanhamento e o tratamento. Essas descobertas podem orientar o planejamento e apoiar esforços para atingir as metas globais de eliminação do câncer do colo uterino.
Palavras-chave: Papilomavirus Humano; Detecção Precoce de Câncer; Saúde Pública; Saúde da Mulher; Teste Molecular.

Resumen
En Brasil, la incidencia y mortalidad por cáncer cervicouterino persisten a niveles elevados, afectando desproporcionadamente a las mujeres vulnerables. Este artículo busca presentar y analizar factores que facilitan o dificultan la implementación del cribado basado en el VPH, importante para alcanzar las metas globales de eliminación del cáncer cervicouterino para 2030. Un análisis FODA evaluó factores internos y externos que afectan la adopción del diagnostico molecular. El análisis se basó en documentos nacionales oficiales, directrices internacionales y literatura cientifica, complementados con perspectivas de investigadores, gestores de salud y miembros de la sociedad civil. El análisis FODA identificó factores facilitadores, como un sistema de salud pública unificado, la capacidad de laboratorio existente y la disponibilidad de las pruebas de VPH recomendadas por la Organización Mundial de la Salud (OMS), junto con importantes debilidades, como baja cobertura del cribado, falta de un sistema organizado de llamadas-y-recordatorios, y desigualdades regionales. Las oportunidades incluyen el apoyo global para la eliminación del cancer, expansión del diagnóstico molecular y el potencial de collecta autonoma de muestras para servir poblaciones desatendidas. Las amenazas incluyen vulnerabilidades de la cadena de suministro, la sostenibilidad financiera y incertidumbres en el seguimiento de mujeres con VPH detectado. El análisis destaca prioridades estratégicas para fortalecer la implementación del cribado basado en el VPH, con recomendaciones prácticas para aumentar la cobertura, mejorar la calidad del diagnóstico y optimizar el seguimiento y el tratamiento. Estos hallazgos pueden orientar la planificación y respaldar los esfuerzos para alcanzar las metas mundiales de eliminación del cáncer cervicouterino.
Palabras clave: Virus del Papiloma Humano; Detección Precoz del Cáncer; Salud Pública; Salud de la Mujer; Pruebas Moleculares.

1. Introduction

Cervical cancer is a global health problem, affecting females since centuries (Smith, 2024; Mavrommatis, 2021). In 2022, cervical cancer was the fourth most common cancer in women globally with over 660 000 new cases and around 350 000 deaths (World Health Organization (WHO), 2025). The highest rates of cervical cancer incidence and mortality are found in low- and lower-middle-income countries (ICO/IARC HPV Information Centre, 2023). This reflects major inequities driven by a lack of access to preventive vaccination, cervical cancer screening, and treatment services.

Cervical cancer disease follows predictable cyto- and histopathological changes over several years, hence largely preventable (National Cancer Institute, 2024). A routine test for this cancer, was reported in 1928 by Papanicolaou & Papanicolaou (Vilos, 1998) - the so-called “Pap” smear or “Pap” test - as precancerous cytological changes, not visible to the naked eye, can be detected in cervical epithelial cells, sampled by clinicians and observed by microscopy. Since 1941 it has been used worldwide as early cancer detection screening (Michalas, 2000).

The fact that genital infections by carcinogenic types of epitheliotropic human papillomavirus (HPV) cause cervical cancer has been firmly established (Zur Hausen, 2009), and scientists showed that nearly all cervical cancer cases are caused by HPV (Walboomers et al., 1999). The International Agency for Research on Cancer (IARC) has recently determined that 17

HPV genotypes are high risk for cervical cancer (Wei et al., 2024). After genital infection by high-risk HPV types, cancer usually can take 10–20 years to develop, providing opportunity for prevention based on vaccination (WHO position paper, 2022), early detection (Arbyn et al., 2020) as well as ablation treatment (Marth et al., 2020). HPV genotypes most associated with the highest cervical cancer attributable fractions are eight (HPV types 16, 18, 31, 33, 35, 45, 52, and 58), are the most carcinogenic and are therefore also clear priority targets for inclusion in HPV-based screening tests (Clifford, 2024) and into recombinant vaccines (Pagliusi & Aguado, 2004; Kim et al., 2024).

In 2018 the WHO announced the Global Cervical Cancer Elimination Initiative, adopted in 2020 by its members at the World Health Assembly, with the ambition to reduce annual incidence rates of cervical cancer below 4 cases per 100 000 women in every country (World Health Organization, 2020). While the national policy is a key step to drive changes in access to healthcare, the incorporation of innovative technologies into the public health system at the operational level is one of the most challenging issues for populations to benefit from novel products and procedures, proven to be more effective than those available, and is the motivation of this analysis.

In Brazil, cervical cancer is the third most common cancer among women and is often diagnosed at advanced stages, particularly among socioeconomically vulnerable populations (Instituto Nacional do Cancer (INCA), 2025). Despite decades of Pap-based screening, the programme has followed an opportunistic model with low population coverage, limited quality assurance, and persistent regional inequities (Teixeira, 2014). As a result, mortality reductions have been modest, and recent data show a trend of increasing mortality among women aged 25–44 years. According to the last version of National Guidelines for screening (INCA, 2016), females aged 25 to 64 are advised to undergo screening every three years. From the second half of the 1970s onwards, cervical cancer was defined as a public health problem, and in 1988 with the creation of the National Unified Health System (Sistema Único de Saúde – SUS) the policies designed to control cervical cancer became widely available. In 1997, INCA introduced a cervical cancer screening project which functioned as a pilot for the creation of a national programme to control the disease, named “Viva Mulher” (Long Live Women) (Porto & Briglia Habib, 2014).

The Brazilian Ministry of Health has embraced the WHO elimination initiative and taken actions to tackle the issue: firstly, by introducing in 2014 the vaccination against 4 types of HPV (6-11-16-18), now available for young people, 9 to 14 years old, and with updated recommendations published in early April 2024, from two doses to a single dose (IARC News, 24 April 2024). The vaccine is also available for specific populations, as people living with HIV/aids (until 45 years old) (Brazil Health Ministry, 2025). Secondly, with recommendations by the National Committee for Health Technology Incorporation (CONITEC), created in 2011 to advise the Ministry of Health: based on scientific evaluation for innovation in the cervical cancer screening programmes (CONITEC Report of recommendations No. 878, 2024), one should incorporate HPV detection technologies in the public health system – SUS. Despite the availability of HPV vaccination since 2014, free of charge for adolescents in the Unified Health System (SUS), the impact on cervical cancer burden, its effect on incidence and mortality occurs only at long-term. In Brazil, HPV vaccination coverage in children and adolescents is around 80% of the target group (Ministry of Health, media, 2025). Therefore, the cervical cancer screening programme remains essential in the coming decades, towards ensuring the WHO elimination goals.

This article aims to present and discuss factors that facilitate or hinder the implementation of HPV-based screening, which is important for achieving cervical cancer global elimination targets by 2030.

Given the complexity of transitioning a large public health programme from Pap-based screening to HPV molecular testing, a structured assessment of the implementation environment is essential. This report uses a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis to identify enabling factors, opportunities, barriers, and potential risks associated with scaling up HPV-based screening nationwide. The findings aim to inform strategic planning and support Brazil’s progress

toward the WHO 2030 elimination targets.

2. Methodology

A qualitative and reflective documentary research was carried out (Risemberg, Wakin & Shitsuka, 2026; Pereira et al., 2018). The IARC standardized, reliable, and validated data sources on cervical cancer incidence and mortality rates globally and tools were consulted. A SWOT analysis is a qualitative strategic planning tool, commonly used in project management and public policy to help organizations make informed decisions, identify and evaluate the key factors influencing a project, initiative or priorities, and plan effectively, by assessing both the internal and external environment (Teoli et al., 2023). The acronym "SWOT" stands for: strengths, internal attributes, policy and resources that provide an advantage over competitors or contribute positively to the project or organization; weaknesses, internal limitations or areas that need improvement, which may hinder performance or success; opportunities, external factors that could be leveraged to benefit the project or organization, such as market trends, new technologies, or changes in regulations; and threats, external challenges or risks that could potentially harm the project or organization, such as competition, or economic changes. By utilizing SWOT Analysis, governments and other services can determine suitable strategies to adopt and implement a health policy. The process for this study began with outlining the management and policy approach and conducting literature-based assessments. The decision analysis used in this project involved a review of official Brazilian policy documents and scientific publications between 2020, the time when the World Health Assembly adopted the WHO strategy and targets for the elimination of cervical cancer, and mid-2025, as related to the screening programmes for control of cervical cancer, incorporating insights from researchers, government officials, and non-governmental expertise on health policies in Brazil. Some references of historical importance are also cited for context.

3. Results and Discussion

3.1 Cervical Cancer Burden and Rationale for Screening Innovation

The need for innovative approaches to cervical cancer screening in Brazil is indicated by the analysis of trends in age-standardized mortality rates over the last decades, according to data sets available from Global Cancer Observatory (Globocan) (IARC Globocan, 2025). Despite more than five decades of Pap-based screening in Brazil, reductions in cervical cancer mortality rates have been modest, from 8.8 in 1980 to 7.8 per 100.000 women in 2020, and less pronounced than in high-income countries. According to Globocan, some high-income countries have shown substantial declines in mortality rates in the same period, such as Sweden (5.6 to 1.8), Switzerland (7.2 to 1.5), and the United States (5.3 to 2.7). Notably, among women aged 25–44 years, Brazil's mortality rate has increased over the past two decades (from 3.7 to 5), while in Sweden, Switzerland and United States in the same age group, it further decreased, from 1.7, 1.3 and 2 to 1, 0.5 and 1.7 respectively) (cf. IARC Global Cancer Observatory, GLOBOCAN, Cancer Over Time webpage). These trends reflect persistent structural challenges of the opportunistic screening model in Brazil, characterized by low coverage, limited quality control, and wide regional inequalities. Additionally, mortality patterns show significant spatiotemporal variation, with the highest mortality rates reported in the North and Northeast regions, suggesting systemic inequities in access to timely screening, diagnosis, and treatment (Melo et al., 2024).

Considering the causal relationship between cervical cancer and carcinogenic HPV infections new strategies have been developed to increase testing sensitivity and optimize screening for cervical cancer prevention (Silva Filho et al., 2024). Molecular tests that amplify viral genetic material (nucleic acid amplification test, NAAT), for example, polymerase chain reaction (PCR) that detects HPV-deoxyribonucleic acid (DNA) and transcription-mediated amplification (TMA), are suitable

for the primary diagnostic of HPV infections in anogenital samples (Arbyn et al., 2020; World Health Organization, 2022). Such molecular testing programmes have been widely introduced and implemented in other countries such as Sweden (Dillner et al., 2024), Switzerland (Cancer Screening Committee Recommendations, Switzerland, 2021), United States of America (Centers for Disease Control and Prevention (CDC), Screening for Cervical Cancer, 2025). Noteworthy, molecular tests are also already registered and available in Brazil, however accessible only in specific implementation projects into SUS and at the privately financed healthcare system, creating inequities among the population. Indeed, between 2000 and 2021 the mortality rate by cervical cancer in Brazil showed spatiotemporal differences between the northern and the southern states as recently reported (Melo et al., 2024). Thus, the implementation of HPV molecular testing for all women included in the screening eligibility criteria under the SUS is necessary.

3.2 SWOT Analysis

The SWOT analysis identified key internal and external factors that may facilitate or hamper the implementation of HPV-based cervical cancer screening in Brazil. These factors are synthesized below and integrated into a strategic interpretation focused on programme readiness, gaps, and opportunities.

We focused on factors related to each SWOT, identifying key existing strengths and opportunities, that provide an enabling environment to implement the new screening programme, based on HPV molecular testing. The analysis focused on identifying the policy and structural strengths tied to national cervical cancer control programme, resources and capabilities that provide a competitive advantage. Weaknesses and threats were also identified, and potential remediation and risk mitigation approaches are presented below.

Strengths

1. **Availability of a Unified Health System grounded in universality, equity, comprehensiveness, and tripartite organization:** The Brazilian Unified Health System (named SUS) ensures nationwide equitable access through its extensive primary care network, enabling decentralized sample collection and timely referral to reference laboratories. Its integrative approach connects screening with prevention, follow-up, and treatment strategies, strengthening public health outcomes. The tripartite governance model — federal, state, and municipal policy alignment — facilitates shared planning, financing, and adaptation to local needs while preserving national coordination, reinforcing the scalability and sustainability of screening programmes (WHO Policy Brief, 16 March 2022).
2. **Availability of local laboratory facilities for cytology and technical personnel related to cervical cancer screening:** The existence in Brazil of laboratories and personnel trained in the analysis of cytopathological tests for cervical screening enabled the use of the Pap smear on a large scale, and will facilitate the use of liquid-based cytology as a method to complement the diagnostic, after HPV-detection in women (Azevedo e Silva et al., 2023). The use of liquid-based cytology is advantageous compared to the use of conventional cytology, as it allows the use of reflex cytology (investigation of already collected and stored cervical material), avoiding that women with high-risk HPV types in screening have to return to the health service for a new collection for cytological screening confirmation purposes. Still, it requires training of technicians in liquid-based cytology.
3. **Molecular HPV tests, recommended by WHO, already registered in Brazil:** According to CONITEC report of 2024, eight different HPV-DNA testing kits were commercially available in Brazil in 2024 (see also table 1 of CONITEC report). A diversified portfolio of approved tests allows the health system to preclude over-reliance on

a single manufacturer, reducing vulnerability to supply chain disruptions, stock-outs, or pricing fluctuations. This flexibility strengthens procurement negotiations, encourages competitive pricing, and enables the programme to adapt quickly, if technical issues arise with any specific platform.

4. **Stable diagnostic industry available locally to provide supplies for a long-term programme**: With around 100 molecular diagnostic companies in Brazil (Associacao Brasileira da Industria Inovadora, ABIIS report, 2021), the Corona Virus Disease 2019 (COVID-19) pandemic also helped to strengthen and better understand the importance of local manufacturers, importers and distributors of equipment, products, and medical supplies for in vitro diagnostics. Large national demand enables international technology-transfer partnerships to reliable local manufacturers of tests, and other tools (e.g. self-collection tools), towards invigorating the local economy, with potential for export to neighbouring countries.

Several strengths of the Brazilian healthcare infrastructures, programmes, and policy can support the implementation of HPV molecular testing for cervical cancer screening nationwide. The country has maintained laboratory infrastructure and trained personnel for cervical cancer screening since the 1960s (Ribeiro et al., 2025). Furthermore, the safe extension of screening intervals to five or more years between screening rounds can contribute to improved logistics, higher coverage, and cost-effectiveness. Manual on screening and treatment of pre-cancer cervical lesions for the prevention of cervical cancer recommends HPV-DNA detection tests for screening purposes, and national cervical screening guidelines have recently been updated to include HPV-DNA testing, demonstrating alignment between policy and scientific advancements (WHO guideline for screening and treatment of cervical pre-cancer lesions for cervical cancer prevention, 2021). In addition, Brazilian health institutions must actively offer specialized and comprehensive care to patients, diagnosis, staging, and treatment nation-wide; these actions are ratified in Ordinance GM/MS Nº 3.121, of 14 March 2024 (Brazil Ministry of Health, 2024), with the objective of stablishing, within the scope of the Ministry of Health, a Working Group for the Control and Elimination of Cervical Cancer. The country benefits from a stable diagnostic industry, and strong collaborations with academic and international institutions supporting the Unified Health System - SUS. Large local population and screening cohort also enables large-scale production, procurement, supply and uptake of molecular HPV test (kits), to achieve economies of scale, as well as professional training of physicians and technicians, while high demand may stimulate international technology-transfer for local production of tests, and self-collection tools, with potential for regional export (Carvalho et al., 2022).

Weaknesses

1. **Low coverage of the current opportunistic screening system:** Although the wide use of the Pap smear has been established since 1997 with the project called Viva Mulher, and its subsequent expansion across the country in the following years, the mortality rates associated with cervical cancer remained similar to the levels recorded before the programme's introduction, suggesting low effectiveness, and showing inequalities among Brazil states (Martins et al., 2009). A recent report mentioned an estimated coverage rate of screening of only 40% of the 25-65 years old population in Brazil (Fernandez-Deaza et al., 2024). The country lacks a robust organized call-recall system necessary to ensure adherence to the recommended five-year HPV screening interval.
2. **High proportion of cancer diagnoses at advanced stages (60–70% in FIGO II–IV):** The majority of cases are detected at advanced stage, average age of diagnosis is 48.7 years (Silva Filho et al., 2024) suggesting inefficiencies in screening, detection/diagnosis, and treatment. This also varies considerably within less populated regions, i.e. areas with high vulnerabilities and challenges on the health services, such as the North and Centre-

West (Melo et al., 2024). Around 60–70% of cervical cancers are diagnosed in advanced stages (at FIGO stage II-III-IV) as reported by Teixeira and colleagues (Teixeira et al., 2024). One factor hindering progress may be the opportunistic pattern of Brazil's current screening programme (Matias et al, 2022), on patient or clinician demand. Due to excess cytology performed outside the official guidelines and low effective coverage, the number of Pap tests registered does not correlate to the number of women screened, because many low-risk women with negative results, have an annual or biannual test (instead of every three years), while high risk groups do not have any test for many years.

3. **Lack of interoperability among information systems; fragmented follow-up:** The lack of interoperability among information systems and the resulting fragmented follow-up remain major barriers to an effective cervical cancer control programme in Brazil. The country relies on multiple digital platforms that often operate in isolation, creating gaps in communication between screening, diagnosis, and treatment services (Matias et al., 2022; Ribeiro et al., 2025). As a result, many women are "lost" along the care pathway, particularly those living in regions with limited digital infrastructure or inconsistent data reporting practices.
4. **Limited public and provider awareness of HPV testing pathways**: Misconceptions among women regarding screening frequency remain a significant obstacle to the effective implementation of cervical cancer prevention strategies in Brazil, leading to unnecessary over-testing, increasing costs and the risk of overtreatment, hampering the effectiveness of the programme. Limited public awareness of HPV may also affect participation rates, particularly in rural and remote areas. Furthermore, insufficient knowledge of guidelines among healthcare providers may contribute to overtreatment (Silva Filho et al., 2024).

Identified strengths and weaknesses are summarized in table 1, and proposed actions to facilitate implementation are discussed below. Notably, low coverage may hamper the implementation of HPV molecular testing in Brazil, its effectiveness and sustainability. Implementing an organized call–recall system integrated with e-SUS, would enable systematic identification, invitation, and follow-up of women eligible for screening, thereby increasing coverage, reducing loss to follow-up, and helping to address the persistent gaps in access and equity (Schiffmann et al., 2018; Teixeira et al., 2024). Based on National Policy, cervical cancer needs to be diagnosed as early as possible, therefore the need for a well-coordinated national screening programme and database with high compliance and coverage of all women at risk. We believe that an organized HPV screening programme could likely reduce the volume of testing by 40% of the present number of Pap tests annually, enabling doctors and laboratories to "liberate" time and resources to increase the coverage of the target population, i.e. women 25-64 years old (Ribeiro et al., 2025). Prioritizing early-detection strategies and implementing targeted outreach to high-burden regions can facilitate the earlier identification of precancerous lesions and asymptomatic women, reduce diagnostic delays, and ensure that underserved populations—particularly those in areas with fragile health infrastructure—receive proactive follow-up and timely access to appropriate care (Serrano et al, 2022; Teixeira et al., 2024). Access to high-quality screening programmes, through the call-recall system, will help address issues of regional discrepancies in coverage, morbidity and mortality, as well as improve detection of cases at early stages, in women 35-45 years old (WHO, Global strategy to accelerate the elimination of cervical cancer, 2020). While HPV molecular testing may lead to a higher proportion of HPV positive results compared to cytology alone (10% vs. 6%), many of these are transient infections that resolve on their own (Schiffmann et al., 2018). Recommendations for reflex cytology for non-16/18 high-risk HPV and colposcopy for HPV 16/18, rather than immediate treatment, reduces overtreatment and ensures only women needing further investigation are referred (Cancer Screening Committee Switzerland, 2021; CONITEC, 2024). Furthermore, the implementation of an organized call-recall system, should help reduce the redundance of opportunistic testing, and consequently raise the efficiency of the

programme and cost-effectiveness, leading to desired outcomes, i.e. reduce mortality rates (Teixeira et al. 2024). Many of these parameters could be assessed in "early adopter" regions, such as in Pernambuco and Espirito Santo state, where HPV molecular screening implementation has already started. Structural limitations include the lack of interoperability in a national network of public and private laboratories within the specialized care system, overburdening of existing health information systems and other digital health platforms, which can limit data exchange and coordination across various levels of care (Fernandez et al., 2025). Strengthening Brazil's digital health architecture by integrating the systems into a unified and interoperable platform would allow real-time follow-up of each patient's journey, trigger alerts for missed appointments or pending procedures, and support better coordination across municipal, state, and federal levels. Information campaigns by the Ministry of Health, national and regional gynecology societies and women's health associations can support the public in general, in disseminating unequivocal information and in professional training, thus increasing the preparedness of the healthcare system to deal with the large influx of women to take the HPV screening test, and to manage the follow up. Implementing coordinated national communication campaigns, tailored to diverse cultural and regional contexts, can help improve public understanding of the importance, safety, and benefits of HPV molecular testing. In parallel, comprehensive clinical training for health professionals—including test indication, management of positive results, and standardized follow-up protocols—would promote uniform practices across the country. We believe that the engagement of scientific societies and civil society organizations can reinforce institutional and community information systems, supporting the rapid transition to HPV testing.

Table 1: Summary of key strengths and weaknesses identified by SWOT analyses, and proposed actions to facilitate implementation of molecular HPV testing for cervical cancer screening programme in Brazil.

Internal Factors	
Strengths	**Proposed Actions to support implementation**
Established Unified Health System (SUS) with primary care network and tripartite governance.	Use the existing Public Health Centers network to decentralize sample collection and strengthen referral pathways.
Established diagnostic laboratory infrastructure and trained personnel from decades of cytology-based screening.	Expand training to liquid-based and reflex cytology for HPV-detected cases; strengthen quality assurance.
Multiple WHO-recommended HPV molecular tests already registered in Brazil.	Maintain a diversified procurement strategy to avoid dependence on a single supplier and supply shortage.
Local diagnostic industry with capacity for supply scale-up.	Foster technology-transfer agreements and promote national production of molecular kits and self-collection devices.
Weaknesses	**Proposed Actions**
Low coverage of the current opportunistic screening system (~40%): Overuse of cytology among low-risk women and underuse among high-risk groups.	Implement an organized call–recall system integrated with e-SUS, and decision-support tools to reorganize screening according to risk.
High proportion of diagnoses at advanced stages (60–70% in FIGO II–IV).	Prioritize early-detection strategies and targeted outreach to high-burden regions.
Lack of interoperability among information systems; fragmented follow-up.	Strengthen digital health infrastructure and data integration for screening–diagnosis–treatment linkage.
Limited public and provider awareness of HPV testing pathways.	Implement national communication campaigns and clinical training for consistent follow-up algorithms.

Source: Authors analysis.

The analysis further highlighted key external factors relevant to implementing the WHO recommended cervical cancer-screening related policies within the landscape of the Brazilian health system. The analysis examined opportunities and certain risks that could unlock or compromise, respectively, the success of a new molecular screening programme, providing solutions to consider.

Opportunities

1. **Global Cervical Cancer Elimination Initiative:** the WHO proposed targets for cervical screening represent an opportunity to advance cervical cancer prevention with support of the global community, and hence contribute to achieving global health goals. The Brazilian Ministry of Health has reviewed the scientific evidence and elaborated clear recommendations to improve the national screening programme, switching from Pap to high performance molecular HPV technology (CONITEC Report of recommendations No. 878, 2024), getting onto the path to eliminate cervical cancer in Brazil.
2. **Brazilian experience in molecular diagnostics through public health surveillance programmes can be leveraged:** Brazil has developed strong national expertise in performing molecular tests within its public health surveillance system, including COVID-19 PCR-based diagnostics, viral load quantification for HIV, HBV, and HCV, as well as molecular detection of infections such as chlamydia and gonorrhea (Gaspar et al., 2024). This accumulated experience demonstrates the technical capacity and capabilities of the SUS, providing a robust foundation for implementing new molecular-based screening strategies, such as cervical cancer prevention programmes nationwide. The use of validated tests and certified laboratories is an opportunity to strengthen quality management systems (quality assurance & control).
3. **Novel self-collection tools for vaginal samples for molecular tests can increase coverage rates among groups with limited access to health services, particularly in remote rural areas:** Self-collection tools of vaginal samples can mitigate access barriers for women living in areas out of reach for screening actions (Serrano et al., 2022), promoting equity, for women who are never screened; it can also reduce stigma and promote increase access for transgender men. Indeed, the proportion of eligible women who never had a Pap test generally decreased, between 2013 and 2019, to 6.1%, however is higher in some Northern states, reaching nearly 16% (Azevedo e Silva et al., 2023). There are also reports of HPV-DNA detection in vaginal samples self-collected by women living with HIV, treated through the Brazilian public health system (Freitas da Silveira et al., 2023).
4. **Potential for stronger local supply chains and regional leadership:** The country already possesses a growing network of biotechnology companies, public laboratories, and strategic partners, with potential for supporting the production, distribution, and maintenance of HPV testing technologies. By promoting long-term procurement planning, the government can provide predictable demand signals that stimulate local manufacturing capacity, reduce dependence on imported inputs, and promote price negotiation and enhance stability. Furthermore, coordinated efforts across the region — particularly through partnerships within Latin America — could promote knowledge sharing, technology transfer, and regional procurement strategies.
5. **Integration with vaccination, sexual health, and women's health programmes:** Aligning HPV screening with vaccination efforts enables consistent communication throughout the life course, reinforcing the importance of both prevention pillars, and helping to reduce misinformation and stigma.

There are significant opportunities in the implementation of HPV molecular testing. Several meta-analyses have

illustrated the improved sensitivity of HPV molecular screening compared with cytology-only based strategies, showing that molecular tests that amplify viral genetic material (nucleic acid amplification test, NAAT), for example, PCR (polymerase chain reaction) that detects HPV-DNA and TMA (transcription-mediated amplification), are suitable for the primary diagnostic of HPV in anogenital samples (Carvalho et al., 2022). Self-collected vaginal samples, with demonstrated good stability (Serrano et al., 2022), offers promising superior logistics and cost-effectiveness, expanding access to screening. Thus, self-collection tools can help increase participation rates, and coverage. Further opportunities lie in fostering innovative technology-transfer partnerships for industry, to enable the local production of molecular diagnostic tests and vaginal self-collection tools, strengthening both national and regional supply chains across Latin America. The feasibility of test automation, enabling high-throughput processing with consistent operational quality, represents an advantage in scale-up and sustainability of the programme. In addition, leveraging established sexual health and primary care services allows health professionals to address multiple needs during the same visit, improving efficiency and patient experience. Coordinated planning and integration between cervical cancer screening and HPV vaccination programmes, considering the use of nonavalent HPV vaccines (Kim et al., 2024), according to the local epidemiology and needs, can also optimize resource allocation, streamline data systems, enhance screening–vaccination synergies, the monitoring of interventions and maximize impact of public health services.

Threats (Risks)

1. **Risk of limited availability of HPV testing kits or related materials globally:** if all countries concomitantly implement the WHO HPV screening recommendations, there could be a shortage of PCR testing kits, reagents and materials globally. So far 48 countries in Asia, Europe, Latin America, and North America have recommended the HPV testing (Bruni et al., 2022), sometimes in conjunction with cytology. Particularly, the procurement of testing kits from only one supplier could create monopoly/ dependency and result in higher prices of kits, threatening the budget and coverage rates at the long term.
2. **Risk that budget may not be sustainable at long-term:** Risk that the costs of implementing a large molecular screening programme may be higher than expected, if not well managed and well controlled. Additionally, the cost-effectiveness of these programmes can vary depending on the specific context (Castañeda et al., 2025). Furthermore, the risk that the costs of implementation in rural areas be higher than expected. Many countries are conducting pilot studies before deciding the long-term strategy, as Brazil did (Freitas da Silveira et al., 2023; PAHO, 2025).
3. **Difficulties faced by some medical professionals and the women in understanding the follow-up process after a HPV-detected result:** The improved screening method and logistics may lead to increase HPV-detected results, that should be confirmed by a cytological test, colposcopy and/or biopsy, as well as follow up over six to twelve months, to ascertain the lesion grade before any treatment is undertaken, if required. The procedure should be clarified and well understood by all gynaecologists, to avoid overtreatment and overburden of the healthcare system.
4. **Risk that the new programme does not reduce incidence and mortality to cervical cancer:** Initially, it is expected that incidence rates may increase due to better detection, and over 5 years the cervical cancer incidence rates should decay (Horn et al., 2019). Lack of compliance at long-term could jeopardize the new programme, thus coordinated information and advocacy campaigns should help minimize this risk.

Every threat is an occasion for action. Among the threats identified, the large demand could place a significant risk on supply of high-quality HPV molecular tests. This risk can be minimized in two manners: by defining the demand forecast for the next 5 to 10 years, and setting long-term contracts or advanced purchase agreements with 2-3 qualified and reliable suppliers. This strategy can be combined with the opportunity of local production of kits and reagents, through technology-transfer agreements, minimizing the risk of low or lack of access to HPV test, potential cost increase threats, and tax importation issues. Establishing multi-supplier procurement and promoting local manufacturing agreements is essential to ensure a stable, resilient, and cost-effective supply of molecular HPV-DNA testing materials. Diversifying suppliers reduces the risk of shortages, price fluctuations, and dependency on a single manufacturer, while encouraging local production strengthens national autonomy, shortens supply chains, and improves responsiveness to demand fluctuations within the SUS. Define indicators to monitor the timely progress of the programme implementation and the success of supply/delivery schedules. High automatization of laboratories and samples processing can minimize the above risks, maximizing laboratory capacity to manage the limited human resources, and avoid competing with other health priorities, such as dengue, respiratory infections, and emerging epidemics, especially in primary care settings. Conducting economic evaluations and prioritizing cost-efficient strategies—such as extended screening intervals and workflow automation—is crucial to ensuring the financial sustainability of HPV testing within the SUS. Many of these variables are being assessed in pilot studies, such “Utero é Vida” (PAHO, 2025), and by phased implementation of the molecular HPV-test based screening starting in 12 states with planned expansion to all states over the course of the rollout. Notably, local implementation initiatives already happened, for example in Espirito Santo state, with about 4 million inhabitants and a median cervical cancer burden (Melo et al., 2024). This state has voluntarily initiated the roll-out of HPV-screening, and could serve as basis for performance assessments of implementation, such as adherence rates to call-recall system, coverage rates, efficiency and cost-effectiveness. Treatment guidelines and clear published algorithms and training courses should be accessible to all healthcare professionals involved, to avoid confusion and misunderstanding. It will be crucial to enhance performance monitoring of cervical cancer incidence and mortality rates, by systematically tracking key indicators—such as screening coverage, laboratory turnaround times, positivity rates, follow-up completion, and regional disparities—to evaluate programme effectiveness, identify gaps, and guide timely corrective actions. Strengthening call–recall compliance should ensure that women receive appropriate follow-up and remain engaged throughout the entire screening–diagnosis–treatment pathway.

Table 2: Summary of key opportunities and threats identified by SWOT analyses, and proposed actions to ensure implementation and tackle risks for smooth molecular HPV testing for cervical cancer screening in Brazil.

External Factors	
Opportunities	**Proposed Actions**
WHO support through the Global Cervical Cancer Elimination Initiative.	Align national indicators with WHO 70–90–90 goals and leverage global technical cooperation.
Expansion of large scale molecular diagnostic capacity in SUS.	Scale molecular networks to process HPV samples with high throughput and automation.
Self-collection of vaginal samples to increase access and equity.	Implement pilot programmes for self-collection in remote areas, among women never screened, and for transgender persons.
Potential for stronger local supply chains and regional leadership.	Promote long-term procurement planning and regional industry coordination.
Integration with vaccination, sexual health, and women's health programmes.	Coordinate screening and vaccination strategies to maximize impact.
Threats	**Proposed Actions**
Global supply shortages of HPV test kits and materials.	Establish multi-supplier procurement and promote local manufacturing agreements.
Risk of long-term financial unsustainability.	Conduct economic evaluations and prioritize cost-efficient strategies such as extended intervals and automation.
Confusion regarding follow-up for HPV-positive results.	Standardize national guidelines and provide clear algorithms and decision-support tools to clinicians.
Risk that incidence may not decline without high coverage and adherence.	Implement performance monitoring and strengthen call–recall compliance.

Source: Authors analysis.

3.3 Limitations of the analysis

Other variables regarding quality of follow-up, clinical exams (such as colposcopy, biopsy quality) and treatment efficacy were not addressed in this analysis. More complex, specific sociodemographic and cultural barriers of communities and/or target audience (e.g. educational level, income, ethnicity, religion) were also not addressed in this study. Social-economic determinants of health—such as income inequality, geographic barriers, and limited access to care—may compromise equitable implementation and deserve further analysis. Social stigma and discrimination, particularly affecting high-risk and vulnerable populations, such as individuals living with HIV, represent additional barriers to access adherence, but it was not possible to cover in this analysis.

4. Conclusion

The Brazilian Ministry of Health is encouraged to contributing to the WHO's Global Strategy for the Elimination of Cervical Cancer by 2030, aligning national policy with health priorities. Brazilian health authorities have expressed the willingness to eliminate cervical cancer and endorsed/adopted the WHO proposed targets to be achieved by 2030:

a. treatment: 90% of women with diagnosed with pre-cancer treated and 90% of women with invasive cancer managed.

b. screening: 70% of women initially screened using a high-performance test by the age of 35, and (if negative) again by the age of 45;
c. vaccination: 90% of girls fully vaccinated with the HPV vaccine by the age of 15;

While many steps in policy, technology and budgeting have been undertaken, a major concern is the risk that the overall implementation of the programme — particularly in remote areas — raises challenges to its long-term financial sustainability within the public health system (SUS). Some key strengths, weaknesses, opportunities, and threats were identified above, and we recommend implementors to consider the proposed solutions (Table 1 and Table 2).

An important opportunity while implementing molecular HPV test in screening, is to increase awareness of HPV carcinogenic types through information campaigns and improving vaccination for adolescents, e.g. school vaccination programmes. Furthermore, evaluate the importance of the nonavalent HPV vaccines in the context of Latin America might prevent 80-85% of cervical cancers, instead of 60-65% by the vaccines against 16-18 HPV carcinogenic types only (Wei F et al. 2024; Pagliusi & Aguado, 2004). Evaluation of the cost-effectiveness of nonavalent HPV vaccines in the national context, as it has been shown in an Asian country (Termrungruanglert et al., 2024), seems as a high priority.

Importantly, the national programme should clearly acknowledge that molecular- HPV screening test is not a test for cancer, rather it is a test to identify women who are positive for high-risk types of HPV, and thus at risk for developing cancer lesions, in order to improve the preventative focus of healthcare programmes and clinical diagnosis.

Screening is aimed at providing high coverage of the population, fast access to testing results and easy admission to follow-up and treatment of precursor lesions. It must be recognized that the success of a cervical cancer screening programme will only be guaranteed by the combined efforts and overall organization of the programme, quality system and swift new technology introduction.

Disclaimer: This report summarizes the personal views and opinions of the authors and does not represent the opinion, decisions or policy of any institution or state.

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