POST-PANDEMIC GLOBAL COVERAGE OF HUMAN PAPILLOMAVIRUS SCREENING COBERTURA GLOBAL DE TAMIZAJE DEL VIRUS DEL PAPILOMA HUMANO POSTPANDEMIA

Edgardo Rojas-Mancilla^{1,2}, Mariela Olguín-Barraza³, Francisca Sanchez-Jorquera⁴, Esteban Mejias-Escobar⁵, Eric Matus-Alarcón⁶, Cecilia Morales-Gonzalez⁷, Diego Morales⁸, Carolina Selman-Bravo^{9*}

ABSTRACT

Human papillomavirus (HPV) is the leading cause of cervical cancer, one of the main causes of female mortality worldwide. Early detection through screening programs, including HPV testing and cytology, is crucial to prevent progression to invasive cancer and reduce mortality. However, the coverage of these programs presents marked geographic disparities, reflecting inequalities in access and resources. Before the COVID-19 pandemic, screening coverage was already insufficient, especially in low- and middle-income countries, where rates were significantly lower than in high-income countries. The pandemic exacerbated this problem, generating a significant reduction in screening coverage. The impact after the health emergency has been analyzed in this review. The decline in coverage has not recovered to pre-pandemic levels, representing a relevant threat to public health, especially among the most vulnerable populations. The data showed a clear correlation between a country's income level and its ability to maintain adequate cervical cancer screening coverage. While high-income countries maintain relatively high coverage, low- and middle-income countries continue to face significant access barriers, including limitations in infrastructure, economic resources, access to screening exams and access to trained personnel. Identifying and addressing these inequalities is crucial to designing and implementing effective prevention and control strategies that reduce cervical cancer morbidity and mortality globally. Significant investment is required in infrastructure, education programs, and public policies in health that promote equity in access to quality health services.

Keywords: Human Papillomavirus (HPV), cervical cancer, screening, COVID-19

RESUMEN

El Virus del Papiloma Humano (VPH) es la principal causa de cáncer cervicouterino, una de las principales causas de mortalidad femenina a nivel mundial. La detección temprana mediante programas de tamizaje, incluyendo pruebas de VPH y citologías, es crucial para prevenir la progresión a cáncer invasivo y reducir la mortalidad. Sin embargo, la cobertura de estos programas presenta marcadas disparidades geográficas, reflejando desigualdades en el acceso y los recursos. Antes de la pandemia de COVID-19, la cobertura ya era insuficiente, especialmente en países de bajos y medianos ingresos. La pandemia redujo significativamente la cobertura del tamizaje, un impacto analizado en este estudio. La disminución no se ha recuperado a los niveles pre-pandémicos, representando una amenaza para la salud pública, especialmente en poblaciones vulnerables. Existe una correlación entre el nivel de ingresos de un país y su capacidad para mantener una cobertura adecuada de cribado. Mientras los países de altos ingresos mantienen una cobertura relativamente alta, los países de bajos y medianos ingresos enfrentan importantes barreras de acceso, incluyendo limitaciones en infraestructura, recursos económicos y personal capacitado. Es crucial abordar estas desigualdades para diseñar e implementar estrategias efectivas de prevención y control que reduzcan la morbimortalidad por cáncer cervicouterino a nivel global, requiriendo una inversión significativa en infraestructura sanitaria, programas de educación y políticas públicas que promuevan la equidad en el acceso a servicios de salud de calidad.

Palabras clave: Virus del Papiloma Humano (VPH), cáncer cervicouterino, tamizaje, COVID-19

¹ Profesor Asistente, Escuela de Terapia Ocupacional, Facultad de Salud y Ciencias Sociales, Universidad de las Américas, Santiago, 7500975 Chile, edgardo.rojas@falp.org

² Tecnólogo Médico, Unidad de Diagnóstico Laboratorio Clínico, Instituto Oncológico Fundación Arturo López Pérez, 7500691 Chile ³ Tecnólogo Médico, Programa de Magíster en Ciencias Químico-Biológicas, Facultad de Ciencias de la Salud, Universidad Bernardo O'Higgins, Santiago, Chile, marielaolquin92@gmail.com

⁴ Tecnólogo Médico, Unidad de Diagnóstico Laboratorio Clínico, Instituto Oncológico Fundación Arturo López Pérez, 7500691 Chile, francisca.sanchez@falp.org

⁵ Tecnólogo Médico, Unidad de Diagnóstico Laboratorio Clínico, Instituto Oncológico Fundación Arturo López Pérez, 7500691 Chile, esteban.mejias@falp.org

⁶ Tecnólogo Médico, Unidad de Diagnóstico Laboratorio Clínico, Instituto Oncológico Fundación Arturo López Pérez, 7500691 Chile, eric.matus@falp.org

⁷ Tecnólogo Médico, Unidad de Diagnóstico Laboratorio Clínico, Instituto Oncológico Fundación Arturo López Pérez, 7500691 Chile, cecilia.morales@falp.org

⁸ Estudiante de pregrado, Medicina, Facultad de Medicina, Universidad de Chile, Santiago, 8380453, Chile, diego.morales.gaete@ug.uchile.cl ⁹ Correspondingauthor, Médico Cirujano, Unidad de Diagnóstico Laboratorio Clínico, Instituto Oncológico Fundación Arturo López Pérez,

⁷⁵⁰⁰⁶⁹¹ Chile, carolina.selman@falp.org

1. INTRODUCTION

Human Papillomavirus (HPV) is the primary cause of virtually all cases of cervical cancer, a disease that remains a leading cause of mortality in women worldwide (Adcock et al., 2019; Buskwofie et al., 2020; WHO, 2021). Significantly, both cancer development and deaths from this cause are preventable if precancerous lesions are detected and treated in early stages through specific examinations that detect HPV and/or lesions on the cervix (Perkins et al., 2023). These examinations have been widely implemented through screening programs, aimed to cover at least 70% of the exposed population (Kundrod et al., 2023; Ramírez et al., 2023; Serrano et al., 2022). Early detection allows for interventions that prevent progression to invasive cancer, making regular screening essential for reducing associated mortality (Bruni et al., 2022; Jensen et al., 2024; Wei et al., 2024).

Screening programs aim to reduce cervical cancer mortality to zero (WHO, 2021) and have been implemented in most countries, targeting women aged 25 to 65, the age group with the highest HPV infection rates (Wang et al., 2024). Globally, program implementation varies depending on the percentage of the target population and is affected by factors such as resource availability, cultural barriers, and geographical limitations. Therefore, a global overview of screening coverage is crucial for monitoring the progress and impact of these initiatives and to identify gaps needing innovative interventions

1.1. Cervical cancer and HPV

The development of cervical cancer is linked to persistent infection with oncogenic types of HPV. According to the World Health Organization (WHO), over 600,000 women were diagnosed with cervical cancer in 2022, and nearly 350,000 died from the disease (WHO, 2022). This represents a substantial public health concern. The average age at initial diagnosis is currently 55 years, a notable decrease of 15 years over the past 25 years. However, a concerning 25% of cases present in women under 35. Furthermore, cervical cancer is the most common malignant gynecological neoplasm during pregnancy, exhibiting an incidence rate of 0.1 to 12 per 10,000 pregnancies (Schubert et al., 2023). This highlights the persistent need for effective prevention and early detection strategies.

High mortality rates are largely attributed to a lack of access to effective prevention programs, particularly HPV screening strategies, given that HPV is the primary cause of most cervical cancer cases (Gopalkrishnan& Karim 2025). Improved access to these crucial preventative measures is critical in reducing the global burden of this disease.

While the incidence of cervical cancer and associated mortality have decreased significantly with the implementation of detection strategies based on HPV genotyping molecular tests and Pap smears, a significant occurrence of cervical cancer remains a threat in certain populations, notably Hispanic/Latina and African American women, especially in rural communities (Olusola et al., 2019). This disproportionate burden of incidence in these groups may be partly due to a lack of adequate health insurance, preventing them from receiving regular preventative screenings and follow-up care. Addressing these health disparities and ensuring equitable access to healthcare are vital for reducing the global impact of cervical cancer.

1.2. HPV screening: a pathway to prevention

HPV is a sexually transmitted virus that, in certain types, can induce early changes in cervical cells which, if not detected in time, can develop into cancer. Primary prevention strategies include encourage safe sexual practices and vaccination against HPV (Kessler, 2017). These preventative measures are vital in reducing the overall incidence of HPV-related cancers. Secondary prevention focuses on the early detection of subclinical precancerous or cancerous lesions; in recent years, HPV detection has significantly improved through molecular techniques. Currently, methodologies exist for detecting HPV and its effects on the cervix, differing in sensitivity, specificity, cost, accessibility, and effectiveness. The selection of an appropriate method is crucial for maximizing impact.

Given the highly effective and cost-effective cervical cancer prevention strategies available, the WHO launched a global initiative in 2020 to eliminate cervical cancer as a public health problem by the 21st century. This global strategy sets ambitious targets: 90% coverage of HPV vaccination, 70% coverage of screening twice in a lifetime, and 90% access to treatment for precancer and cervical cancer, including palliative care by 2030. Achieving these targets would significantly reduce the incidence rate to a threshold of four cases per

100,000 women-years (WHO, 2023; Rajaram et al., 2021). This ambitious goal requires a substantial and coordinated global effort.

Modeling studies conducted by the WHO's Modeling Consortium for Cervical Cancer Elimination (CCEMC) demonstrated that successful implementation of this three-pronged intervention strategy would reduce mortality by 98.6%, preventing 62.6 million deaths by 2120 (Rajaram et al., 2021). This underscores the potential impact of fully achieving the WHO's goals.

Regions capable of implementing HPV screening every 5 years and achieving 70% coverage among women aged 30-50 could experience a 50% or greater reduction in cervical cancer incidence and a 60% or greater reduction in mortality (Simms et al., 2023). However, achieving this level of success varies drastically depending on a country's socioeconomic status (Bruni et al., 2022), with cervical cancer screening coverage in high-income countries being seven times or higher than in lowand middle-income countries. This persistent disparity highlights the need for targeted interventions to address socioeconomic barriers to access and improve global health equity.

1.3. HPV screening methods

Several HPV screening strategies exist, each with advantages and limitations. The most commonly used methods include cytology (Pap smears), visual inspection, HPV testing (from the cervix or via self-sampling), and combined HPV-cytology testing (cotesting), which are described below.

1.4. PAP smear screening.

The Pap smear (Pap test), or cervical cytology, is one of the oldest and most widely used screening tests globally. This test involves collecting cells from the cervix for microscopic analysis to detect abnormalities. While Pap-based screening strategies have been instrumental in reducing cervical cancer incidence, their effectiveness heavily relies on the skill of the healthcare provider in sample collection and the laboratory's proficiency in processing the samples. Its sensitivity, particularly in detecting low-grade lesions or HPV infections, is relatively low, leading to potential false negatives, especially in younger women (Saslow et al., 2012). Improving both collection techniques and laboratory processing is therefore crucial to enhance the test's accuracy and effectiveness.

1.5. Visual inspection.

An alternative to cytology is visual inspection using 3-5% acetic acid (VIA) and/or Lugol's iodine solution (VILI). Abnormal areas appear acetowhite with VIA, and negative with Lugol's iodine. These tests are simple, inexpensive, and user-friendly, making them suitable for healthcare providers, particularly in resource-limited settings lacking significant funding, experience, infrastructure, and technical support. However, VIA's performance depends on the operator's skill, and its accuracy may be lower in postmenopausal women (Rajaram et al., 2021). Further training and standardization of techniques are necessary to optimize its use.

1.6. Cervical HPV testing.

HPV testing detects the presence of high-risk HPV genotypes genetic material; HPV infection is strongly associated with cervical cancer. The test involves analyzing DNA from a cervical cell sample. This method has proven to be more sensitive than Pap smears in detecting HPV infections, allowing for the identification of women at risk of developing cervical cancer at earlier stages (Ramírez et al., 2023). In many countries, HPV testing has shown to be a more efficient and effective screening option than Pap smears, especially for women over 30. A key advantage of HPV testing is its lower dependence on operator skill compared to cytology, making it better suited for resource-constrained environments (Cuzick et al., 2011; Serrano et al., 2022).

1.7. HPV-cytology co-testing.

Co-testing combines HPV testing with Pap smears, increasing detection sensitivity by identifying both HPV infections and early cervical cell lesions. Studies by the American Cancer Society (ACS) indicate that co-testing is more effective than Pap smears alone and offers improved prediction of cervical cancer risk (Saslow et al., 2012). This combined approach maximizes the chances of early detection.

1.8. Self-collected vaginal HPV testing.

Molecular HPV detection using self-collected vaginal samples represents a significant advancement in cervical cancer screening. Women collect samples at home using a specifically designed device, then send them to a lab for molecular testing to detect HPV DNA (Nishimura et al., 2021). This approach addresses accessibility barriers.

This method is considered promising by numerous public health organizations, as it overcomes access barriers to healthcare. In countries with limited infrastructure or rural areas, the need to visit a healthcare facility for sample collection poses a significant obstacle. Self-collected vaginal samples offer a convenient and accessible solution, empowering women to screen privately and at their convenience, thereby increasing participation in screening programs (Nishimura et al., 2021). Further research is needed to assess the long-term impact and effectiveness of this method.

Self-collected HPV sample collection has gained significant global interest and support, partly due to experiences during the COVID-19 pandemic, providing a practical solution to minimize in-person visits (Elfström et al., 2022).

Despite its potential benefits, implementing self-collected vaginal sampling presents challenges, including training healthcare workers to adequately explain the procedure to participants, managing sample transportation, addressing technical differences in laboratory processing between cervical and vaginal samples, and ensuring sufficient numbers of qualified clinicians to manage and follow up on positive results.

In this line, various screening tests offer powerful tools for HPV detection and cervical cancer prevention. However, reaching the target population of women aged 25-64 and achieving at least 70% coverage remains crucial to significantly reduce the progression to cervical cancer (Kundrod et al., 2023). Addressing the challenges related to access, training, and resources is vital for achieving this goal.

2. CERVICAL CANCER SCREENING COVERAGE

HPV detection rates in the United States declined from 86% to 77% between 2005 and 2019, with the lowest rates observed among non-white women, those lacking health insurance, rural residents, and non-heterosexual individuals (Suk et al., 2022). These disparities highlight existing inequities in access to healthcare and preventative services. The subsequent COVID-19 pandemic further decreased screening rates, resulting in a staggering 94%

reduction. Even after lockdown measures were lifted, screening rates remained 35% below prepandemic levels (Wentzensen et al., 2021). This significant drop underscores the pandemic's profound impact on preventative healthcare and the urgent need for strategies to mitigate future disruptions to essential services. The disproportionate impact on vulnerable populations highlights the importance of addressing systemic inequalities in healthcare access.

2.1. Barriers to screening coverage

Access to crucial HPV screening, essential for early detection of precancerous lesions, faces numerous barriers that hinder effective implementation of public health programs. In many regions, inadequate healthcare infrastructure poses a critical challenge. In rural or remote areas, a lack of clinics and qualified personnel prevents regular HPV testing, thereby preventative program reducing coverage. Insufficient resources—both human and material coupled with deficiencies in public health systems, contribute to many women lacking access to necessary care for cervical cancer prevention (Schubert et al., 2023). These systemic issues require significant investment and reform to ensure equitable access to vital services.

Significant social and cultural barriers also limit women's participation in screening programs. In many communities, particularly in conservative areas, gender norms and the stigma surrounding reproductive health play a major role in reducing HPV testing uptake. Misinformation and myths about Pap smears and HPV can create fear and embarrassment, leading many women to postpone or avoid testing. Low health literacy and a lack of targeted educational campaigns for vulnerable women further reinforce these barriers, hindering active participation in screening programs. Addressing these deeply rooted social and cultural barriers is paramount (US Preventive Services Task Force, 2018; Afsah et al., 2023). Effective public health campaigns can play a critical role in dispelling myths and misconceptions and promoting informed decision-making.

Economic barriers also significantly contribute to low cervical cancer screening coverage. In many low-and middle-income countries, the cost of testing and the lack of efficiently funded healthcare systems restrict women's access to screening. Even with free or subsidized programs, indirect costs such as

transportation and lost wages can be prohibitive. Furthermore, the absence of public policies that support inclusive and accessible healthcare systems perpetuates the exclusion of the most vulnerable populations (Islam, 2017). Investing in affordable and accessible healthcare is essential for improving health outcomes for all.

3. IMPACT OF THE COVID-19 PANDEMIC ON SCREENING COVERAGE

The COVID-19 pandemic had a devastating impact on global public health programs, and cervical cancer screening, through HPV detection, was no exception. As healthcare systems worldwide struggled to cope with the health emergency, many countries postponed or temporarily suspended routine screenings, leading to a significant drop in screening coverage. This disruption to essential preventative healthcare services had far-reaching consequences. A WHO report highlighted that in numerous regions, the interruption of preventative healthcare services resulted in a decrease in the early detection of precancerous cervical lesions; this, in turn, is likely to lead to a long-term increase in undetected cervical cancer cases (WHO, 2020). The pandemic'sprofound effects on already strained healthcare systems had particularly devastating consequences for those in need of vital preventative screening.

Access to HPV screening was particularly affected in low- and middle-income countries due to additional barriers created by the pandemic. In these regions, the pre-existing scarcity of resources and inadequate healthcare infrastructure were further exacerbated by the global health crisis. A study conducted in South Africa revealed a substantial reduction in HPV screening coverage. This was attributed to healthcare units prioritizing COVID-19 care, and many women feeling apprehensive about visiting healthcare facilities due to fears of infection (Gourd et al., 2021; Vahabi et al., 2023). Furthermore, clinic closures and shortages of trained personnel contributed to the decline in screening coverage. The pandemic exposed and significantly worsened existing inequalities in access to healthcare.

3.1. Prepandemic coverage disparities

To characterize national screening program coverage globally, maps were created indicating ranges of 20 percentage points, with each range

assigned a specific color to aid visualization. Two maps were produced, one depicting coverage before the COVID-19 pandemic, using data from around 2020 (figure 1), and another showing more recent post-pandemic data (figure 2). To ensure data validity, reliable sources such as peer-reviewed scientific publications and government data were utilized. Countries with unavailable data were represented in white, enabling clear comprehensive global interpretation of screening coverage. The maps provide a powerful visual representation of the disparities in access to vital screening programs across the globe and the devastating impact of the pandemic on global health.

Before the pandemic, cervical cancer screening coverage in developing countries averaged only 19%, mainly attributed to low coverage rates in countries from Africa and Asia (Figure 1). In depth, effective coverage is substantially lower outside of high-income nations, with women at the highest risk of developing cervical cancer being the least likely to receive screening. Coverage rates also decrease with age, despite the increased incidence of cervical cancer in older women (Lofters et al., 2023; Gerstl et al., 2022; Bogdanova et al., 2022; Zhang et al., 2022; Aoki et al., 2022; Téguété et al., 2021; Descamps et al., 2025; Olthof et al., 2024; Fernández-Deaza et al., 2024; Bruni et al., 2024; Rojas-Zumaran et al., 2024).

Cervical cancer screening in Africa faces considerable challenges, reflecting global disparities in the burden of this disease and the critical need for more effective public health strategies (Bouvard et al., 2021). In 2022, Africa reported the highest incidence rates of cervical cancer globally, a stark indicator of the magnitude of the problem and the urgent need to address underlying causes (Osmani et al., 2024). This alarming situation necessitates immediate action and the implementation of sustainable, long-term strategies to address this health critical issue. The significant disparities in access to care are particularly pronounced in sub-Saharan Africa.

Of the 47 sub-Saharan African countries, only 15 had established national screening policies at any given time, demonstrating a significant lack of national-level policy and investment in prevention (Kundrod et al., 2023). Within this limited group, only Botswana and Rwanda included HPV DNA testing in their national policies, highlighting the low uptake of this high-yield test (Gopalkrishnan& Karim, 2025)

that could enable earlier detection and significantly reduce morbidity and mortality. Overall screening coverage was a concerning 13% (Yimer et al., 2021), reflecting the low implementation of HPV testing

despite its high sensitivity and specificity in detecting high-risk HPV infections.

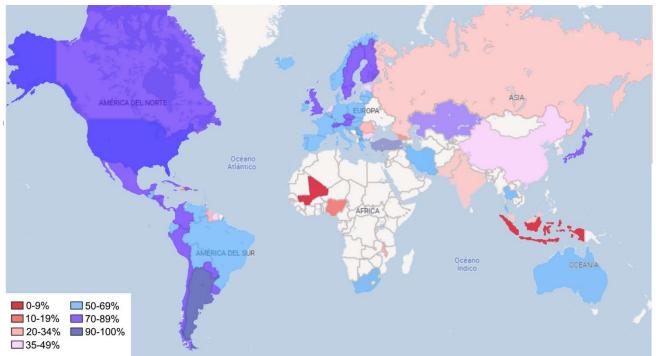


Figure 1. Global map of cervical cancer screening coverage from 2010 to 2019. Source: Prepared by the authors, based on Lofters et al., 2023; Gerstl et al., 2022; Bogdanova et al., 2022; Zhang et al., 2022; Aoki et al., 2022; Téguété et al., 2021; Descamps et al., 2025; Olthof et al., 2024; Fernández-Deaza et al., 2024; Bruni et al., 2024; Rojas-Zumaran et al., 2024.

Of the 47 sub-Saharan African countries, only 15 had established national screening policies at any given time, demonstrating a significant lack of national-level policy and investment in prevention (Kundrod et al., 2023). Within this limited group, only Botswana and Rwanda included HPV DNA testing in their national policies, highlighting the low uptake of this high-yield test (Gopalkrishnan& Karim, 2025) that could enable earlier detection and significantly reduce morbidity and mortality. Overall screening coverage was a concerning 13% (Yimer et al., 2021), reflecting the low implementation of HPV testing despite its high sensitivity and specificity in detecting high-risk HPV infections.

This situation is further aggravated by the strong correlation between high HIV prevalence and the elevated incidence and mortality rates of cervical cancer in the region (Jensen et al., 2024; Yimer et al., 2021). This co-morbidity necessitates integrated interventions addressing both HIV and cervical

cancer needs simultaneously, providing comprehensive care for affected women. Investing in resources and healthcare infrastructure to effectively address these linked health crises is of critical importance.

Furthermore, women living in poverty, who are likely to have higher exposure to known biological risk factors such as smoking and unprotected sex, face significantly lower rates of screening (Gakidou et al., 2008). Addressing these persistent inequalities and promoting equitable access to healthcare are paramount to achieving significant improvements in global health outcomes. These significant disparities underscore the critical need for increased investment in public health infrastructure, training, and resources to improve screening access for all women in sub-Saharan Africa.

Furthermore, asian countries included in this study are striving to establish optimal cervical cancer screening programs and improve coverage rates, tailored to their specific national circumstances and needs. However, other Asian countries with a substantial cervical cancer burden, including Nepal, Myanmar, and the Philippines, were not included in this analysis (Aoki et al., 2020). Further research should focus on these areas.

Additionally, in Latin America, cervical cancer remains a significant public health problem, despite progress made. Although a decline in incidence and mortality rates suggests improvements in screening and treatment, further research is needed to fully understand the reasons behind these reductions and identify areas needing attention. Incidence and decreasing, mortality rates, while considerably high in several countries in the region, posing an ongoing challenge to public health systems (Pilleron et al., 2020). A thorough analysis of the contributing factors, including socioeconomic elements and access to healthcare, is crucial.

Over the past three years, estimates of screening coverage reveal a striking disparity between the Americas. While all North American countries report coverage exceeding 70%, reflecting wide access to preventative healthcare, only 29% of countries in Latin America and the Caribbean have achieved this level of coverage (Fernández-Deaza et al., 2024). This significant difference highlights inequities in access to healthcare and effective screening programs, necessitating urgent investment in healthcare infrastructure, human resources, and awareness campaigns to improve coverage and reduce the disease burden in the region. Targeted strategies to overcome the barriers to access faced by women in Latin America are crucial to ensure timely and effective care.

Finally, in Chile, cervical cancer was the fifth most common cancer among women in 2022, with 1,559 new cases and the seventh leading cause of death, resulting in 308 fatalities (WHO, 2022). With an incidence rate of 16 per 100,000 women and a mortality rate of 8.5 per 100,000 women, it was the fifth most frequent and seventh most deadly cancer. Cervical cancer therefore presents a significant public health concern in Chile, demanding continued investment in preventative healthcare.

By 2030, in low- and middle-income countries,

cervical cancer mortality is projected to decrease by 34.2% due to HPV screening and treatment, potentially preventing up to 400,000 deaths (Canfell et al., 2020). This significant reduction highlights the life-saving potential of widespread access to preventative screening.

3.2. Post-pandemic coverage disparities

The maps reveal significant disparities in global HPV screening program coverage after pandemic, highlighting notable regional differences (Figure 2). Furthermore, a concerning decline in coverage rates is observed in several countries, threatening the progress made over the past decade. These disparities underscore the need for targeted interventions to address the root causes of unequal access to screening (Lofters et al., 2023; Ong et al., 2023; Descamps et al., 2025; Olthof et al., 2024; Portero de la Cruz & Cebrino, 2022).

Screening is crucial in combating cervical cancer, as this disease is often asymptomatic in its early stages, allowing it to progress to more invasive malignancies before symptoms appear (Bogdanova et al., 2022). New methods such as self-sampling can be particularly useful in resource-constrained settings, mitigating access barriers and increasing screening rates. Following the pandemic, an increase in cervical cancer cases is anticipated, particularly in low-resource countries, leading to a surge in demand for oncology clinics, both due to new patients and the resumption of treatments postponed (Aden et al., 2022). Strategic planning and resource allocation are critical to meet this rising need

Although 604,127 cases of cervical cancer were reported globally in 2020, a staggering 85% occurred in low- and middle-income countries. In sub-Saharan Africa, cervical cancer has become the leading cause of death among women, with an alarming mortality rate of 30 per 100,000 in 2018 (Lott et al., 2020). The lack of effective screening programs in this region significantly contributes to this high mortality rate, emphasizing the urgent need to improve access to and coverage of life-saving screening services. Targeted interventions and investments are critical to address this public health crisis.

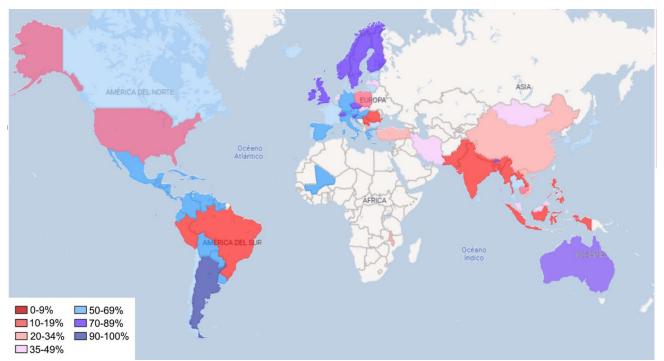


Figure 2. Global map of cervical cancer screening coverage from 2021 to 2025. Source: Prepared by the authors, based on Lofters et al., 2023; Ong et al., 2023; Descamps et al., 2025; Olthof et al., 2024; Portero de la Cruz & Cebrino, 2022.

Reduced cervical cancer screening could lead to a future increase in cancer rates (Wentzensen et al., 2021). This underscores the critical importance of maintaining and expanding access to screening services, especially in regions with limited resources.

Significant global inequalities account for the higher cervical cancer mortality rates in low-income countries. The global burden of this disease clearly reflects these inequalities, as approximately 90% of the estimated 604,127 cases and 341,831 annual deaths occurred in low- and middle-income nations in 2020 (Sung et al., 2020). These stark statistics highlight the need for addressing systemic inequities in access to preventative healthcare. Average compliance rates for triage testing among women with positive screening results were reported at 77.1%, while referral for treatment was at 69.4%, with variations based on a country's income level and screening guidelines (Wang et al., 2024). Since the launch of the global call to action in 2018, detection and treatment strategies have been thoroughly evaluated, streamlining best practices in WHO guidelines and providing a clear roadmap towards cervical cancer elimination. Sustained effort and international collaboration are required to achieve this ambitious goal.

4. CONCLUSIONS

The COVID-19 pandemic significantly impacted global cervical cancer detection coverage, exposing pre-existing inequalities and highlighting the urgent need for improved strategies. The pandemic exacerbated existing challenges, creating a crisis in preventative healthcare. While pre-pandemic coverage was already inadequate, reaching only 19% in developing countries, the pandemic caused a dramatic further reduction. Disruptions to healthcare systems, fear of infection, and economic hardship contributed to this decline. disproportionately affecting vulnerable populations. reveals significant geographical disparities, with post-pandemic coverage remaining below pre-pandemic levels. High-income countries consistently demonstrate better coverage than lowand middle-income countries, highlighting the critical need for global equity in access to healthcare.

In many regions, healthcare systems prioritized COVID-19 care, resulting in clinic closures and reduced availability of screening services. Women also avoided medical visits due to fear of infection, further contributing to the decline. Low- and middle-

income countries were particularly affected, where limited healthcare infrastructure and resource constraints were worsened by the pandemic, significantly reducing access to HPV screening. The inconsistent use of effective detection methods, such as HPV testing and co-testing, underscores the importance of implementing standardized and accessible screening programs worldwide. Addressing these disparities requires a concerted global effort.

Cervical cancer is unique among cancers in that it is largely preventable through timely and adequate detection and intervention. A global perspective on cervical cancer screening coverage is therefore paramount. Post-pandemic recovery has been uneven, with many regions failing to return to prepandemic levels. Addressing these challenges strengthening healthcare improving access to testing, and implementing effective strategies to overcome socio-economic and cultural barriers hindering participation in screening programs. Sustainable solutions require addressing the root causes of healthcare disparities and ensuring equitable access to vital preventative services for all women, regardless of socioeconomic status or geographic location.

5. REFERENCES

Adcock, R., Cuzick, J., Hunt, W. C., McDonald, R. M., Wheeler, C. M., & New Mexico HPV Pap Registry Steering Committee (2019). Role of HPV Genotype, Multiple Infections, and Viral Load on the Risk of High-Grade Cervical Neoplasia. Cancer Epidemiology, Biomarkers & Prevention, 28(11), 1816–1824. https://doi.org/10.1158/1055-9965.EPI-19-0239

Aden, D., Zaheer, S., & Raj, S. (2022). Challenges faced in the cancer diagnosis and management-COVID-19 pandemic and beyond-Lessons for future. Heliyon, 8(12), e12091. https://doi.org/10.1016/j.heliyon.2022.e12091

Aden, D., Zaheer, S., Khan, S., Jairajpuri, Z. S., &Jetley, S. (2024). Navigating the landscape of HPV-associated cancers: From epidemiology to prevention. Pathology, Research and Practice, 263, 155574. https://doi.org/10.1016/j.prp.2024.155574

Afsah, Y. R., & Kaneko, N. (2023). Barriers to cervical cancer screening faced by immigrant Muslim women: a systematic scoping review. BMC

Public Health, 23(1), 2375. https://doi.org/10.1186/s12889-023-17309-9

Aoki, E. S., Yin, R., Li, K., Bhatla, N., Singhal, S., Ocviyanti, D., Saika, K., Suh, M., Kim, M., &Termrungruanglert, W. (2020). National screening programs for cervical cancer in Asian countries. Journal of Gynecologic Oncology, 31(3), e55. https://doi.org/10.3802/jgo.2020.31.e55

Bogdanova, A., Andrawos, C., &Constantinou, C. (2022). Cervical cancer, geographical inequalities, prevention and barriers in resource depleted countries. Oncology Letters, 23(4), 113. https://doi.org/10.3892/ol.2022.13233

Bouvard, V., Wentzensen, N., Mackie, A., Berkhof, J., Brotherton, J., Giorgi-Rossi, P., Kupets, R., Smith, R., Arrossi, S., Bendahhou, K., Canfell, K., Chirenje, Z. M., Chung, M. H., Del Pino, M., de Sanjosé, S., Elfström, M., Franco, E. L., Hamashima, C., Hamers, F. F., Herrington, C. S., ... Lauby-Secretan, B. (2021). The IARC Perspective on Cervical Cancer Screening. The New England Journal of Medicine, 385(20), 1908–1918. https://doi.org/10.1056/NEJMsr2030640

Bruni, L., Serrano, B., Roura, E., Alemany, L., Cowan, M., Herrero, R., Poljak, M., Murillo, R., Broutet, N., Riley, L. M., & de Sanjose, S. (2022). Cervical cancer screening programmes and agespecific coverage estimates for 202 countries and territories worldwide: a review and synthetic analysis. The Lancet. Global Health, 10(8), e1115–e1127. https://doi.org/10.1016/S2214-109X(22)00241-8

Buskwofie, A., David-West, G., & Clare, C. A. (2020). A Review of Cervical Cancer: Incidence and Disparities. Journal of the National Medical Association, 112(2), 229–232. https://doi.org/10.1016/j.jnma.2020.03.002

Canfell, K., Kim, J. J., Brisson, M., Keane, A., Simms, K. T., Caruana, M., Burger, E. A., Martin, D., Nguyen, D. T. N., Bénard, É., Sy, S., Regan, C., Drolet, M., Gingras, G., Laprise, J. F., Torode, J., Smith, M. A., Fidarova, E., Trapani, D., Bray, F., ... Hutubessy, R. (2020). Mortality impact of achieving WHO cervical cancer elimination targets: a comparative modelling analysis in 78 low-income lower-middle-income and countries. Lancet England), 395(10224). 591-603. https://doi.org/10.1016/S0140-6736(20)30157-4

Cuzick, J., Clavel, C., Petry, K. U., Meijer, C. J., Hoyer, H., Ratnam, S., Szarewski, A., Birembaut, P., Kulasingam, S., Sasieni, P., &Iftner, T. (2006). Overview of the European and North American studies on HPV testing in primary cervical cancer screening. International Journal of Cancer, 119(5), 1095–1101. https://doi.org/10.1002/ijc.21955

Descamps, P., Bosch Jose, F. X., Monsonego, J., Neisingh, O., Nguyen, L., & O'Connor, M. (2025). Cervical cancer screening: Sharing best practices and addressing common challenges in cervical cancer screening programs. *International journal of cancer*, 156(3), 679–681. https://doi.org/10.1002/ijc.35220

Elfström KM, Dillner J. Cervical cancer screening improvements with self-sampling during the COVID-19 pandemic [Internet]. MedRxiv. 2022 [cited 2022 Dec 21]. p. 2022.07.19.22277806. Available from: https://www.medrxiv.org/content/10.1101/2022.07.19.22277806v1

Fernández-Deaza, G., Serrano, B., Roura, E., Castillo, J. S., Caicedo-Martínez, M., Bruni, L., & Murillo, R. (2024). Cervical cancer screening coverage in the Americas region: a synthetic analysis. Lancet Regional Health. Americas, 30, 100689. https://doi.org/10.1016/j.lana.2024.100689

Filho, A. M., Laversanne, M., Ferlay, J., Colombet, M., Piñeros, M., Znaor, A., Parkin, D. M., Soerjomataram, I., & Bray, F. (2025). The GLOBOCAN 2022 cancer estimates: Data sources, methods, and a snapshot of the cancer burden worldwide. International Journal of Cancer, 156(7), 1336–1346. https://doi.org/10.1002/ijc.35278

Gakidou, E., Nordhagen, S., & Obermeyer, Z. (2008). Coverage of cervical cancer screening in 57 countries: low average levels and large inequalities. PLoS Medicine, 5(6), e132. https://doi.org/10.1371/journal.pmed.0050132

Gerstl, S., Lee, L., Nesbitt, R. C., Mambula, C., Sugianto, H., Phiri, T., Kachingwe, J., & Llosa, A. E. (2022). Cervical cancer screening coverage and its related knowledge in southern Malawi. *BMC public health*, 22(1), 295. https://doi.org/10.1186/s12889-022-12547-9

Gopalkrishnan, K., & Karim, R. (2025). Addressing Global Disparities in Cervical Cancer Burden: A

Narrative Review of Emerging Strategies. Current HIV/AIDS Reports, 22(1), 18. https://doi.org/10.1007/s11904-025-00727-2

Gourd E. (2021). COVID-19 pandemic causes cervical cancer screening crisis. The Lancet. Oncology, 22(8), 1060. https://doi.org/10.1016/S1470-2045(21)00382-X

Islam, R. M., Billah, B., Hossain, M. N., &Oldroyd, J. (2017). Barriers to Cervical Cancer and Breast Cancer Screening Uptake in Low-Income and Middle-Income Countries: A Systematic Review. Asian Pacific Journal of Cancer Prevention: APJCP, 18(7), 1751–1763. https://doi.org/10.22034/APJCP.2017.18.7.1751

Jensen, J. E., Becker, G. L., Jackson, J. B., &Rysavy, M. B. (2024). Human Papillomavirus and Associated Cancers: A Review. Viruses, 16(5), 680. https://doi.org/10.3390/v16050680

Kessler T. A. (2017). Cervical Cancer: Prevention and Early Detection. Seminars in Oncology Nursing, 33(2), 172–183. https://doi.org/10.1016/j.soncn.2017.02.005

Kundrod, K. A., Jeronimo, J., Vetter, B., Maza, M., Murenzi, G., Phoolcharoen, N., & Castle, P. E. (2023). Toward 70% cervical cancer screening coverage: Technical challenges and opportunities to increase access to human papillomavirus (HPV) testing. PLOS Global Public Health, 3(8), e0001982. https://doi.org/10.1371/journal.pgph.0001982

Lofters, A. K., Wu, F., Frymire, E., Kiran, T., Vahabi, M., Green, M. E., & Glazier, R. H. (2023). Cancer Screening Disparities Before and After the COVID-19 Pandemic. *JAMA network open*, *6*(11), e2343796. https://doi.org/10.1001/jamanetworkopen.2023.437

Lott, B. E., Trejo, M. J., Baum, C., McClelland, D. J., Adsul, P., Madhivanan, P., Carvajal, S., Ernst, K., &Ehiri, J. (2020). Interventions to increase uptake of cervical screening in sub-Saharan Africa: a scoping review using the integrated behavioral model. BMC Public Health, 20(1), 654. https://doi.org/10.1186/s12889-020-08777-4 Machii, R., Takahashi, H., Miyazawa, J., & Nakayama, T. (2024). Cancer screening in Japan 2 years after the COVID-19 pandemic: Changes in participation, 2017-2021. Preventive Medicine

Reports, 39, 102649. https://doi.org/10.1016/j.pmedr.2024.102649

Olusola, P., Banerjee, H. N., Philley, J. V., & Dasgupta, S. (2019). Human Papilloma Virus-Associated Cervical Cancer and Health Disparities. Cells, 8(6), 622. https://doi.org/10.3390/cells8060622

Olthof, E. M. G., Aitken, C. A., Siebers, A. G., van Kemenade, F. J., & de Kok, I. M. C. M. (2024). Resilience of the Dutch HPV-based cervical screening programme during the COVID-19 pandemic. Public Health, 227, 42–48. https://doi.org/10.1016/j.puhe.2023.11.026

Ong, S. K., Abe, S. K., Thilagaratnam, S., Haruyama, R., Pathak, R., Jayasekara, H., Togawa, K., Bhandari, A. K. C., Shankar, A., Nessa, A., Jugder, U., Agustina, J., Biglari, M., Yusuf, A., Tshomo, U., Fernando, E., Cairo, C., Kaung, K. K., Rath, B., Vongdala, C., ... Hwang, W. Y. K. (2023). Towards elimination of cervical cancer - human papillomavirus (HPV) vaccination and cervical cancer screening in Asian National Cancer Centers Alliance (ANCCA) member countries. *The Lancet regional health. Western Pacific*, 39, 100860. https://doi.org/10.1016/j.lanwpc.2023.100860

Osmani, V., Hörner, L., Nkurunziza, T., Rank, S., Tanaka, L. F., & Klug, S. J. (2025). Global prevalence of cervical human papillomavirus in women aged 50 years and older with normal cytology: a systematic review and meta-analysis. The Lancet. Microbe, 6(1), 100955. https://doi.org/10.1016/j.lanmic.2024.100955

Perkins, R. B., Wentzensen, N., Guido, R. S., & Schiffman, M. (2023). Cervical Cancer Screening: A Review. JAMA, 330(6), 547–558. https://doi.org/10.1001/jama.2023.13174

Pilleron, S., Cabasag, C. J., Ferlay, J., Bray, F., Luciani, S., Almonte, M., & Piñeros, M. (2020). Cervical cancer burden in Latin America and the Caribbean: Where are we?. International Journal of Cancer, 147(6), 1638–1648. https://doi.org/10.1002/ijc.32956

Portero de la Cruz, S., &Cebrino, J. (2022). Trends and Determinants in Uptake of Cervical Cancer Screening in Spain: An Analysis of National Surveys from 2017 and 2020. *Cancers*, *14*(10), 2481. https://doi.org/10.3390/cancers14102481

Ramírez, A. T., Valls, J., Baena, A., Rojas, F. D., Ramírez, K., Álvarez, R., Cristaldo, C., Henríquez, O., Moreno, A., Reynaga, D. C., Palma, H. G., Robinson, I., Hernández, D. C., Bardales, R., Cardinal, L., Salgado, Y., Martínez, S., González, E., Guillén, D., Fleider, L., ... ESTAMPA Study Group (2023). Performance of cervical cytology and HPV testing for primary cervical cancer screening in Latin America: an analysis within the ESTAMPA study. Lancet Regional Health. Americas, 26, 100593. https://doi.org/10.1016/j.lana.2023.100593

Rojas-Zumaran, V., Walttuoni-Picón, E., Campos-Siccha, G., Cruz-Gonzales, G., Huiza-Espinoza, L., & Moya-Salazar, J. (2022). Decline of cytology-based cervical cancer screening for COVID-19: a single-center Peruvian experience. Declive del cribado de cáncer cervical basado en citología by COVID-19: una experiencia unicéntrica peruana. *Medwave*, 22(10), e2589. https://doi.org/10.5867/medwave.2022.S3.2589

Saslow, D., Solomon, D., Lawson, H. W., Killackey, M., Kulasingam, S. L., Cain, J., Garcia, F. A., Moriarty, A. T., Waxman, A. G., Wilbur, D. C., Wentzensen, N., Downs, L. S., Jr, Spitzer, M., Moscicki, A. B., Franco, E. L., Stoler, M. H., Schiffman, M., Castle, P. E., Myers, E. R., & ACS-Guideline ASCCP-ASCP Cervical Cancer Committee (2012). American Cancer Society, American Society for Colposcopy and Cervical Pathology, and American Society for Clinical Pathology screening guidelines for the prevention and early detection of cervical cancer. CA: a cancer Journal for Clinicians, 62(3), 147-172. https://doi.org/10.3322/caac.21139

Schubert, M., Bauerschlag, D. O., Muallem, M. Z., Maass, N., &Alkatout, I. (2023). Challenges in the Diagnosis and Individualized Treatment of Cervical Cancer. Medicina (Kaunas, Lithuania), 59(5), 925. https://doi.org/10.3390/medicina59050925

Serrano, B., Ibáñez, R., Robles, C., Peremiquel-Trillas, P., de Sanjosé, S., & Bruni, L. (2022). Worldwide use of HPV self-sampling for cervical cancer screening. Preventive Medicine, 154, 106900.

https://doi.org/10.1016/j.ypmed.2021.106900

Suk, R., Hong, Y. R., Rajan, S. S., Xie, Z., Zhu, Y., & Spencer, J. C. (2022). Assessment of US Preventive Services Task Force Guideline-

Concordant Cervical Cancer Screening Rates and Reasons for Underscreening by Age, Race and Ethnicity, Sexual Orientation, Rurality, and Insurance, 2005 to 2019. JAMA Network Open, 5(1), e2143582.

https://doi.org/10.1001/jamanetworkopen.2021.435

Sung, H., Ferlay, J., Siegel, R. L., Laversanne, M., Soerjomataram, I., Jemal, A., & Bray, F. (2021). Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. CA: a Cancer Journal for Clinicians, 71(3), 209–249. https://doi.org/10.3322/caac.21660

Téguété, I., Tounkara, F. K., Diawara, B., Traoré, S., Koné, D., Bagayogo, A., Sissoko, A., &Traoré, C. B. (2021). A population-based combination strategy to improve the cervical cancer screening coverage rate in Bamako, Mali. *Acta obstetricia et gynecologicaScandinavica*, 100(4), 794–801. https://doi.org/10.1111/aogs.14119

Teixeira, J. C., Vale, D. B., Campos, C. S., Polegatto, I., Bragança, J. F., Discacciati, M. G., & Zeferino, L. C. (2024). Transition from opportunistic cytological to organized screening program with DNA-HPV testing detected prevalent cervical cancers 10 years in advance. *Scientific reports*, 14(1), 20761. https://doi.org/10.1038/s41598-024-71735-2

US Preventive Services Task Force, Curry, S. J., Krist, A. H., Owens, D. K., Barry, M. J., Caughey, A. B., Davidson, K. W., Doubeni, C. A., Epling, J. W., Jr, Kemper, A. R., Kubik, M., Landefeld, C. S., Mangione, C. M., Phipps, M. G., Silverstein, M., Simon, M. A., Tseng, C. W., & Wong, J. B. (2018). Screening for Cervical Cancer: US Preventive Services Task Force Recommendation Statement. JAMA, 320(7), 674–686. https://doi.org/10.1001/jama.2018.10897

Wang, M., Maimaitiming, M., Bi, Y., &Jin, Y. (2024). Compliance Rate With Triage Test and Treatment for Participants Screening Positive in Cervical Cancer Screening Programs: A Systematic Review and Meta-analysis. Obstetrics and Gynecology, 144(6), 791–800. https://doi.org/10.1097/AOG.000000000000005723

Wei, F., Georges, D., Man, I., Baussano, I., & Clifford, G. M. (2024). Causal attribution of human

papillomavirus genotypes to invasive cervical cancer worldwide: a systematic analysis of the global literature. Lancet, 404(10451), 435–444. https://doi.org/10.1016/S0140-6736(24)01097-3

Wentzensen, N., Clarke, M. A., & Perkins, R. B. (2021). Impact of COVID-19 on cervical cancer screening: Challenges and opportunities to improving resilience and reduce disparities. Preventive Medicine, 151, 106596. https://doi.org/10.1016/j.ypmed.2021.106596

World Health Organization (WHO), Global cancer observatory (GLOBOCAN), International Agency for Research on Cancer (IARC) [Internet]. Data viz. Cancer today. 2022 [cited 2025 Mar 20]. Available from: https://gco.iarc.fr/today/en/dataviz/barscompare-

populations?mode=cancer&key=crude_rate&cance rs=15&populations=152&group_populations=1&typ es=0_1&sort_by=value1&sexes=2

World Health Organization (WHO). (2020). Impact of the COVID-19 pandemic on noncommunicable disease resources and services: Results of a rapid assessment. WHO. Recuperado de: https://www.who.int/publications/i/item/9789240010 291

WHO guideline for screening and treatment of cervical pre-cancer lesions for cervical cancer prevention. (2021). (2nd ed.). World Health Organization.

Yimer, N. B., Mohammed, M. A., Solomon, K., Tadese, M., Grutzmacher, S., Meikena, H. K., Alemnew, B., Sharew, N. T., &Habtewold, T. D. (2021). Cervical cancer screening uptake in Sub-Saharan Africa: a systematic review and meta-analysis. Public Health, 195, 105–111. https://doi.org/10.1016/j.puhe.2021.04.014

Zhang, M., Zhong, Y., Wang, L., Bao, H., Huang, Z., Zhao, Z., Zhang, X., Li, C., Sun, K. L., Wu, J., Zheng, X., & Wang, L. (2022). Cervical Cancer Screening Coverage - China, 2018-2019. *China CDC weekly*, 4(48), 1077–1082. https://doi.org/10.46234/ccdcw2022.217