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Cervical cancer screening in Brazil: challenges of cytology and the transition to HPV DNA testing.

Cervical cancer screening in Brazil: challenges of cytology and transition to DNA-HPV testing

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Summary

Introduction: Cervical cancer remains a significant public health issue in Brazil, with a high impact on morbidity and mortality. Screening was based on cytological examinations, but this strategy has limitations, such as low sensitivity and difficulties in early detection. The introduction of the HPV-DNA molecular test represents a significant evolution of the screening program, enhancing the effectiveness in detecting high-risk infections and contributing to disease control. Objective: This study aims to analyze the performance of the Brazilian cervical cancer screening program, considering its limitations and the implementation of the HPV-DNA test as a primary method. Methodology: This is a narrative literature review based on secondary data from national (INCA, SISCAN, IBGE) and international (GLOBOCAN, WHO) sources, between 2020 and 2025. Trends and operational challenges for the transition to the HPV-DNA test were evaluated. Results: The implementation of the HPV DNA molecular test in the Brazilian Unified Health System (SUS) should significantly reduce the incidence and mortality of cervical cancer in Brazil by increasing sensitivity in early detection, expanding access in rural and socioeconomically vulnerable regions, promoting greater efficiency in the use of resources, and strengthening equity and social participation in disease prevention.

Conclusion: The transition from cytology-based screening to HPV-DNA testing constitutes a promising public health strategy, with the potential to increase the effectiveness of the program, improve epidemiological indicators, and contribute to the elimination of cervical cancer in Brazil.

Keywords: HPV DNA Detection Test. HPV Infection. Cervix. Cell Tracking. Brazil.

Abstract

Introduction: Cervical cancer remains a major public health issue in Brazil, with a significant impact on morbidity and mortality. Screening has traditionally been based on cytological tests; however, this strategy has limitations, such as low sensitivity and challenges in early detection. The introduction of the molecular HPV-DNA test represents a significant advancement in the screening program, enhancing the effectiveness of detecting high-risk infections and contributing to disease control.

Objective: This study aims to analyze the performance of the Brazilian cervical cancer screening program, considering its limitations and the implementation of the HPV-DNA test as the primary screening method. Methodology: This is a narrative literature review based on secondary data from national sources (INCA, SISCAN, IBGE) and international sources (GLOBOCAN, WHO), covering the period from 2020 to 2025. Trends and operational challenges related to the transition to HPV-DNA testing were evaluated. Results: The implementation of the molecular HPV-DNA test within



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Brazil's Unified Health System (SUS) is expected to significantly reduce the incidence and mortality of cervical cancer by increasing the sensitivity of early detection, expanding access in rural and socioeconomically vulnerable regions, promoting greater efficiency in resource utilization, and strengthening equity and social participation in disease prevention. Conclusion: The transition from cytology-based screening to HPV-DNA testing represents a promising public health strategy, with the potential to enhance the program's effectiveness, improve epidemiological indicators, and contribute to the elimination of cervical cancer in Brazil.

Keywords: Human Papillomavirus DNA Tests. HPV Infections. Cervix Uteri. Cell Tracking. Brazil.

1. Introduction

According to data from *Global Cancer Statistics*, in 2022 there were 348,189 deaths from cancer. Cervical cancer is the leading cause of cancer deaths worldwide, accounting for 3.6% of all cancer deaths. Cancer. In 2020, the World Health Organization (WHO) estimated 604,000 new diagnoses of cancer disease (Urbano *et al.*, 2025).

In Brazil, data from the *National Cancer Institute (INCA)* from 2023 indicated that cancer of Cervical cancer is the third most common type of malignant neoplasm among women, representing 7% of all cancer cases, with an incidence rate of 17,010 cases, despite the existence of the screening program offered by the *Unified Health System (SUS)*.

Between the years 2000 and 2012, an increasing trend was observed in the country. diagnoses at advanced stages, totaling 65,843 new cases during this period. Furthermore, the INCA's 2022 annual report indicated that approximately 35% of cases are still diagnosed in Stages III and IV.

To date, the National Cervical Cancer Screening Program maintains It is opportunistic in nature and is based on conventional cytology (Pap smear). The target audience These are women aged 25 to 64 who can undergo the examination spontaneously, without formal invitations or program restrictions (INCA, 2022).

It is recommended that the first two tests be performed with an annual interval; if both If the results are negative, subsequent tests should be performed every three years. Screening ends at age 64, provided the woman has two negative test results. last five years and have no history of precursor lesions or cancer (INCA, 2022).

It is important to highlight that the sensitivity of cytology is approximately 51%, while Its specificity reaches 98%, making it a well-performing test, but far from ideal. ideal. Among the possible explanations for the suboptimal performance of the current program are: low population coverage, weaknesses in the quality control of pre-analytical factors, qualification Insufficient number of professionals involved in data collection and low representation of the transformation zone. in the slides analyzed (Ministry of Health, 2024).



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Since 1999, Primary Health Care in Brazil has offered cytological exams and Histopathological studies for the prevention of cervical cancer, guided by quality standards defined nationally. Despite the coverage target set at 80%, in 2020 only 55% was achieved. of the expected women underwent cytopathological examination (Teixeira *et al.*, 2023).

Data from the *Cancer Information System (SISCAN)* indicate that between January 1st and 31st In December 2020, 3,754,408 cytological examinations were performed in the country. Of these, 741,215 (16.5%) were performed on women outside the recommended age range, and only 62,493 women They maintained adequate adherence to the protocol, undergoing periodic examinations every three years (SISCAN, 2024).

It is therefore estimated that less than a third of the tests performed are compliant. in accordance with official guidelines, as long as more than two-thirds are unnecessary. Considering the Population estimate from the *Brazilian Institute of Geography and Statistics (IBGE)* for the year 2020. With approximately 61,742,997 women aged 25 to 64 and the recommended ideal coverage of 80%, it can be inferred that... Insufficient adherence to the national cervical cancer screening protocol.

Globally, screening programs vary widely between the countries, reflecting distinct impacts on early diagnosis and prevention of the disease. Until the In the last decade, most programs were based exclusively on cytology. However, in recent years... Over the decades, cervical cancer screening has incorporated DNA testing. Human Papillomavirus (HPV), while HPV vaccination has become established as a strategy. primary prevention, directly influencing cervical cytology incidence metrics (Follador *et al.*, 2025).

WHO guidelines recommend replacing conventional cytology with the test of HPV-DNA testing as a primary screening method, whenever financial resources are available and operational capacity.

However, it becomes crucial to analyze how this transition can be made viable in countries such as Brazil, where cytology-based screening remains the primary strategy, despite His performance fell short of expectations.

2 methodologies

This is a narrative literature review of descriptive data-based studies. secondary data from national and international sources. The objective was to analyze the performance of the Brazilian cervical cancer screening program, considering its limitations and Challenges in relation to global recommendations for the incorporation of the Human Papillomavirus DNA test. Human (HPV) as a primary screening method.



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Data available from official reports and systems, including the Institute, were used.

National Cancer Institute (INCA), the Cancer Information System (SISCAN), the Brazilian Institute of The Brazilian Institute of Geography and Statistics (IBGE) and the Ministry of Health, in addition to information from Global Cancer Observatory (GLOBOCAN), of the World Health Organization (WHO) and Global Cancer Statistics. The information collected covered the period from 2020 to 2025, including indicators. incidence, mortality and coverage of cytological screening, as well as guidelines and recommendations by Google from national and international bodies.

The data analysis was performed in a descriptive and interpretive manner. The following were evaluated: Temporal trends in screening coverage and the proportion of diagnoses at specific stages. advanced, comparing Brazilian results to the goals set by public policies. national and successful international experiences were discussed. Additionally, aspects were discussed. operational and structural factors that interfere with the effectiveness of the program, including adherence. The population, the quality of the tests, and the challenges for the implementation of the HPV DNA test.

The use of secondary data, which is subject to possible limitations, is acknowledged as a result of this study. Underreporting and methodological variations between different information databases. Even so, the The study provides a comprehensive and up-to-date analysis of the national landscape of screening. cervical cancer, contributing to reflection on more effective prevention strategies. and disease control.

2.1 Inclusion and exclusion criteria

This study included reports, databases, and official publications that presented information about:

- a) Incidence, mortality, and coverage of cervical cancer screening in Brazil;
- b) National cytological or DNA-based HPV screening programs;
- c) Guidelines and recommendations from the World Health Organization (WHO) or related societies
International gynecology and oncology conferences;
- d) Studies published between the years 2000 and 2023.
- e) Documents and articles that were excluded were those that:
 - f) They did not present specific data on cervical cancer screening;
 - g) If they referred exclusively to populations outside the target age range of the Brazilian program (25-64 years old);
 - h) They were not available in Portuguese, English, or Spanish;
 - i) They consisted of opinion pieces or editorials without data or documentary evidence.

2.2 Descriptors used

For data retrieval and analysis, the following descriptors were used in Portuguese and English:

- a) Portuguese: cervical cancer, screening, prevention, cytology, Pap smear, DNA HPV, HPV, National Screening Program, Primary Health Care, Brazil.
- b) English: cervical cancer, screening, prevention, cytology, Pap smear, HPV-DNA, national screening program, primary health care, Brazil.

The combinations of descriptors were used in national databases (INCA, SISCAN, DATASUS) and international databases (GLOBOCAN, PubMed, WHO), allowing the collection of Epidemiological information, screening guidelines, and evidence for public policy.

3. Results and discussion

The Unified Health System (SUS) has undergone several updates and improvements. Over the years, it was introduced into the cervical cancer screening program in 2024. the HPV DNA molecular test, considered a milestone in the SUS (Brazil, 2024).

This test allows for the detection of DNA from oncogenic HPV types, especially those associated with the development of cervical cancer, using PCR technology. The target audience is women between 25 and 64 years old, with a five-year interval between exams after a [previous exam]. initial negative result, configuring an alternative to the traditional cytological examination (Brazil, 2024).

The purpose of this test is the early detection of HPV. For immunocompromised women, The recommendation is to have the exam every three years. Women over 60 who present with A negative result from this age onwards may result in the test being suspended (Brazil, 2024).

Sample collection will be carried out in Primary Health Care (PHC), at the same sites. Anatomical cytology using a swab is a simple and easy procedure to perform. The sample The collected sample may also be used for reflex cytology in cases where types 16 or 18 of HPV are not detected, allowing for re-evaluation when necessary (Brazil, 2024).

Exam flow

Cervical cancer screening using HPV DNA testing for women For those aged 25 to 64, a specific flow is followed according to the results obtained. Initially, all Women within the age range undergo sample collection for the examination at Primary Health Care (INCA, 2022).

SITUATION	ACTION	NOTES
Negative result	Repeat the exam in 5 years.	If the woman is 60 years old, it is not a new examination is necessary, because the The next person would surpass 64 years of age.
Positive result for HPV 16 or 18	Direct referral to colposcopy	Priority due to higher risk oncogenic
Positive result for other types HPV (not 16/18)	Perform reflex cytology in the same sample	-
Reflex cytology with alteration even discreet	Referral for colposcopy. If normal, repeat in 12 months.	
Normal reflex cytology	Follow routine monitoring.	With normality, it repeats in 12 months.

If the result is negative, the patient should repeat the test after five years. However, If a woman turns 60 and tests negative, no further tests will be necessary. tests, since the next test would occur outside the recommended age range for screening.

If the test identifies the presence of HPV type 16 or 18, the patient should be referred. directly for colposcopy, regardless of other factors.

In cases where the result is positive for HPV types other than 16 and 18, Reflex cytology is performed on the same sample collected. If the cytology identifies any Even a slight alteration should prompt the patient to be referred for colposcopy.

If the cytology is normal, the patient continues follow-up according to protocol. established by the national tracking program, maintaining adequate surveillance.

This workflow aims to optimize the early detection of oncogenic HPV and reduce its progression to the disease. serious injuries or cervical cancer, ensuring that the highest-risk patients receive immediate intervention while those at lower risk are adequately monitored (Brazil, 2024).

Cervical cancer, also called uterine cancer, is caused by infection. persistent due to oncogenic types of human papillomavirus (HPV), especially types 16 and 18, which can develop into precancerous lesions and, if left untreated, into cancer over several years. (INCA, 2021).

Worldwide, this neoplasm is the fourth most frequent cancer in women, with Approximately 604,000 new cases occur annually, representing 6.5% of all female cancers, with the highest incidence recorded in Africa.



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In Brazil, in 2020, there were 6,627 deaths, with a crude mortality rate of 6.12 per 100,000. thousand women (BRAZIL, 2022; INCA, 2020). Factors that increase the risk of progression include Immunosuppression, HIV infection, smoking, multiparity, and prolonged use of contraceptives. oral.

Currently, the disease is considered eliminateable through vaccination against the types of Most prevalent HPV types, high-performance screening, and treatment of precursor lesions.

Following WHO global targets for 2030: 90% of girls vaccinated by age 15, 70% of...

Women screened at ages 35 and 45, and 90% of women with lesions or cancer receiving treatment. adequate (Migowski, 2025).

Limitations of cytological screening in Brazil

Conventional cytology has a sensitivity of only 51%, resulting in risks. significant number of false negatives. Furthermore, population coverage is insufficient, with only 55% of women undergoing the examination according to the recommended protocol. The quality of the examinations. It is hampered by weaknesses in professional qualifications and in the control of pre-analytical factors. while the low representation of the transformation zone in the slides compromises accuracy diagnostic (Corrêa, *et al.*, 2022).

Implementation of the HPV DNA test

In August 2025, the Ministry of Health began introducing molecular DNA testing.

HPV testing in the Brazilian public health system (SUS), with expansion planned until 2026. The test is entirely nationally developed by [the relevant authority/organization].

The Institute of Molecular Biology of Paraná (Fiocruz), and it is estimated that it will benefit approximately 7 millions of women aged 25 to 64 per year until the end of 2026, representing a transition to a tracking system with greater sensitivity and precision.

Epidemiological impact

Cervical cancer, mainly caused by persistent infection with HPV 16 and 18, is the The fourth most frequent cancer among women worldwide, with approximately 604,000 new cases per year and the highest incidence in Africa (INCA, 2021). In Brazil, there were 6,627 deaths in 2020, with mortality rate of 6.12 per 100,000 women (Brazil, 2022; INCA, 2020).

The introduction of the HPV DNA test has the potential to significantly reduce the incidence and mortality, due to greater sensitivity for detecting precursor lesions (>90%) compared to traditional cytology (~51%). This reduces false negatives and allows for greater...



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efficiency in screening, especially considering that only 55% of women underwent testing. cytology according to the recommended protocol (Vilela & Ribeiro, 2025).

Limitations of cytological screening

Conventional cytology, although historically used as the main tool of Cervical cancer screening has significant limitations that compromise its effectiveness. efficacy. Studies indicate that its sensitivity is relatively low, ranging from 50% to 70% for the detection of high-grade precursor lesions, which means that a considerable proportion of Cases may remain undiagnosed in the early stages of the disease (Castanheira *et al.*, 2025).

Population coverage for the exam is still insufficient in several regions, especially in rural areas and urban peripheries, where socioeconomic factors, geographical barriers and limitations Lack of access to healthcare services hinders adherence to screening. The quality of the examination also... It can be compromised by professional weaknesses, such as variability in cytological interpretation. and due to problems related to the collection and preservation of samples, resulting in tests inconclusive or false-negative results (Lima *et al.*, 2023).

These limitations directly impact the early detection of precancerous lesions. delaying therapeutic interventions and contributing to the maintenance of high rates of morbidity and mortality.

In this context, the need for more sensitive tracking methods becomes evident. reproducible and accessible, capable of overcoming these barriers and significantly improving the Public health indicators related to cervical cancer.

Implementation and coverage of HPV DNA testing.

The Ministry of Health began introducing the HPV DNA test in August 2025, with Expansion planned until 2026. Developed nationally by the Institute of Molecular Biology of Paraná (Fiocruz), it is estimated that it will benefit approximately 7 million women per year, representing a transition to more precise tracking.

Adopting the test could also increase population adherence to screening, since that the longer interval between exams (5 years) reduces the necessary frequency of visits, and the greater Sensitivity increases confidence in the results.

Impact on SUS indicators and social innovation

The introduction of HPV DNA testing into the Brazilian public health system (SUS) has the potential to generate positive effects. significant impacts on the system's health indicators. Among the main impacts are:

Improved early detection, due to the greater sensitivity of the molecular test compared to... Conventional cytology contributes to increasing the detection rate of precancerous lesions. cervical cancer, reducing the number of advanced cases and associated mortality. This directly reflects in indicators such as the early detection rate and the reduction in mortality from cervical cancer (Roriz *et al.*, 2025).

The possibility of spacing out tests for women with negative results (5-day interval) Over the years), there has been optimization of Primary Health Care resources, reducing operational costs and increasing service capacity. This impacts population coverage indicators and tracking efficiency.

Because it is a simple test to collect and is produced nationally, the HPV DNA test It expands access for women from different regions and socioeconomic backgrounds, contributing to the reducing health inequalities and strengthening the role of the SUS as a universal system and inclusive.

The national development of the test represents an advance in accessible health technology. and sustainable. By integrating science, national production, and public policies, the program promotes Social innovation by transforming technology into direct benefits for the population, strengthening trust. within the Brazilian public health system (SUS) and encouraging community participation in preventive care.

Impact on health determinants in urban and rural areas

The implementation of HPV DNA testing also influences health determinants. especially those related to social, economic, and geographic factors:

In regions with less developed healthcare infrastructure, the simplicity of the test (collection with a swab) in Primary Health Care) facilitates the provision of testing without the need for complex laboratories. or long commutes. This reduces access barriers and contributes to equity between urban areas. and rural (Guimarães, 2025).

Populations in peripheral or lower-income areas historically exhibit lower screening coverage. Expanding nationally produced testing allows these women They also have access to highly accurate tests, mitigating the effect of social determinants. adverse factors, such as low education levels, economic vulnerability, and difficulty in commuting. (Guimarães, 2025).

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The implementation of the test is accompanied by information and awareness strategies regarding cervical cancer prevention. This strengthens positive social determinants, such as Knowledge of health, autonomy over personal care, and community participation.

By making high-tech exams available in primary care units of different

In these contexts, the SUS (Brazilian Unified Health System) contributes to reducing territorial disparities and strengthening cohesion between policies. national and local health strategies.

Thus, the introduction of the HPV DNA test not only improves clinical indicators, but it acts directly on the social and territorial determinants of health, promoting equity, Access and inclusion throughout the national territory.

Integration with HPV vaccination

HPV DNA screening should be complemented by vaccination against HPV types.

Most prevalent HPV types. The combination of vaccination and high-performance screening follows the... WHO global targets for 2030: 90% of girls vaccinated by age 15, 70% of women Screened at ages 35 and 45, 90% of women with lesions or cancer are receiving appropriate treatment. (Santos *et al.*, 2025).

Public health

The HPV DNA test is highly relevant to public health because it allows for the detection of HPV. Early detection of oncogenic HPV types, such as 16 and 18, enabling rapid interventions that reduce The progression to serious lesions and cervical cancer. Early detection directly contributes to reducing mortality and morbidity associated with the disease, in addition to optimizing resources. health system, reducing the need for complex and costly treatments (Correa *et al.*, 2025).

Large-scale implementation improves population tracking indicators and It strengthens epidemiological surveillance capacity, generating essential data for planning. public policy and for evaluating the effectiveness of preventive strategies, such as vaccination against HPV.

Public Health

From a public health perspective, the HPV DNA test represents a significant advancement. for equity and social justice in health, as it expands access to highly sensitive diagnoses. both in urban and rural areas, reducing disparities between different populations (Guimarães, 2025).

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Early detection and proper screening promote the prevention of serious diseases, positively impacting social and environmental determinants of health, such as education, income and access to primary care services. Furthermore, by reducing the incidence of advanced cancer, It contributes to improving the quality of life of the female population by strengthening prevention. collective action, the integration of health services, and the achievement of global goals for the elimination of Cervical cancer, aligning local actions with international health policies (Vilela & Ribeiro, 2025).

Potential of HPV DNA Testing in Promoting Health in Brazil

The Human Papillomavirus (HPV-DNA) DNA test represents a significant advancement. in strategies for preventing cervical cancer, especially in countries like Brazil, where The disease still has a high incidence and mortality rate. Unlike cytological examination. In addition to the conventional Pap smear, which identifies pre-malignant cellular changes, there is the HPV DNA test. It directly detects the presence of high-risk oncogenic viral types, enabling identification. early onset in women susceptible to disease progression (Guimarães, 2025).

The adoption of HPV DNA testing has the potential to enhance the promotion of health in various ways:

The test's superior sensitivity allows for the identification of persistent high-risk HPV infections. risk before the manifestation of cytological changes, enabling early interventions and contributing to the reduction in the incidence of cervical cancer (Follador *et al.*, 2025).

The reliability of the test reduces the occurrence of false-negative results, minimizing the risk. risk of underdiagnosis and strengthening public confidence in screening programs. A possibility of extending the intervals between tests in women with negative HPV results High-risk situations allow for more efficient allocation of resources by focusing efforts. diagnostics and therapeutics in the most vulnerable groups (Migowski, 2025).

The implementation of the test can support more effective population-based screening programs. structured, allowing for epidemiological mapping of HPV infection and prioritization of regions or population groups at higher risk, promoting equity in health care (Corrêa *et al.*, 2022).

The introduction of the test represents an opportunity to expand educational initiatives on HPV, vaccination, screening, and sexual health, encouraging preventive behaviors and adherence. regular to prevention programs (Santos *et al.*, 2025).

In this way, the HPV DNA test not only improves the early diagnosis of infections It is high-risk, but it also constitutes a strategic instrument for promoting public health. contributing to the reduction of morbidity and mortality from cervical cancer in Brazil.

Future prospects

The complete transition to HPV-DNA testing as the primary screening method in the Brazilian public health system (SUS) could allow for greater effectiveness in cervical cancer prevention, with cytology restricted to specific cases. reflexes or specific effects. It is expected that, in the next 5 to 10 years, the epidemiological impacts will... make them visible, with a reduction in advanced cases and mortality, strengthening the control of this Neoplasia as a public health problem (Correa *et al.*, 2025).

CONCLUSION

The recent introduction of the HPV DNA molecular test into the Unified Health System. (SUS), initiated in 2025, represents a strategic advancement in screening, offering greater sensitivity (>90%) and allowing five-year intervals between exams for women with A negative result, which tends to increase the program's adherence and efficiency.

The test allows for the early identification of women at higher risk, especially those... infected with oncogenic HPV types 16 and 18, referring them quickly for colposcopy, While women with infections from other types of HPV may be monitored by cytology. reflexive, ensuring adequate surveillance without overloading the system.

The gradual transition from screening based exclusively on cytology to testing for DNA-HPV, combined with vaccination against the most prevalent types of HPV, constitutes a strategy integrated primary and secondary prevention.

It is expected that, in the next five to ten years, the widespread implementation of DNA testing- HPV in the SUS (Brazilian Public Health System) results in a significant reduction in the incidence of advanced cases, a decrease in... cervical cancer mortality and strengthening the control of this neoplasm as a problem of public health in Brazil.

In summary, the adoption of the HPV DNA molecular test represents an essential evolution. of the national tracking program, offering greater accuracy and streamlining of resources. **health** and potential positive epidemiological impact, establishing itself as a promising strategy. for the elimination of cervical cancer in the country.

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