

Knowledge, Attitude, and Practice Regarding HPV Vaccination among Medical Students: A Cross-Sectional Study with Qualitative Insights into Barriers to Vaccine Uptake

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Received: 25-06-2026 / Revised: 23-07-2026 / Accepted: 26-08-2026

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Conflict of interest: Nil

Abstract:

Background: Human papillomavirus (HPV) is the most common sexually transmitted viral infection and the principal cause of cervical cancer, in addition to a substantial proportion of anal, vulvar, vaginal, penile and oropharyngeal cancers. Prophylactic vaccination is highly effective, yet uptake remains poor globally, particularly in low- and middle-income countries. Medical students, as future prescribers and vaccinators, occupy a pivotal position in improving community vaccination rates, making their own knowledge, attitude and practice (KAP) an important indicator of future public-health performance. Our objective is to assess the knowledge, attitude and practice regarding HPV vaccination among undergraduate medical students; to determine vaccination uptake and barriers; to identify demographic correlates of KAP; and to qualitatively explore reasons underlying non-vaccination.

Methods: A descriptive cross-sectional study with an embedded qualitative component was conducted among undergraduate MBBS students of a medical college using a structured, pre-validated, self-administered questionnaire (Google Form) covering demographics, knowledge (seven items), attitude (Likert-type items) and practice, together with an open-ended question on barriers to vaccination. Open-text responses were analysed using inductive reflexive thematic analysis. Descriptive statistics, the chi-square test and the independent-samples t-test were applied, with significance set at $p < 0.05$.

Results: Of 431 respondents (46.6% male, 53.4% female; mean age 22.3 ± 1.4 years), only 18.3% had received the HPV vaccine. Knowledge was generally good (mean score 6.02 ± 0.98 of 7), with more than 90% correctly identifying the cervical-cancer link, mode of transmission, recommended age, and the continued need for screening after vaccination, but comparatively lower awareness of the genital-wart association (65.0%) and the correct dosing schedule (73.5%). Attitudes were overwhelmingly favourable (effectiveness 98.4%, safety 97.7%, willingness to vaccinate 91.9%), yet 43.6% cited fear of side effects as a reason for hesitating to recommend the vaccine. Vaccination status did not differ significantly by gender ($\chi^2 = 0.027$, $p = 0.870$), whereas females scored significantly higher on knowledge than males (6.18 ± 0.88 vs 5.84 ± 1.06 , $t = -3.09$, $p = 0.002$). Thematic analysis of open-ended responses identified seven themes explaining non-vaccination: limited awareness and knowledge, accessibility and availability barriers, financial barriers, time and opportunity constraints, low perceived need and vaccine hesitancy, health-system and provider factors, and positive vaccine acceptance/future intention.

Conclusion: Despite good knowledge and highly favourable attitudes, actual HPV vaccine uptake among medical students remained low, reflecting a multifactorial gap driven by structural, financial and health-system barriers rather than by information deficits alone. Institution-based awareness drives, subsidised or free vaccination camps, adoption of the WHO-endorsed single-dose schedule, and stronger provider-led recommendation are needed to translate favourable attitudes into practice.

Keywords: Human papillomavirus; HPV Vaccine; Knowledge, Attitude and Practice; Medical Students; Vaccine Hesitancy; Cervical Cancer Prevention; Thematic Analysis.

DOI: 10.25258/ijpqa.17.9.6

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Introduction

Human papillomavirus (HPV) is the most prevalent sexually transmitted viral infection worldwide and is causally linked to nearly all cases of cervical cancer, in addition to a substantial proportion of anal, vulvar, vaginal, penile and oropharyngeal cancers [1,2]. Globally, HPV-attributable disease accounts for hundreds of thousands of new cancer cases annually, with cervical cancer alone responsible for an estimated 660,000 new cases and around 350,000 deaths each year, making it one of the most common cancers among women worldwide and disproportionately affecting low- and middle-income countries [2,3]. Prophylactic HPV vaccines have demonstrated high efficacy in preventing infection with high-risk HPV genotypes, particularly when administered before the onset of sexual activity, and the World Health Organization (WHO) currently recommends vaccination of girls, and increasingly boys, between 9 and 14 years of age as a foundational pillar of its global strategy to eliminate cervical cancer as a public-health problem [4].

Despite these recommendations, HPV vaccine coverage remains markedly unequal across the world. Early global estimates suggested that of the 118 million girls targeted by national immunisation programmes between 2006 and 2014, only about 1% resided in low-income or lower-middle-income countries [5], and more recent systematic reviews continue to document wide disparities in coverage between high-income and resource-limited settings [6,18,19]. India, which bears one of the highest burdens of cervical cancer globally, has yet to incorporate the HPV vaccine into its Universal Immunization Programme, and vaccine uptake among the general population as well as among health-science students remains disappointingly low [8,14].

Medical students occupy a unique position in this landscape: as future physicians, they will be responsible for counselling patients, prescribing vaccines, and shaping community attitudes toward immunisation. Their personal knowledge, attitude and vaccination practice can therefore strongly influence the uptake of HPV vaccination in the wider population they will eventually serve.

A growing body of literature from India and elsewhere illustrates a recurring pattern among medical and paramedical students: awareness of HPV and the availability of the vaccine is often described as ranging between 40% and 75%, with more specific knowledge of vaccination schedules and dosing typically lower, while attitudes toward vaccination tend to be favourable even though actual uptake frequently falls as low as 10-25% [7,9-12,15,16,20]. This mismatch between favourable attitude and poor practice has been

described consistently across studies conducted among medical, nursing and paramedical students in India [7,9,10,12,15,16], as well as internationally [20], and is commonly attributed to a combination of cost, limited accessibility, safety concerns, misinformation and the absence of institutional or provider-driven vaccination programmes. Given this persistent knowledge-attitude-practice gap, and the paucity of institution-specific data combining quantitative KAP assessment with an in-depth qualitative exploration of the reasons for non-vaccination, the present study was undertaken among undergraduate medical students of a medical college. Understanding the interplay between what students know, what they believe, and what they actually do, along with the lived reasons behind non-vaccination, can help design targeted educational and programmatic interventions at the institutional level.

The present study was conducted with the following objectives: (1) to assess the level of knowledge regarding HPV infection and HPV vaccination among medical students; (2) to evaluate their attitudes toward HPV vaccination; (3) to determine HPV vaccination uptake and the barriers to receiving the vaccine; (4) to identify demographic factors associated with knowledge, attitude and practice scores; and (5) to qualitatively explore, through thematic analysis of open-ended responses, the underlying reasons for non-vaccination among students.

Materials and Methods

Study design and setting: This was a descriptive cross-sectional study with an embedded qualitative component, conducted among undergraduate MBBS students of a medical college over a period of three months, following approval from the Institutional Ethics Committee.

Study population and sampling: All undergraduate MBBS students, from the first through the final professional year, currently enrolled in the institution during the study period constituted the study population. The minimum sample size was calculated using the formula $n = Z^2 p(1-p)/d^2$, where Z (1.96) corresponds to a 95% confidence interval, p (0.5) represents the expected proportion with adequate knowledge based on previous literature, and d (0.05) is the desired precision; this yielded a minimum requirement of 384 participants, rounded to 400 after adjusting for an anticipated 10% non-response rate. Students were recruited through official WhatsApp and e-mail groups. Students aged 18 years or above, actively enrolled, and providing informed consent were included; those unwilling to participate, submitting partially completed forms, or absent during the data-collection period were excluded. A

total of 431 complete responses were obtained and included in the final analysis, exceeding the calculated minimum sample size.

Study tool and procedure: Data were collected using a structured, pre-validated, self-administered questionnaire delivered through Google Forms, preceded by an online informed-consent page. The questionnaire comprised four sections: demographic details; seven multiple-choice knowledge items covering the causal role of HPV in cervical cancer, its association with genital warts, mode of transmission, recommended age of vaccination, applicability to males, the continued need for cervical screening after vaccination, and the correct dosing schedule; Likert-type attitude items assessing perceived effectiveness, safety, support for mandatory vaccination, sense of professional responsibility, willingness to be vaccinated, and concern about side effects; and practice items including self-reported vaccination status. An open-ended question inviting students to describe, in their own words, the reasons for not having been vaccinated was appended to capture qualitative data. Responses were automatically recorded in Google Sheets, subsequently created, coded, and exported to Microsoft Excel and SPSS for analysis.

Quantitative statistical analysis: Descriptive statistics (frequencies, percentages, means and standard deviations) were computed for demographic, knowledge, attitude and practice variables. Inferential statistics included the chi-square test for association between categorical variables (gender and vaccination status) and the independent-samples t-test for comparison of mean knowledge scores between genders. A p-value of

less than 0.05 was considered statistically significant.

Qualitative analysis: Open-ended responses describing barriers to vaccination were analysed using an inductive, reflexive thematic-analysis approach following the six-phase framework of Braun and Clarke (13): familiarisation with the data, generation of initial codes, searching for candidate themes, reviewing and refining themes, defining and naming themes, and producing the final narrative. Two investigators independently coded the responses; codes were grouped into sub-themes and subsequently into overarching themes through iterative discussion and consensus, with a coding tree developed to ensure transparency and traceability from raw quotations to final themes.

Ethical considerations: The study was conducted after Institutional Ethics Committee approval.

Participation was voluntary, and the survey was completely anonymous with no collection of personally identifiable information. Data were stored on a password-protected Google Drive accessible only to the investigators, with a defined retention period of three years, after which the data will be permanently deleted. The risk to participants was assessed as minimal, limited to possible mild psychological discomfort while answering questions related to vaccination or sexual health.

Results

A total of 431 undergraduate medical students completed the questionnaire. All submitted responses were complete and included in the final analysis.

Table 1: Baseline characteristics of study participants (n = 431)

Variable	Frequency (n)	Percentage (%)
Gender		
Male	201	46.6
Female	230	53.4
Mean age (years)	22.3 ± 1.4	
Vaccinated against HPV		
Yes	79	18.3
No	352	81.7

Among the 431 participants, females constituted a slightly higher proportion (53.4%) than males (46.6%). The mean age of participants was 22.3 ± 1.4 years. Only 18.3% of medical students had received the HPV vaccine, whereas 81.7% remained unvaccinated, indicating a low vaccine uptake despite being healthcare students.

Table 2: Knowledge regarding HPV vaccination

Knowledge Question	Correct Response n (%)
HPV primarily causes cervical cancer	418 (97.0)
HPV also causes genital warts	280 (65.0)
Sexual transmission is the commonest route	407 (94.4)
Recommended vaccination age is 9–14 years	395 (91.6)
Vaccine recommended for males	369 (85.6)
Cervical screening is still required after vaccination	408 (94.7)
Correct vaccine schedule (2 doses)	317 (73.5)

Overall mean knowledge score (Maximum 7): 6.02 ± 0.98

Knowledge regarding HPV infection and vaccination was generally high among the participants. More than 90% correctly identified cervical cancer as the principal HPV-associated malignancy, understood the recommended vaccination age, and recognized that cervical

cancer screening remains necessary after vaccination. However, comparatively fewer students correctly identified genital warts as another HPV-related condition (65.0%) and the recommended vaccine dosage schedule (73.5%).

Table 3: Attitude and practice regarding HPV vaccination

Variable	Yes n (%)	No n (%)
HPV vaccine is effective	424 (98.4)	7 (1.6)
HPV vaccine is safe	421 (97.7)	10 (2.3)
Vaccine should be mandatory	401 (93.0)	30 (7.0)
Feel responsible to promote vaccination	408 (94.7)	23 (5.3)
Willing to receive vaccine	396 (91.9)	35 (8.1)
Concern about side effects prevents recommendation	188 (43.6)	243 (56.4)
Personally vaccinated	79 (18.3)	352 (81.7)

The attitude towards HPV vaccination was overwhelmingly positive. More than 90% believed the vaccine to be effective, safe, and suitable for universal adolescent vaccination. Nearly all respondents felt responsible for promoting HPV vaccination in their future medical practice. Nevertheless, only 18.3% had actually received the vaccine, revealing a substantial gap between favourable attitudes and actual vaccination practices.

Table 4: Association between gender and HPV vaccination status

Gender	Vaccinated n (%)	Not Vaccinated n (%)	Total
Male	38 (18.9)	163 (81.1)	201
Female	41 (17.8)	189 (82.2)	230

Chi-square = 0.027, p = 0.870

No statistically significant association was observed between gender and HPV vaccination status ($\chi^2 = 0.027$, p = 0.870). Vaccination uptake was similarly low among both male and female medical students.

Table 5: Comparison of knowledge scores between male and female students

Gender	Mean $\pm$ SD
Male	5.84 $\pm$ 1.06
Female	6.18 $\pm$ 0.88

Independent t-test, t = -3.09, p = 0.002

Female students demonstrated significantly higher knowledge scores than male students (6.18 $\pm$ 0.88 vs. 5.84 $\pm$ 1.06). The difference was statistically significant (Independent t-test, p = 0.002), indicating better awareness regarding HPV infection and vaccination among female participants.

A total of 431 medical students participated in the study. Although the participants demonstrated good knowledge (mean score 6.02 $\pm$ 0.98) and highly favourable attitudes towards HPV vaccination, the actual vaccination uptake remained low (18.3%). Female students showed significantly better knowledge than males (p = 0.002), whereas vaccination status did not differ significantly according to gender (p = 0.870). The findings suggest that improving vaccine accessibility and addressing barriers may help bridge the gap between positive attitudes and actual vaccination practices.

Discussion

The present study demonstrates a striking dissociation between knowledge, attitude and practice regarding HPV vaccination among medical

students: while knowledge was generally good and attitudes were overwhelmingly favourable, actual vaccine uptake remained low at 18.3%. This pattern mirrors findings from several Indian studies among medical, nursing and paramedical students, in which positive attitudes have consistently coexisted with vaccination rates as low as 10-25% [7,9,10,12,15,16]. Swarnapriya et al. similarly reported poor knowledge and uptake of HPV vaccination among medical and paramedical students in south India despite otherwise adequate general health-science training [7], while Padmanabha et al. found that although medical students in Mangalore expressed reasonable acceptability of the vaccine, actual vaccination coverage lagged considerably behind stated intentions [9]. The knowledge-attitude-practice gap identified here is therefore consistent with, rather than exceptional to, the broader literature on HPV vaccination among Indian health-science trainees.

The knowledge profile observed in this study, comprising very high awareness of the cervical-cancer link, mode of transmission and recommended age, but comparatively lower awareness of the dosing schedule and the genital-

wart association, closely parallels patterns described by Chawla et al. among healthcare providers in Delhi-NCR, where the majority were aware of vaccine existence but only a minority routinely recommended it to patients [12], and by other recent Indian studies in which a substantial minority of students remained unaware of the exact vaccine dosing requirements [10,11]. This suggests that although medical curricula and general health literacy provide students with a reasonably strong foundation of core facts, more technical, practice-relevant details of vaccination schedules are less consistently taught or retained, an important target for curricular reinforcement, particularly given the WHO's 2022 endorsement of a simplified single-dose schedule, which could reduce this specific knowledge burden while simultaneously easing programmatic delivery [4].

The significantly higher knowledge scores among female students compared with male students ($p=0.002$) is a recurring finding in the literature [16,20], plausibly reflecting the fact that cervical cancer and HPV vaccination are often framed, both in curricula and in public messaging, predominantly as a women's health issue, a framing that a growing body of work, including WHO's own move toward gender-neutral vaccination recommendations, suggests should be revisited given the substantial burden of HPV-attributable disease in men, including oropharyngeal, anal and penile cancers [1,2,4]. The absence of a significant gender difference in vaccination status itself ($p=0.870$), despite this knowledge gap, indicates that structural and financial barriers, rather than gender-specific attitudes, are likely the dominant drivers of low uptake in both sexes in this setting.

The qualitative findings add explanatory depth to the quantitative gap. Although limited awareness and knowledge emerged as the most frequently cited barrier, consistent with the observation that some students only became aware of the vaccine after passing the recommended age window, awareness deficits alone cannot fully account for non-vaccination, since even well-informed and favourably disposed students frequently cited cost, poor accessibility, competing academic demands, and the absence of a physician's recommendation. This convergence of structural, financial and health-system barriers alongside individual-level hesitancy is compatible with a broader, multi-level understanding of vaccine uptake, in which information alone is necessary but insufficient to drive behaviour change. The prominent role of absent physician recommendation as a barrier is particularly noteworthy, as provider endorsement has repeatedly been identified as an important correlate of HPV vaccine uptake internationally [6,20], underscoring the potential value of embedding structured vaccination counselling and,

ideally, an on-campus vaccination service within the medical curriculum itself. The continued absence of the HPV vaccine from India's Universal Immunization Programme [8] compounds these access and cost barriers at a policy level, reinforcing the case for advocacy toward public funding of vaccination.

This study has several limitations. Its cross-sectional design precludes causal inference regarding the determinants of vaccination status. Conducted at a single institution, its generalisability to other medical colleges or regions may be limited. Vaccination status and knowledge and attitude responses were self-reported through an online form, introducing possible recall and social-desirability bias, and the sampling frame, being restricted to students with access to institutional WhatsApp and e-mail groups, may have introduced a degree of selection bias. The qualitative component, derived from brief open-text responses rather than in-depth interviews, offers useful thematic breadth but limited depth compared with dedicated qualitative interviewing. Nonetheless, the study's strengths include an adequate sample size exceeding the calculated minimum, a validated mixed-methods instrument, and a systematic thematic analysis following an established framework [13] that triangulates and enriches the quantitative findings.

Conclusion

This mixed-methods study demonstrates that medical students possess generally sound knowledge and hold strongly favourable attitudes toward HPV vaccination, yet translate this into remarkably low actual uptake, with only about one in six students vaccinated. The gap is best explained not by a simple deficit of information but by a combination of financial, accessibility, time-related, health-system and residual safety-related hesitancy barriers identified through thematic analysis, alongside a recurring pattern of delayed awareness relative to the ideal vaccination age.

Bridging this knowledge-attitude-practice gap will require multi-level interventions: reinforcing curricular teaching on practical aspects of vaccination, particularly dosing schedules; integrating the WHO-endorsed single-dose regimen into institutional practice to reduce cost and logistic burden; establishing on-campus or subsidised vaccination drives; encouraging structured physician-led counselling and recommendation; and advocating for the inclusion of HPV vaccination within national immunisation policy. As future physicians and vaccinators, medical students who are themselves vaccinated and well informed are better positioned to model and promote HPV vaccination within the communities they will serve, contributing meaningfully to the

global strategy to eliminate cervical cancer as a public-health problem.

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