



**INTERNATIONAL JOURNAL OF  
PHARMACEUTICAL SCIENCES**  
[ISSN: 0975-4725; CODEN(USA): IJPS00]  
Journal Homepage: <https://www.ijpsjournal.com>



## Review Paper

# A Review on Global HPV Vaccination Programs and Coverage Rates

Isha, Akash Deep, Akshay, Supriya, Ayush Dutta, Pooja Jamwal\*, Kavita Pathania

*Dreamz College of Pharmacy, Khilra, Sundernagar, Mandi (H.P.), 175036.*

## ARTICLE INFO

Published: 14 May 2026

### Keywords:

Cervical cancer, global health, HPV vaccination, human papillomavirus, next-generation vaccines

### DOI:

10.5281/zenodo.20180961

## ABSTRACT

Cervical cancer has been an important health issue of global concern which has almost universally been fuelled by the persistent infection of high-risk Human Papillomavirus (HPV). The most effective way of primary prevention is prophylactic HPV vaccination. The extensive real-world evidence obtained through national immunization programs throughout the world has given unambiguous evidence of the effect of the vaccine as a decline in the incidence of high-grade cervical pre-cancers and more importantly a reduction of risk of invasive cervical cancer (ICC) in cohorts vaccinated at a young age of adolescence. To achieve the elimination goals identified by World Health Organization (WHO) global efforts are progressively focusing on highly effective simplified strategies especially the introduction of a single-dose schedule, which is supported by long-term follow-up studies. The advent of the cheap locally produced vaccines and concomitant governmental promises in high-burden situations is a watershed turning point to overcome the historical obstacles of price and availability. The future research is aimed at next generation vaccines, such as broad spectrum L2 based vaccines and therapeutic platforms, which are likely to increase coverage and shorten logistics in distributing the vaccine, thus hastening the global initiative to end cervical cancer. This venture will only succeed with the help of the political will that is going to be maintained, the fair access, as well as the implementation of both primary and secondary preventive measures

## INTRODUCTION

One of the most prevalent malignancies in women is cervical cancer. Globally, women's cervical cancer incidence and mortality rank fourth, according to GLOBOCAN 2022 data. [1] Over 90% of cervical malignancies are linked to high-

risk human papillomavirus (hr HPV), which is a major contributing factor to the development of cervical precancerous lesions and cervical cancer<sup>[2-4]</sup> Cervical cancer can be successfully prevented by HPV vaccination<sup>[5-7]</sup> Many nations have progressively embraced the use of the HPV

**\*Corresponding Author:** Pooja Jamwal

**Address:** Department of Pharmacognosy, Dreamz College of Pharmacy, Khilra, Sunder Nagar, Mandi (H.P.) 175036

**Email** ✉: [poojaguleria.snr@gmail.com](mailto:poojaguleria.snr@gmail.com)

**Relevant conflicts of interest/financial disclosures:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



vaccine since it was first introduced in 2006. HPV vaccination is crucial for the eradication of cervical cancer, especially in low-income nations with a high disease burden and few cervical cancer screening and treatment programs. In 2020, the World Health Organization (WHO) proposed the "Global Strategy to Accelerate the Elimination of Cervical Cancer"<sup>[3,4]</sup>, committed by 194 countries. One of its main 2030 targets is to guarantee that 90% of girls have received the vaccination by the age of 15.<sup>[9]</sup> Tracking HPV vaccination coverage is essential for assessing the vaccine's efficacy and possible effects on associated illnesses. On the other hand, little is currently known about the rates of HPV vaccination worldwide. In order to provide evidence for future immunisation policy formulation, this study attempts to give a thorough overview of global HPV vaccination policies, analyse global HPV vaccination coverage rates, and look at the temporal trends of HPV vaccination coverage and incidence rates of cervical cancer in the female population in corresponding years.

The World Health Organization (WHO) has set ambitious goals to end cervical cancer worldwide. The 90–70–90 concept aims to vaccinate 90% of girls aged 15 by 2030, screen 70% of all women for high-grade lesions, and treat 90% of eligible cases.<sup>[5, 6]</sup> The development of next-generation vaccine technologies that boost coverage, streamline delivery, and become more accessible is necessary in order to achieve this elimination goal. On the one hand, it is necessary to overcome implementation challenges and expand the scale of application of already proven high-efficacy vaccines in geographic locations with the highest disease burden.<sup>[6]</sup>

### 1.1 Global Context: Efficacy and Broader Implementation

Prophylactic HPV vaccinations have had a significant real-world impact on public health

since they were added to national immunisation programs (NIPs). High-grade cervical disease (CIN2/3) vaccine-type protection in HPV-naive women was remarkably high over 90% (or high-grade protection), according to the first evidence backed by comprehensive randomised controlled trials (RCTs) utilising the quadrivalent vaccine<sup>[7]</sup>. Booster shots are not necessary in this situation because a follow-up longitudinal investigation of these cohorts has demonstrated a continuum of protection of at least 10–14 years<sup>[8]</sup>.

### 1.2 Real-World Impact and Herd Immunity

Reductions of a factor of two to three in the prevalence of vaccine-type HPV infections, genital warts, and high-grade cervical lesions have been observed following the deployment of NIP in Australia, the UK, and Sweden<sup>[9]</sup>. Lei *et al.* conducted the first population-based linkage analysis in Sweden. (2020) discovered a statistically significant decrease in invasive cervical cancer, especially in girls immunised prior to the age of 17, with a risk reduction of 63% when compared to those who were not vaccinated<sup>[10]</sup>. Immunisation strategies are crucial for teenagers, as evidenced by the fact that this protective effect was further enhanced in vaccinated individuals who had been immunised before the age of 17, with an 88% lower risk<sup>[10, 11]</sup>. Similarly, Palmer *et al.* (2019) presented monitoring data from the UK that demonstrated nearly total eradication of precancerous lesions and cervical cancer in women who received vaccinations between the ages of 12 and 13<sup>[11, 12]</sup>. Statistics demonstrate that populations that achieve a high level of coverage also acquire herd immunity in addition to personal protection. Gender-neutral, high-coverage programs clearly benefit individuals in this age group, as evidenced by the synthesis of Australian and US studies by Drolet *et al.* (2015), which shows that HPV prevalence and genital warts are

significantly reduced in unvaccinated older women and males [12].

### 1.3 STREAMLINED DOSING SCHEDULES

Simplifying the dosing schedule is one of the most significant adjustments that support the worldwide scale-up. In low- and middle-income settings, the initial WHO recommendation of a three-dosage regimen caused substantial logistical challenges. WHO changed its guidelines to suggest a one- or two-dose regimen in the major target group of girls aged 9–14 years due to trial results on immunogenicity and efficacy, most notably the IARC India study [13, 14].

The effectiveness of a single vaccination dose is confirmed by long-term follow-up research. For instance, the quadrivalent vaccine can provide the same level of long-term protection against persistent HPV-16/18 infection with a single dose as two to three doses over a 10-year period, according to the Joshi et al. (2023) experiment conducted in India [14–16]. Adopting a single-dose regimen can help improve coverage in high-burden areas by saving a substantial amount of money, streamlining the supply chain, and facilitating delivery and monitoring [15, 17]. Despite an overwhelming amount of information regarding safety and efficacy, the coverage of the world is still not uniform.

At least 144 countries have included the HPV vaccine in their NIPs by the end of 2024, but as of 2023, the first dose coverage rate for females aged 9 to 14 was anticipated to be 27%. This is a significant disparity, particularly in LMICs [16].

### 1.4 Indian Context: Burden, Barriers, and Breakthroughs

With over 125,000 new cases and 75,000 deaths annually, India has one of the highest rates of cervical cancer worldwide, accounting for one-fifth of the global burden [17]. About 80% of cervical malignancies in India are caused by HPV

16 and 18, according to Sankaranarayanan et al. (2012), underscoring the importance of the current bivalent and quadrivalent vaccines to the epidemiological profile of the nation [18].

### 1.5 The Implementation Is Also a Problem That Is Difficult to Handle

When it comes to its implementation, the HPV vaccine has previously encountered significant difficulties in India. [19]

- **Cost and Accessibility:** Due to the recent reliance on imported vaccinations, the immunisation is now too costly for the majority of people, restricting its use to the private sector. [20]

- **Hesitancy and Controversy:** In 2009, a pilot demonstration project in two states was halted because of controversy and a number of premature deaths of girls. Later, scientific studies revealed that the vaccination had nothing to do with these deaths [21]. However, the general public became hesitant and suspicious about vaccines as a result of this incident, according to Gupta et al. (2019), who found that misinformation and fear of side effects were the main obstacles to adopting [22].

- **Awareness and Stigma:** Research on knowledge, attitudes, and practices (KAP), such as that conducted by Arora *et al.* (2025), revealed that adult women had little understanding of the connection between HPV, vaccination, and cervical cancer [23]. Additionally, the vaccine's link to an STD causes social and religious stigma, which makes it difficult to gain community acceptance and parental agreement, particularly in school-based programs [24].

- **Absence of National Program:** In contrast to the majority of high-income countries, India has not created a publically sponsored, universal National Immunisation Program (NIP) to ensure HPV vaccination, severely restricting widespread coverage [25].

## 1.6 Simplifying the Production and Delivery of Vaccines

In addition to being challenging to manufacture, the new VLP-based vaccines are costly to create because they require cell culture-based systems (such as yeast or insect cells) to express proteins and assemble themselves [26].

- Other Expression Systems: Research is being done to create more affordable and scalable expression systems. For instance, some bivalent vaccines employ *Pichia pastoris* or *E. coli* expression, as shown in the formulation of several Chinese-made vaccines, which is cost-effective and time-efficient [27].

- Thermostable and Non-Refrigerated Vaccines: The cold chain is a significant logistical issue in low- and middle-income nations. Thermostable next-generation vaccines are being developed, and they may be delivered via patch or dry powder, which will eliminate the need for refrigeration and greatly improve distribution in rural and isolated locations [28].

- Nucleic Acid Based Vaccines: The COVID-19 pandemic is being investigated in HPV, which was once groundbreaking in mRNA and DNA-based systems [29]. Compared to VLP-based vaccinations, these technologies are easier to produce and may be rapidly adapted to new HPV strains [30]. Although prophylaxis application is still in its early stages, the mRNA technology has a highly attractive rapid scaling, and there is significant promise for its wide applicability when it comes to a universal deployment [31].

## 1.7 Therapeutic HPV Vaccines

The next generation of vaccinations, known as oncolytic vaccines, are designed to both detect precancerous or cancerous lesions and eradicate established diseases [32].

- Immune Stimulation: Therapeutic vaccines, which are usually based on peptides, proteins, or nucleic acids, are intended to elicit a potent

specific cytotoxic T-lymphocyte (CTL) response in tumor cells that express E6/E7 [33]. According to preclinical research examined by Kaufman et al. (2020), certain E6/E7 targeting vaccines can elicit particular T-cell immunity and result in clinical responses in individuals with invasive cancer or high-grade precancerous lesions (CIN 2/3) [34].

- Combination Therapeutics: In order to boost the anti-tumor immune response, the most promising future path for therapeutic vaccines will be their combination with immune checkpoint inhibitors or traditional oncological modalities [35].

## DISCUSSION

The information that is currently available unequivocally shows that the HPV vaccination has a significant impact on both the population and the health of individuals, reaffirming its position as the most effective method of preventing cervical cancer. The Cochrane reviews (2025) and Lei *et al.* (2020) findings of long-term follow-up in Nordic countries shift the debate from potential efficacy to demonstrated effectiveness in reducing invasive cervical cancer among vaccine-based cohorts [8, 11]. Adolescent school-based programs should be the main focus worldwide due to the narrow dose response curve and the significant reduction in risks associated with vaccination at a younger age.

## CONCLUSION

A significant advancement in preventive medicine, the prophylactic HPV vaccine has been shown to significantly reduce the incidence of invasive cervical cancer and precancer. An essential and evidence-based strategy for overcoming budgetary and logistical challenges in high-burden settings on a global scale is the single-dose schedule. The duty to produce vaccines domestically also aids in resolving the fundamental problems of supply and cost.



Although next-generation vaccines would provide a broader coverage and enable delivery in a more straightforward manner, the WHO's elimination goals will only be achieved with persistent political will, equal access, and the combination of high-coverage vaccination with efficient screening program technologies. The essential elements that determine the success of the process of reducing the incidence of cervical cancer and its absence in the globe are population education to overcome the lack of will and the equity of the use of present and future vaccine technologies. HPV Immunisation: Expanded Use and Creation of Next-Generation Vaccines.

## REFERENCES

1. International Agency for Research on Cancer Global Cancer Observatory: Cervical Cancer Fact Sheet(2022) <https://gco.iarc.fr/today/data/factsheets/cancers/23-Cervix-uteri-fact-sheet.pdf>
2. World Health Organization Human papillomavirus (HPV) and cervical cancer [https://www.who.int/news-room/factsheets/detail/human-papillomavirus-\(hpv\)-and-cervical-cancer](https://www.who.int/news-room/factsheets/detail/human-papillomavirus-(hpv)-and-cervical-cancer)
3. The Lancet Oncology Walboomers JM et al. (1999). "Human papillomavirus is a necessary cause of invasive cervical cancer worldwide." <https://pubmed.ncbi.nlm.nih.gov/10052454/>
4. The Lancet Drolet M et al. (2019). Population-level impact and herd effects following HPV vaccination <https://pubmed.ncbi.nlm.nih.gov/31400477/>
5. World Health Organization Global strategy to accelerate the elimination of cervical cancer (2020) <https://www.who.int/publications/i/item/9789240014107>
4. Nature Reviews Disease Primers Arbyn M et al. (2020). Estimates of incidence and mortality of cervical cancer <https://www.nature.com/articles/s41572-020-00218-0>
5. UNICEF Immunization coverage data (HPV) <https://data.unicef.org/topic/child-health/immunization/>
6. The Lancet Global Health Bruni L et al. (2021). Global estimates of HPV vaccination coverage <https://pubmed.ncbi.nlm.nih.gov/33640069/>
7. The Lancet Infectious Diseases Garland SM et al. (2016). Impact and effectiveness of the quadrivalent HPV vaccine: a systematic review of 10 years of real-world experience <https://pubmed.ncbi.nlm.nih.gov/27339493/>
8. 10. New England Journal of Medicine Lei J et al. (2020). HPV Vaccination and the Risk of Invasive Cervical Cancer <https://www.nejm.org/doi/full/10.1056/NEJMoa1917338>
9. 11. The Lancet Falcaro M et al. (2021). The effects of the national HPV vaccination programme in England <https://pubmed.ncbi.nlm.nih.gov/34741816/>
10. 12. The BMJ Palmer T et al. (2019). Prevalence of cervical disease at age 20 after immunisation with bivalent HPV vaccine <https://www.bmj.com/content/365/bmj.l11161>
11. World Health Organization WHO updates recommendations on HPV vaccination schedule (2022) <https://www.who.int/news/item/20-12-2022-WHO-updates-recommendations-on-HPV-vaccination-schedule>
12. The Lancet Oncology Basu P et al. (2021/updated analyses). Efficacy of single-dose HPV vaccination in India <https://pubmed.ncbi.nlm.nih.gov/33845044/>
13. 15. The Lancet Global Health Joshi S et al. (2023). Single-dose HPV vaccine protection against persistent infection <https://pubmed.ncbi.nlm.nih.gov/37669806/>



14. International Agency for Research on Cancer Global Cancer Observatory (GLOBOCAN 2022 – India factsheet) <https://gco.iarc.fr/today/data/factsheets/populations/356-india-fact-sheets.pdf>
15. 17. The Lancet Oncology Sankaranarayanan R et al. (2012). HPV screening for cervical cancer in rural India <https://pubmed.ncbi.nlm.nih.gov/22901819/>
16. World Health Organization HPV and cervical cancer fact sheet [https://www.who.int/news-room/fact-sheets/detail/human-papillomavirus-\(hpv\)-and-cervical-cancer](https://www.who.int/news-room/fact-sheets/detail/human-papillomavirus-(hpv)-and-cervical-cancer)
17. Human Vaccines & Immuno therapeutics Gupta P et al. (2019). HPV vaccine acceptance in India <https://pubmed.ncbi.nlm.nih.gov/30714905/>
18. 20. BMC Public Health Perlman S et al. (2014). Knowledge and attitudes about HPV vaccination globally <https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-14-363>
19. Vaccine Qiao YL et al. Development of HPV vaccines in China <https://pubmed.ncbi.nlm.nih.gov/30878293/>
20. Lancet Oncology Trimble CL et al. (2015). Safety, efficacy, and immunogenicity of VGX-3100 therapeutic DNA vaccine <https://pubmed.ncbi.nlm.nih.gov/26008750/>
21. 23. Nature Reviews Immunology Ott PA et al. (2020). Combination immunotherapy: vaccines and checkpoint blockade <https://www.nature.com/articles/s41577-020-0301-5>
22. Journal of Clinical Oncology Combination of HPV therapeutic vaccines with immunotherapy
23. New England Journal of Medicine – Swedish cohort (Lei et al., 2020)
24. <https://www.nejm.org/doi/full/10.1056/NEJMoa1917338>
25. 26. The BMJ – UK HPV impact study (Falcaro et al., 2021)
26. <https://www.bmj.com/content/372/bmj.n256>
27. 27. The Lancet Infectious Diseases – Herd immunity (Drolet et al., 2015)
28. [https://www.thelancet.com/journals/laninf/article/PIIS1473-3099\(15\)00298-4/fulltext](https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(15)00298-4/fulltext)
29. 28. Single-dose HPV vaccine evidence (2024)
30. <https://pubmed.ncbi.nlm.nih.gov/39521566/>
31. 29. Systematic review of single-dose efficacy (2024)
32. <https://www.sciencedirect.com/science/article/pii/S2590136224000597>
33. 30. Clinical effectiveness of single-dose HPV vaccination (2024)
34. <https://pubmed.ncbi.nlm.nih.gov/39339988/>
35. 31. Updated review on HPV single-dose vaccination (2024)
36. <https://pubmed.ncbi.nlm.nih.gov/39529520/>
37. 32. IARC cohort study (India, 12–15 year follow-up)
38. <https://www.iarc.who.int/news-events/a-prospective-cohort-study-comparing-efficacy-of-1-dose-of-quadrivalent-human-papillomavirus-vaccine-to-2-and-3-doses-at-an-average-follow-up-of-12-years-postvaccination/>
39. 33. IARC press release on single-dose HPV (2024)
40. <https://www.iarc.who.int/pressrelease/new-research-highlights-the-potential-of-single-dose-hpv-vaccination-to-advance-cervical-cancer-prevention-in-low-resource-settings/>
41. 34. IARC evidence summary: single-dose protection (2023)
42. <https://www.iarc.who.int/news-events/new-hpv-vaccines-and-fewer-doses-promising-recent-developments-towards-eliminating-cervical-cancer-iarc-evidence-summary-brief-no-4/>



43. 35. HPV vaccination scale-up in GAVI-supported countries (2026)
44. <https://www.sciencedirect.com/science/article/abs/pii/S0264410X25014859>

**HOW TO CITE:** Isha, Akash Deep, Akshay, Supriya, Ayush Dutta, Pooja Jamwal, Kavita Pathania, A Review on Global HPV Vaccination Programs and Coverage Rates, *Int. J. of Pharm. Sci.*, 2026, Vol 4, Issue 5, 3501-3507, <https://doi.org/10.5281/zenodo.20180961>

