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CERVICAL CANCER IN INDIA: EPIDEMIOLOGICAL STATUS AND MANAGEMENT STRATEGIES

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Abstract

Background:
Cervical cancer is a largely preventable malignancy, yet it remains a major cause of cancer-related mortality among women in low- and middle-income countries (LMICs). India contributes nearly one-quarter of the global cervical cancer burden, with the majority of cases occurring in rural and underserved populations. Despite the availability of effective prevention and screening tools, uptake remains critically low.

Objective:
This literature review synthesizes current evidence on the epidemiological status of cervical cancer in India and evaluates prevention, screening, and management strategies, with particular emphasis on national initiatives and alignment with global elimination targets.

Methods:
Relevant peer-reviewed articles, national surveys, cancer registry data, and policy documents were reviewed. The focus was placed on epidemiology, HPV vaccination, screening methods (Pap cytology, VIA, HPV DNA testing), treatment options, and systemic challenges within the Indian healthcare context.

Results:
India records nearly 97,000 new cases and 60,000 deaths annually, with significant regional variation in incidence. HPV vaccination has shown >90% efficacy in preventing high-grade precancerous lesions, and recent evidence suggests even a single dose provides substantial protection. However, vaccine uptake remains limited, though the introduction of the indigenous Cervavac vaccine holds promise. Screening methods such as VIA have demonstrated mortality reductions of up to 31% in rural trials, while HPV DNA testing is now recommended by WHO as the preferred modality. Despite this, NFHS-5 data show that only 1.9% of women aged 30–49 have ever been screened. Treatment is stage-dependent, ranging from cryotherapy and LEEP for precancerous lesions to radical hysterectomy, chemoradiation, and palliative care for advanced disease. Key barriers include inadequate infrastructure, shortage of trained personnel, sociocultural stigma, and high out-of-pocket expenditure.

Conclusion:
Cervical cancer in India represents a paradox: a highly preventable disease that continues to claim thousands of lives annually. Progress depends on scaling up HPV vaccination, expanding affordable and sensitive screening, strengthening primary healthcare systems, and ensuring timely treatment. Aligning national programmes with the WHO's 90-70-90 elimination targets offers a clear pathway towards reducing the burden and moving India closer to eliminating cervical cancer as a public health problem.

Keywords: Cervical cancer; HPV vaccination; Visual Inspection with Acetic Acid (VIA); Screening; India; Public health; Elimination strategy.

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Introduction

Cervical cancer is one of the most preventable cancers, yet it remains a leading cause of death among women in low- and middle-income countries (LMICs). Globally, it ranks as the fourth most common cancer in women, but its burden is disproportionately concentrated in countries with limited healthcare infrastructure. India, home to nearly one-sixth of the world's female population, contributes about one-quarter of the global cervical cancer burden .[1] Despite advances in prevention and the existence of effective tools such as human papillomavirus (HPV) vaccination and cervical cancer screening, the disease continues to be the second most common cancer among Indian women, particularly in rural and underserved regions[2].

What makes this situation paradoxical is that cervical cancer is both detectable at a precancerous stage and highly preventable. With appropriate public health strategies, the majority of cases and deaths could be avoided. However, the persistence of high incidence and mortality in India reflects the intersection of biological risk factors, such as persistent infection with high-risk HPV strains, with sociocultural and systemic barriers, including stigma, lack of awareness, poverty, and weak health system readiness. This literature review therefore seeks to explore the current epidemiological status of cervical cancer in India and critically appraise prevention, screening, and management strategies within both national and global contexts.

Epidemiological Status of Cervical Cancer in India

India's cervical cancer burden is staggering, with nearly 97,000 new cases and 60,000 deaths reported each year. This translates into almost one in every four cervical cancer cases worldwide, underscoring the country's central role in the global fight against this disease. The sheer magnitude of cases is driven not only by the size of India's population but also by persistent gaps in preventive health coverage.

The disease does not affect all women equally. There are marked regional disparities in both incidence and outcomes. According to the National Cancer Registry Programme (2020), northeastern states such as Mizoram report the highest age-adjusted incidence rates (AARs), exceeding 25 per 100,000 women, compared to rates of less than 10 per 100,000 in some urban centres such as Delhi and Mumbai[3]. These differences can be attributed to a combination of socioeconomic inequality, rural–urban divides, cultural practices, and healthcare accessibility. Rural women are disproportionately affected, as they face barriers such as low literacy levels, entrenched gender norms, stigma surrounding gynecological examinations, and limited autonomy in making health decisions [4].

Equally concerning is the stage at which cervical cancer is diagnosed. More than two-thirds of Indian women are diagnosed at advanced stages of the disease . At this point, survival rates drop drastically, with fewer than 30% of women surviving five years after diagnosis, compared to over 90% survival when the disease is detected early. The reasons for late diagnosis are multifactorial. On one hand, there is a lack of widespread, organized screening programmes, and on the other, there is low community awareness about the symptoms and importance of early detection. Fear, stigma, and misconceptions about reproductive health often delay women from seeking care until symptoms become severe.

Cervical cancer in India is therefore not just a medical issue, but also a social and systemic challenge. It reflects a broader landscape where poverty, gender inequity, weak health infrastructure, and limited public health prioritization intersect to create an environment where a preventable disease continues to thrive.

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Table 1: Cervical Cancer Burden in India vs Global

Indicator	India	Global	Source
New cases annually	96,922	~604,000	ICO/IARC (2021)
Deaths annually	60,078	~342,000	ICO/IARC (2021)
Contribution to global burden	25%	–	ICO/IARC (2021)
Common age group affected	30–60 yrs	30–60 yrs	NCRP (2020)
Screening coverage (30–49 yrs)	1.9%	>70% in high-income countries	NFHS-5 (2021)

Source: ICO/IARC HPV Information Centre (2021); NCRP (2020); IARC GLOBOCAN 2020; NFHS-5 (2019–21).

Primary Prevention: HPV Vaccination

- Primary Prevention: HPV Vaccination

At the heart of cervical cancer prevention lies the human papillomavirus (HPV), a virus now recognised as the necessary cause of almost all cases of the disease. Among its many subtypes, HPV-16 and HPV-18 alone are responsible for nearly 70% of cervical cancers worldwide[3]. This clear causal link makes HPV vaccination one of the most powerful tools in public health, capable of dramatically reducing future incidence if implemented effectively.

- Efficacy of HPV vaccines

International evidence demonstrates that HPV vaccines are highly effective, with efficacy rates above 90% in preventing high-grade cervical intraepithelial neoplasia (CIN)—the precancerous lesions that precede invasive cancer. In India, a landmark multicentre study by Bhatla et al. (2021) revealed that even a single dose of the vaccine provided strong protection against persistent HPV infection. This is a particularly important finding in a country where the cost and logistical challenges of delivering multi-dose regimens remain significant.

- Types of vaccines available

Currently, India has access to multiple vaccines:

- The bivalent vaccine (Cervarix), which targets HPV-16 and 18.
- The quadrivalent vaccine (Gardasil), which protects against HPV-6, 11, 16, and 18.
- The newly introduced indigenous vaccine (Cervavac), which is both cost-effective and designed to be scalable for national immunisation.

The launch of Cervavac represents a watershed moment. Until recently, HPV vaccines were prohibitively expensive for large-scale use in low-resource settings. An affordable, locally manufactured vaccine has the potential to revolutionise India's approach to cervical cancer prevention, allowing integration into routine national immunisation programmes.

Global lessons

Experiences from high-income countries offer an optimistic outlook. For instance, Australia's school-based HPV vaccination programme has achieved high coverage, resulting in a dramatic fall in HPV prevalence, genital warts, and high-grade cervical lesions among young women [8]. Australia is now projected to be among the first countries to eliminate cervical cancer as a public health problem. These results highlight what is possible when vaccination is prioritised and implemented systematically[5-8].

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Table 2: Prevention and Screening Strategies in India

Strategy	Description	Advantages	Challenges
HPV Vaccination	Cervarix, Gardasil, Cervavac (indigenous)	>90% efficacy; one-dose protection feasible	Low uptake; sociocultural hesitancy; cost barriers (improving with Cervavac)
Pap smear cytology	Detects abnormal cells early	Gold standard in high-income settings	Requires labs, pathologists; poor rural feasibility
Visual Inspection with Acetic Acid (VIA)	Low-cost visual screening; results immediate	Mortality reduced by 31% in Indian RCTs	Quality depends on training; false positives possible
HPV DNA testing	Detects high-risk HPV; longer screening intervals	Highest sensitivity; WHO-recommended	High cost; limited availability, though low-cost indigenous tests emerging

Source: Walboomers et al., 1999; Bhatla et al., 2021; Sankaranarayanan et al., 2009; Arbyn et al., 2020; WHO, 2013.

Challenges in India

Despite these promising developments, HPV vaccination uptake in India remains low and uneven. The reasons are complex and include:

- Cost barriers (before Cervavac, imported vaccines were unaffordable for mass rollout).
- Limited awareness among communities and even healthcare providers.
- Sociocultural hesitancy, with resistance from parents due to misconceptions about vaccinating adolescent girls against a sexually transmitted infection.
- Logistical challenges in delivering vaccines to rural and hard-to-reach population

Secondary Prevention: Screening Strategies

One of the unique features of cervical cancer is its long precancerous phase, which makes early detection not only possible but highly effective in preventing disease progression. Screening, therefore, forms the backbone of secondary prevention, allowing precancerous lesions to be detected and treated before they develop into invasive cancer.

In India, three main screening modalities are employed:

- Papanicolaou (Pap) smear cytology: Long considered the gold standard in high-income countries, Pap smears can detect abnormal cellular changes at an early stage. However, its implementation in India has been limited. The technique requires laboratory infrastructure, cytopathology expertise, and repeated follow-up visits—resources that are often scarce outside urban and tertiary centres.
- Visual Inspection with Acetic Acid (VIA): VIA is a low-cost, point-of-care method where the cervix is inspected after application of diluted acetic acid. Results are immediate, allowing "screen-and-treat" approaches. Crucially, VIA does not require advanced laboratories and can be performed by trained nurses or frontline workers. Evidence from India is compelling: a large randomized controlled trial demonstrated a 31% reduction in cervical cancer mortality with VIA delivered at the community level .[9] For resource-limited settings, VIA has emerged as a practical and scalable solution.
- HPV DNA testing: With higher sensitivity than Pap or VIA, HPV DNA testing has been endorsed by the World Health Organization as the preferred screening method where feasible .[10] It offers the advantage of longer screening intervals, reducing the burden on women and health systems alike. However, cost and infrastructure requirements

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remain significant barriers in India, though the development of indigenous low-cost HPV DNA tests is an encouraging step forward.

Despite the availability of these tools, screening coverage in India remains critically low. According to the NFHS-5 (2019–21), only 1.9% of women aged 30–49 years reported ever undergoing cervical cancer screening.[11] This stark statistic reflects the persistent challenges: limited awareness of cervical cancer, stigma around reproductive health, inadequate infrastructure at primary health centres, shortage of trained personnel, and weak referral systems.

The evidence shows that screening is effective and feasible in India when implemented well, but the gap lies in translating policy into widespread practice. To close this gap, India needs a stronger focus on community-level awareness campaigns, training of health workers, integration of screening into routine reproductive health services, and expansion of cost-effective HPV testing.

Management and Treatment Strategies

The management of cervical cancer depends heavily on the stage of disease at diagnosis.

Precancerous lesions are typically treated with ablative or excisional procedures such as cryotherapy, loop electrosurgical excision procedure (LEEP), or cold knife conization. In low-resource settings, the "screen-and-treat" model—where VIA-positive women are offered immediate cryotherapy—has been shown to be both cost-effective and practical, particularly in rural areas where loss to follow-up is a frequent concern .[12]

Early invasive cancers are best managed surgically, with radical hysterectomy being the standard approach. Outcomes are favourable at this stage, but unfortunately, only a minority of women in India are diagnosed early enough to benefit from surgical treatment.

Locally advanced disease requires radiotherapy in combination with cisplatin-based chemotherapy, which is widely accepted as the gold standard. However, access to radiotherapy is a major limitation in India; facilities are scarce and unevenly distributed, leading to delays that worsen prognosis.

Advanced or recurrent disease often necessitates systemic therapy, targeted treatment, and palliative care. Unfortunately, outcomes at this stage remain poor, as most women present late, when curative options are limited.

Challenges in India further compound these treatment pathways. There are too few radiotherapy centres, long waiting times, frequent delays in referral, and significant out-of-pocket costs, which force many women to delay or abandon treatment. These systemic barriers mean that survival outcomes in India lag far behind those in high-income countries, even when similar treatments are available.

Table 3: Management Strategies by Disease Stage

Stage	Treatment Modalities	Notes/Challenges
Precancerous lesions (CIN)	Cryotherapy, LEEP, Cold knife conization	VIA-based "screen-and-treat" practical in rural areas; prevents loss to follow-up
Early invasive cancers	Radical hysterectomy (surgical)	Effective if detected early, but most Indian women present late
Locally advanced disease	Radiotherapy + Cisplatin chemotherapy	Limited radiotherapy facilities; delays worsen prognosis
Advanced/recurrent disease	Systemic therapy, palliative care	Survival poor due to late presentation; high out-of-pocket costs

Source: Goldie et al., 2005 ; Sankaranarayanan et al., 2009 ; Krishnan et al., 2015 ; Mehta et al., 2017.

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Health System Challenges

The Indian health system faces multiple structural and social barriers that hinder the effective prevention and management of cervical cancer.

- Infrastructure gaps: Many Primary Health Centres (PHCs) lack basic supplies such as speculums, acetic acid, Pap smear kits, and functional diagnostic equipment [13]. Without these essentials, routine screening cannot be delivered.
- Human resources: Community Health Officers (CHOs), who are central to the Ayushman Bharat Health and Wellness Centres, often lack adequate training, refresher courses, and supportive supervision to confidently conduct VIA or interpret results .[14]
- Sociocultural barriers: Deep-rooted stigma, fear of cancer diagnosis, and misconceptions around gynaecological health discourage women from attending screening. For many, modesty concerns and lack of female providers are additional deterrents [15]

Policy Framework and Global Alignment

India's efforts to control cervical cancer are embedded within the National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS) and the Ayushman Bharat Health and Wellness Centres, which integrate cancer screening into primary care. While these initiatives represent strong policy commitments, their translation into effective, community-level action remains inconsistent.

Globally, India's strategy must be aligned with the World Health Organization's Global Strategy (2020) to eliminate cervical cancer as a public health problem. The 90-70-90 targets provide a clear roadmap:

- 90% of girls fully vaccinated against HPV by age 15.
- 70% of women screened at least twice in their lifetime (at ages 35 and 45).
- 90% of women with precancer or invasive cancer receiving appropriate treatment.

For India, meeting these targets will require scaling up affordable HPV vaccination, expanding low-cost and sensitive screening methods, and ensuring timely treatment through strengthened referral pathways and expanded oncology services

Table 4: Key Barriers to Cervical Cancer Control in India

Barrier Category	Description	Impact on Screening/Management	References
Infrastructure	Many PHCs lack speculums, acetic acid, Pap smear kits, HPV testing facilities, and private exam rooms	Limited capacity for routine screening; weak diagnostic confirmation	Mehta et al., 2017; NCRP, 2020
Human Resources	Shortage of trained personnel; CHOs and frontline workers often lack adequate skills or supervision	Low confidence in conducting VIA/HPV testing; variable quality of services	Swaminathan et al., 2018; George et al., 2019
Sociocultural Factors	Stigma around reproductive health, fear of cancer diagnosis, modesty concerns, preference for female providers	Low participation in screening; late health-seeking behaviour	Varughese & Richman, 2010; Bansal et al., 2021
Economic Barriers	High out-of-pocket costs for treatment, transportation costs, income loss during hospital visits	Treatment delays; discontinuation of therapy; catastrophic health expenditure	Krishnan et al., 2015

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Systemic Challenges	Weak referral systems, lack of follow-up mechanisms, irregular supply chains	Missed opportunities for early treatment; fragmented care pathways	Dey et al., 2021; NFHS-5, 2021

Source: Varughese & Richman, 2010; Mehta et al., 2017; Swaminathan et al., 2018; George et al., 2019; Bansal et al., 2021; Dey et al., 2021; NFHS-5, 2021.

Conclusion

The literature highlights a striking paradox: cervical cancer is a disease that is both highly preventable and highly treatable, yet it continues to claim the lives of tens of thousands of Indian women every year. This reflects not a lack of scientific solutions, but rather systemic gaps in prevention, access, and delivery of care. Evidence shows that progress depends on four pillars: strengthening HPV vaccination programmes, expanding affordable screening through VIA and HPV DNA testing, ensuring timely and equitable treatment, and addressing persistent barriers in infrastructure and workforce capacity.

Equally important is the social dimension of cervical cancer. Stigma, fear, and silence around reproductive health continue to discourage women from seeking preventive services. Community awareness campaigns, engagement with local leaders, and empowerment of women to take charge of their health are critical to bridging this gap.

India is at a pivotal moment. With the availability of indigenous HPV vaccines, low-cost HPV DNA tests, and established national guidelines, the technical capacity to eliminate cervical cancer already exists. What is needed now is sustained political will, strategic investment, and strong partnerships with communities to translate these tools into real change on the ground. Aligning national efforts with the WHO's 90-70-90 elimination targets offers a clear pathway forward. If these strategies are implemented with urgency and inclusivity, India has the opportunity not only to reduce the cervical cancer burden dramatically but also to serve as a global model for eliminating this preventable disease.

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