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Knowledge, Attitudes, and Vaccine Advocacy Preparedness Regarding Human Papillomavirus (HPV) Vaccination among Medical Students: A Cross-Sectional Study

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Abstract

Background: Human papillomavirus (HPV) is a major cause of cervical and non-cervical cancers. Medical students are future frontline healthcare professionals, and their knowledge, personal vaccination practices, and confidence in counselling may influence vaccine advocacy.

Objectives: To assess HPV-related knowledge, personal vaccination status, attitudes, and preparedness to counsel vaccine-hesitant patients among medical students at a tertiary teaching institution, and to examine factors associated with high HPV knowledge.

Methods: An institutional cross-sectional study was conducted among medical students at Surabhi Institute of Medical Sciences, Siddipet, Telangana, between February and August 2026. The sampling frame comprised 580 students, from Phase I MBBS through clinical internship; the minimum required sample was 232 using Cochran's formula with finite population correction. A 35-item questionnaire, adapted from earlier instruments and pilot-tested, assessed knowledge (15 items), attitudes and health beliefs (10 items), and advocacy preparedness and perceived barriers (5 items). A knowledge score of at least 80% (12 or more of 15) was defined as high knowledge. Data were analysed using chi-square tests and binary logistic regression.

Results: Of 580 eligible students, 520 provided valid responses (89.7%). Most (93.1%) correctly identified sexual contact as the main route of HPV transmission, but only 48.8% knew that HPV causes non-cervical cancers and 54.2% knew that vaccination is recommended for both sexes. The mean knowledge score was 9.1 ± 2.7 out of 15, and 164 students (31.5%; 95% CI 27.7–35.7) had high knowledge. Clinical-phase students (adjusted OR 3.64, 95% CI 2.32–5.71, $p < 0.001$) and vaccinated students (adjusted OR 2.45, 95% CI 1.56–

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3.84, p < 0.001) had higher odds of high knowledge. Personal vaccine uptake was 24.6%; 57.1% cited cost as the main barrier and 64.4% felt unprepared to counsel vaccine-hesitant patients.
Conclusions: Attitudes towards HPV vaccination were positive, but important knowledge gaps remained regarding male vaccination and non-cervical cancers, and most students felt unprepared to counsel vaccine-hesitant patients. These findings support consideration of strengthened vaccinology and communication-skills training in the curriculum, together with improved access to vaccination.

Keywords: Human Papillomavirus, HPV Vaccination, Medical Students, Vaccine Confidence, Health Education

What Is Already Known and What This Study Adds

What is already known	What this study adds
Indian medical students show gaps in HPV knowledge and low personal vaccine uptake, and provider recommendation strongly influences vaccination.	Across the assessed training phases, only 31.5% had high knowledge; gaps were largest for non-cervical cancers and male vaccination, and 64.4% felt unprepared to counsel vaccine-hesitant patients.

1. Introduction

Human papillomavirus (HPV) is the most common sexually transmitted viral infection worldwide. It is responsible for virtually all cervical cancers and for a substantial proportion of oropharyngeal, anal, penile, vaginal, and vulvar cancers [1,2]. Prophylactic vaccines are highly efficacious, yet coverage in many regions remains well below the World Health Organization target of 90% of girls fully vaccinated by age 15 because of vaccine hesitancy, limited awareness, and cost [1,3–5].

Physicians are a primary source of vaccine counselling for patients and guardians, and a clear provider recommendation is consistently among the strongest influences on vaccine uptake [6]. Medical students will become these providers; their own vaccination status, factual understanding, and communication skills may therefore shape preventive oncology and vaccine confidence in the community.

Studies among Indian college and medical students have described gaps in HPV knowledge and low vaccine uptake [7–14], and similar patterns have been reported internationally [15,16]. Educational interventions have been associated with improved knowledge among health-science students [17]. However, evidence on HPV knowledge, personal vaccination, and preparedness to counsel vaccine-hesitant patients across the stages of undergraduate medical training remains limited. This study therefore assessed these domains among medical students at a tertiary teaching institution and examined factors associated with high HPV knowledge.

2. Methods

2.1 Study design and setting

An institutional cross-sectional survey was conducted at Surabhi Institute of Medical Sciences, Siddipet, Telangana, from February to August 2026, after approval by the Institutional Ethics Committee.

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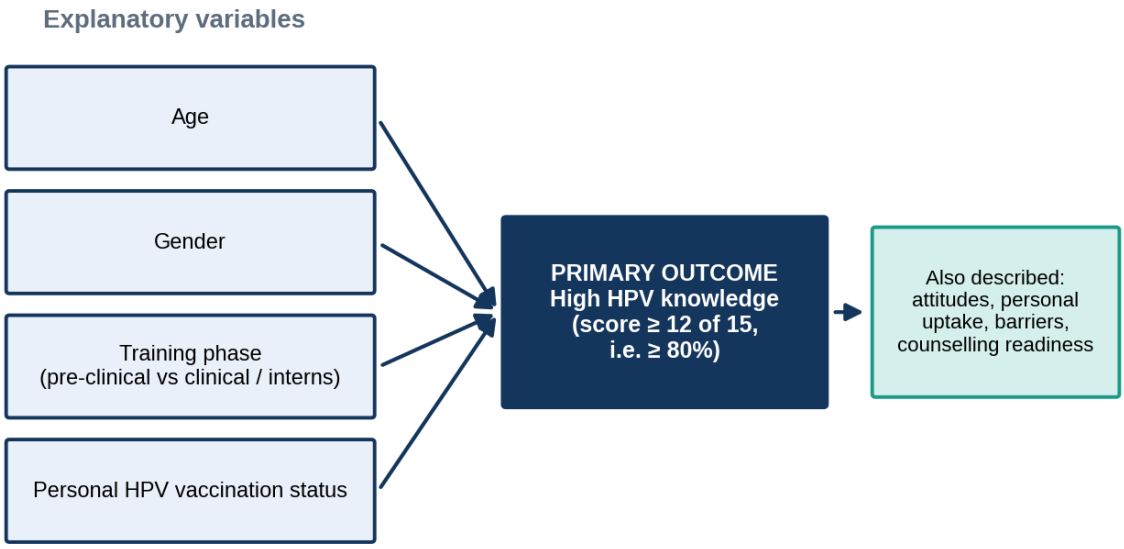


Figure 1. Conceptual framework of the study

2.2 Participants and sampling

The study population comprised undergraduate medical students enrolled in all academic years and clinical interns. Eligibility required active enrolment and consent to participate; forms with more than 10% of items missing were excluded. Institutional enrolment rosters formed the sampling frame, which was divided by academic phase into five strata: Phase I MBBS, Phase II MBBS, Phase III Part 1, Phase III Part 2, and clinical interns. The total eligible population was 580. Selection within strata used computer-generated random numbers. Stratum-wise eligible numbers and valid responses are presented in Table 1.

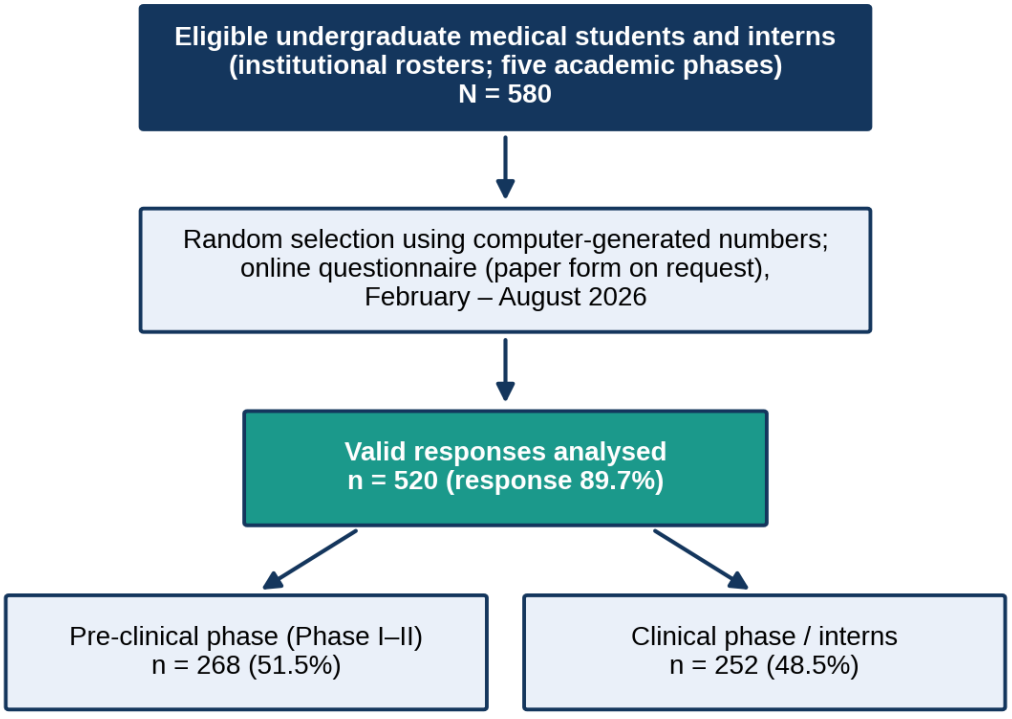


Figure 2. Participant flow

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2.3 Sample size determination

The minimum sample size was calculated for a cross-sectional survey of a known, finite population (N = 580 eligible medical students and interns) using Cochran's formula with finite population correction:

$$n = \frac{N \cdot Z^2 \cdot p\,(1-p)}{d^2\,(N-1) + Z^2 \cdot p\,(1-p)}$$

where N = 580 (total eligible students and interns); Z = 1.96 (95% confidence level); p = 0.50 (expected proportion with high knowledge or vaccine uptake, set at 50% to maximise the required sample size); and d = 0.05 (desired absolute precision, ±5%).

Substituting these values gives n = (580 × 3.8416 × 0.25) ÷ (0.0025 × 579 + 3.8416 × 0.25) = 557.03 ÷ 2.408 ≈ 231.3, so a minimum of 232 participants was required after rounding up. Allowing for 10% non-response or incomplete questionnaires would raise this figure to approximately 258. The achieved sample of 520 valid responses from N = 580 well exceeded the minimum required sample size.

2.4 Instrument and data collection

Data were collected using a secure online questionnaire, with paper forms available for participants who preferred offline completion. The 35-item questionnaire was adapted from previously used instruments and pilot-tested among 30 medical students, who were excluded from the analysis, to assess readability and clarity. Internal consistency in the pilot was high (Cronbach's alpha = 0.84). The questionnaire comprised four sections: sociodemographic characteristics (5 items), knowledge (15 items), attitudes and health beliefs (10 items on a 5-point Likert scale), and advocacy preparedness and perceived barriers (5 items).

2.5 Scoring and definitions

The primary outcome was derived from 15 knowledge items covering transmission, natural history, oncogenic types, screening, and vaccination schedules. A correct answer scored 1 point; incorrect or 'unsure' answers scored 0, giving a total score out of 15. A score of at least 80% (12 or more of 15) was defined a priori as high knowledge.

Personal vaccination status was self-reported as fully vaccinated (recommended doses completed) versus unvaccinated or partially vaccinated.

2.6 Statistical analysis

Proportions are presented with 95% Wilson confidence intervals. Associations with high knowledge were assessed using chi-square tests and binary logistic regression. Age, gender, training phase (pre-clinical versus clinical or intern), and personal vaccination status were prespecified for the adjusted model. Multicollinearity was assessed using variance inflation factors (all below 1.4), and model fit was assessed using the Hosmer–Lemeshow test (p = 0.682). Missing data were handled by complete-case analysis. A two-sided p-value < 0.05 was considered statistically significant.

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2.7 Ethics

The study was approved by the Institutional Ethics Committee of Surabhi Institute of Medical Sciences, Siddipet. Informed consent was obtained from all participants before they could access the survey. Responses were anonymous; identifiers were removed and numerical study codes were used.

3. Results

3.1 Participant characteristics

Of 580 eligible students, 520 returned valid responses, giving an overall response rate of 89.7%. The mean age was 21.2 ± 1.6 years, and 53.5% (n = 278) were female. The detailed stratum-wise distribution is shown in Table 1. Table 2 summarises the respondent characteristics.

Table 1. Stratum-wise distribution and response rate of study participants (N = 580)

Academic phase / stratum	Eligible population (N_s)	Valid responses analysed (n_s)	Response rate (%)
Phase I MBBS	125	112	89.6
Phase II MBBS	160	156	97.5
Phase III Part 1 MBBS	110	98	89.1
Phase III Part 2 MBBS	105	85	81.0
Clinical interns	80	69	86.3
Total	580	520	89.7

Response rate = valid responses analysed ÷ eligible population × 100 within each stratum. Valid responses were questionnaires with no more than 10% of items missing.

Table 2. Characteristics of respondents (N = 520)

Characteristic	Category	n	%
Age (years)	Mean ± SD	21.2 ± 1.6	–
Gender	Male	242	46.5
	Female	278	53.5
Training phase	Pre-clinical (Phase I–II)	268	51.5
	Clinical phase / interns	252	48.5
Personal HPV vaccination	Fully vaccinated	128	24.6
	Unvaccinated / partial	392	75.4

Counts for male gender and for unvaccinated students are derived by subtraction from the totals.

3.2 Knowledge

The mean knowledge score was 9.1 ± 2.7 out of 15 (60.7%), and 164 students (31.5%, 95% CI 27.7–35.7) reached the high-knowledge threshold. Item-wise performance is shown in Table 3 and Figure 3. Nearly all students (93.1%) correctly identified sexual contact as the main route of transmission. Approximately two-thirds knew that most high-risk infections are initially asymptomatic (69.6%) and that vaccinated women still need routine cervical screening (66.9%). The largest knowledge gaps concerned the association between HPV

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and non-cervical cancers (48.8% correct), vaccination of both sexes (54.2%), the fact that vaccination does not treat existing infection (45.0%), and spontaneous clearance of most infections (42.5%).

Table 3. Item-wise performance on selected knowledge items (N = 520)

Domain	Statement	Correct n (%)	95% CI	Incorrect / unsure n (%)
Transmission	HPV is mainly transmitted by sexual contact	484 (93.1)	90.6–95.0	36 (6.9)
Natural history	Most high-risk infections are initially asymptomatic	362 (69.6)	65.5–73.4	158 (30.4)
Cancers	High-risk HPV causes oropharyngeal, anal and penile cancers	254 (48.8)	44.6–53.1	266 (51.2)
Natural history	Most acute infections clear spontaneously	221 (42.5)	38.3–46.8	299 (57.5)
Vaccination	Vaccination is recommended for both males and females	282 (54.2)	49.9–58.5	238 (45.8)
Vaccination	Routine vaccination is before sexual debut (9–14 years)	321 (61.7)	57.5–65.8	199 (38.3)
Screening	Vaccinated women still need routine cervical screening	348 (66.9)	62.8–70.8	172 (33.1)
Vaccination	Vaccination treats existing infection (false statement)*	234 (45.0)	40.8–49.3	286 (55.0)

*The correct response is to identify the statement as false. Eight of the 15 knowledge items are shown. CI, Wilson 95% confidence interval.

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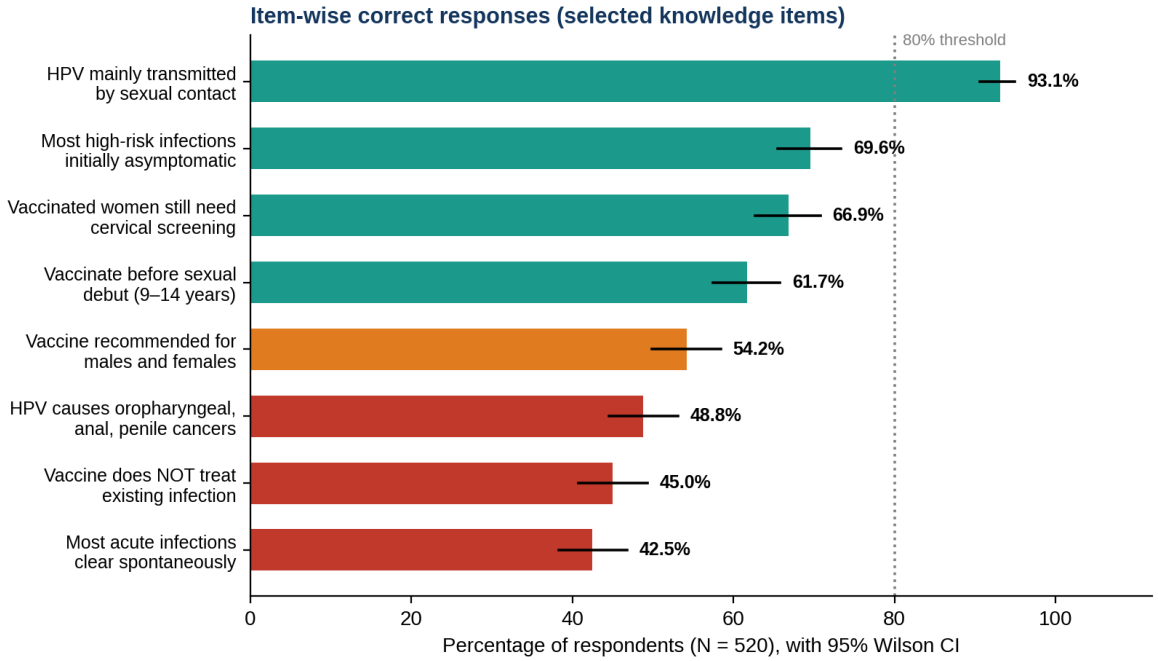


Figure 3. Item-wise correct responses for selected knowledge items (N = 520)

3.3 Attitudes, personal uptake, barriers, and counselling preparedness

A large majority (82.7%) agreed that HPV vaccination is essential for cancer prevention, yet only 24.6% were fully vaccinated. Cost was the main barrier cited by 57.1%, and 64.4% felt unprepared to counsel vaccine-hesitant patients (Table 4, Figure 4).

Table 4. Attitudes, personal uptake, barriers, and counselling preparedness (N = 520)

Domain	Item / response	n	% (95% CI)
Attitude	Agree / strongly agree: HPV vaccination is essential for cancer prevention	430	82.7 (79.2–85.7)
Personal uptake	Fully vaccinated	128	24.6 (21.1–28.5)
Barrier	High out-of-pocket cost cited as primary barrier	297	57.1 (52.8–61.3)
Preparedness	Felt unequipped to counsel vaccine-hesitant patients (agree / strongly agree)	335	64.4 (60.2–68.4)

Selected attitude items are reported. CI, Wilson 95% confidence interval.

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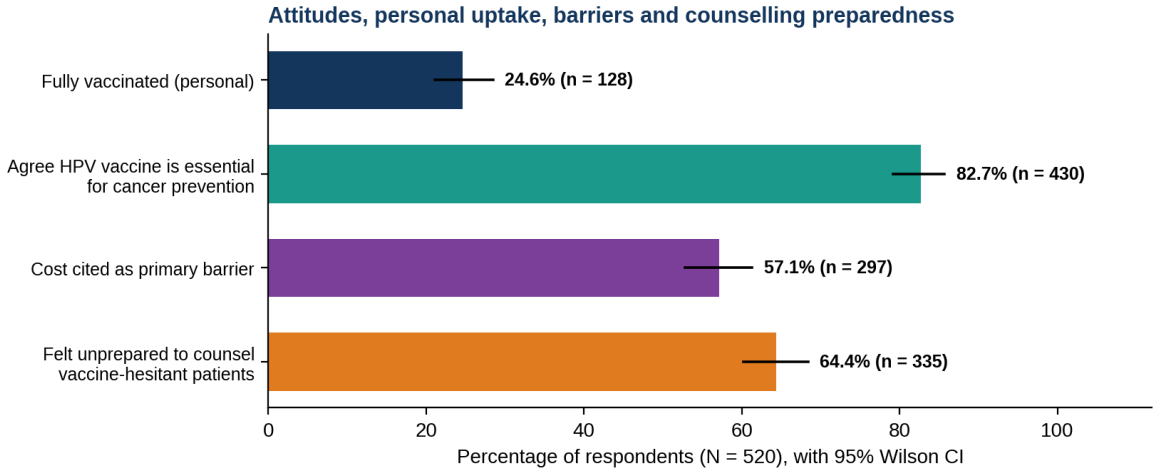


Figure 4. Attitude, uptake, barrier, and counselling-preparedness responses

3.4 Factors associated with high knowledge

High knowledge was more frequent among clinical-phase students (47.2% versus 16.8%) and vaccinated students (51.6% versus 25.0%) and did not differ materially by gender (32.7% in females versus 30.2% in males; Figure 5). In the reported adjusted model, clinical-phase students had approximately 3.6 times the odds of high knowledge (adjusted OR 3.64, 95% CI 2.32–5.71, $p < 0.001$), and vaccinated students had approximately 2.5 times the odds (adjusted OR 2.45, 95% CI 1.56–3.84, $p < 0.001$). Gender was not associated with high knowledge (adjusted OR 0.98, 95% CI 0.66–1.45, $p = 0.912$).

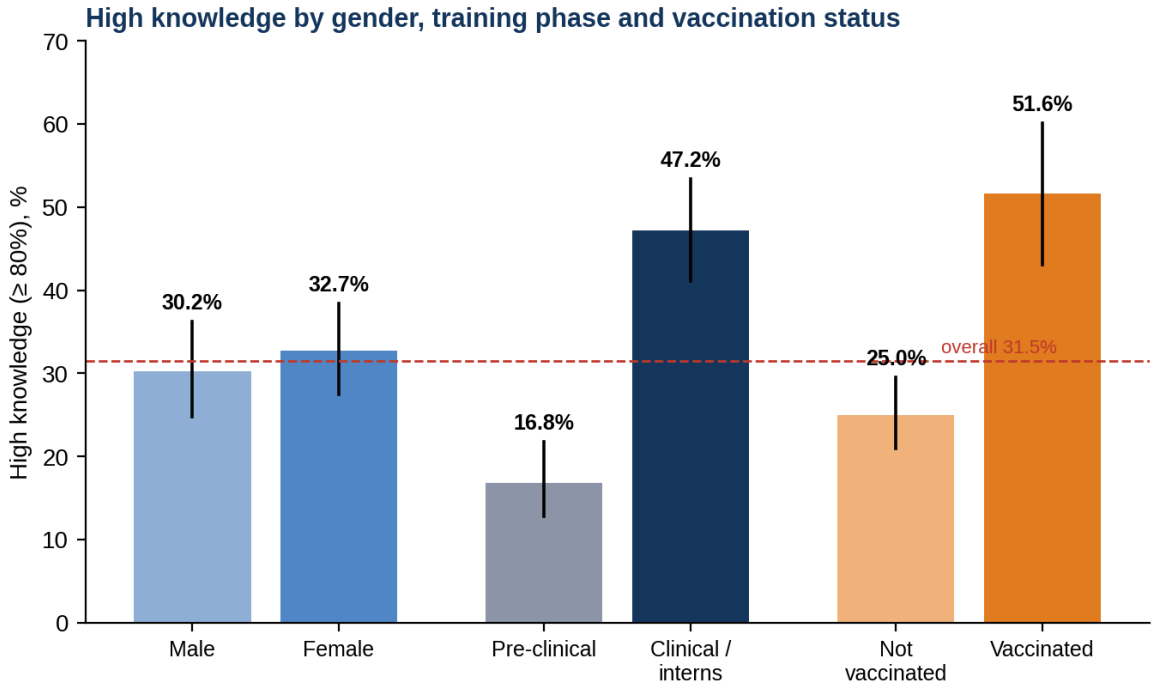


Figure 5. High knowledge by gender, training phase, and vaccination status

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Table 5. Bivariable and multivariable logistic regression for high knowledge (≥ 80%)

Variable	High knowledge n (%)	Crude OR (95% CI)	Adjusted OR (95% CI)	p value
Gender				
Male (reference)	73 (30.2)	1.00	1.00	–
Female	91 (32.7)	1.13 (0.78–1.63)	0.98 (0.66–1.45)	0.912
Training phase				
Pre-clinical (reference)	45 (16.8)	1.00	1.00	–
Clinical phase / interns	119 (47.2)	4.43 (2.96–6.65)	3.64 (2.32–5.71)	< 0.001
Personal vaccination				
Unvaccinated (reference)	98 (25.0)	1.00	1.00	–
Vaccinated	66 (51.6)	3.19 (2.11–4.84)	2.45 (1.56–3.84)	< 0.001

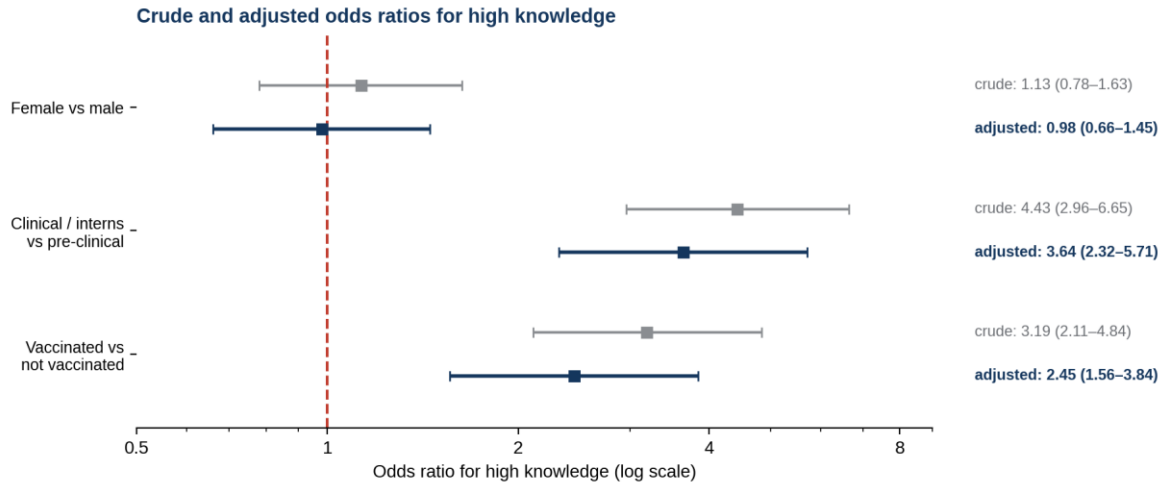


Figure 6. Crude and adjusted odds ratios for high knowledge

The adjusted odds ratios were smaller than the crude estimates (for example, 4.43 to 3.64 for training phase), indicating that part of the crude association was explained by the other variables included in the model.

4. Discussion

Medical students in this study strongly supported HPV vaccination as a cancer-prevention measure (82.7%), yet important knowledge gaps were identified. Fewer than half recognised the link between HPV and oropharyngeal, anal, and penile cancers (48.8%), and only 54.2% knew that vaccination is recommended for both sexes. More than half (55.0%) incorrectly identified or were unsure about the statement that vaccination treats existing infection. These findings are broadly consistent with reports from other Indian student groups [7–12], while knowledge of HPV-associated head and neck cancers among medical students has also been

examined internationally [16]. The limited recognition of non-cervical cancers may reflect limited curricular emphasis; however, curriculum content and prior exposure were not measured in this study, so this explanation requires direct evaluation.

Knowledge of the recommendation to vaccinate both sexes (54.2%) was lower than that reported in a survey of 543 medical students in Pune, in which 71.1% answered correctly [13]. In contrast, personal uptake in the present study was 24.6% fully vaccinated, compared with 17.3% who had completed the schedule in the Pune study [13]. A recent systematic review and meta-analysis of university students reported low overall uptake, with 7.7% pooled vaccination coverage among medical students [15]. Differences in populations, vaccine schedules, definitions, and measurement instruments limit direct comparisons across studies.

Clinical-phase students were more likely to have high knowledge, and the association persisted after adjustment in the reported model. Because this was a cross-sectional comparison of different students, the association should not be interpreted as evidence that clinical training itself caused the increase in knowledge; cohort effects, age, and other unmeasured differences may contribute. Vaccinated students also had higher odds of high knowledge, but the direction of this association is uncertain: students with greater knowledge may be more likely to seek vaccination, vaccination may prompt greater learning about HPV, or both may be influenced by other factors.

Personal uptake was low (24.6%) despite positive attitudes, and cost was the most frequently cited barrier (57.1%). This finding is consistent with recent Indian evidence identifying cost, limited awareness, misinformation, and sociocultural factors as important barriers to HPV vaccination [3]. A recent Indian medical-student survey likewise found substantial awareness but low vaccine uptake and identified knowledge gaps and concerns about benefits and safety among important barriers [13].

Separately, 64.4% of students felt unprepared to counsel vaccine-hesitant patients. Because provider communication is closely associated with vaccine uptake [6], this finding has practical importance, although the present study measured perceived preparedness rather than observed counselling competence or the amount of formal communication training received. An interventional study among health-science students demonstrated improvement in HPV-related awareness and acceptance following health education [17], supporting evaluation of structured vaccinology and communication-skills teaching within undergraduate medical education.

The findings suggest three complementary educational and access priorities: strengthening knowledge of HPV-associated cancers and vaccination of both sexes; developing practical communication skills through structured counselling and simulated consultations; and improving affordability and access through subsidised or campus-linked vaccination services. These measures should be evaluated prospectively rather than assumed to be effective on the basis of this cross-sectional study.

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Table 6. Present findings compared with recent evidence

Study (setting)	Design / n	Vaccinated	Knew vaccine is for both sexes
Present study (Siddipet)	Cross-sectional; 520	24.6% fully vaccinated	54.2%
Sondankar et al. 2025 (Pune)	Cross-sectional; 543	17.3% complete schedule; 75.1% none	71.1%
Li et al. 2025 (meta-analysis)	Pooled university students	7.7% pooled coverage in medical students (95% CI 1.3–18.4)	Not reported

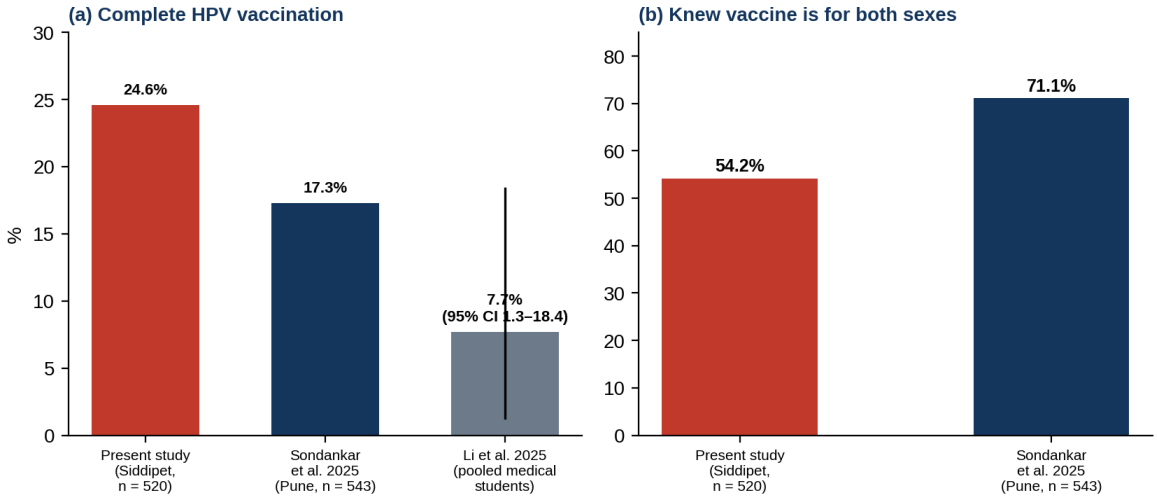


Figure 7. Present findings compared with recent evidence

The findings are also consistent with recent Indian evidence showing that economic and informational barriers remain important determinants of HPV vaccine uptake. A 2025 systematic review identified cost, lack of awareness, misinformation, and sociocultural factors as important barriers, while education, healthcare-provider recommendation, community engagement, and subsidised vaccination were identified as potential facilitators [3]. A 2025 survey among 543 medical students reported high awareness but substantial non-uptake and identified insufficient knowledge, safety concerns, limited availability, and uncertainty about benefits among barriers [13].

The present study has an important educational implication: factual knowledge alone may be insufficient if future clinicians do not feel confident in communicating with vaccine-hesitant patients. A 2024 interventional study among health-science students found that targeted health education improved HPV-related awareness and acceptance [17]. The combination of content knowledge, communication practice, and improved access therefore warrants formal evaluation in undergraduate medical education.

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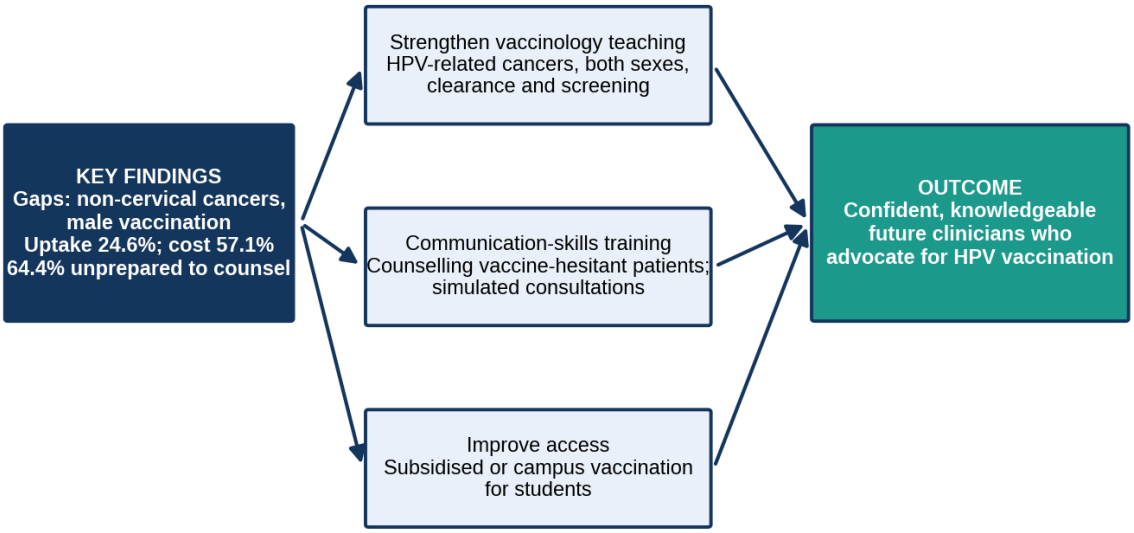


Figure 8. Proposed curriculum and access response for evaluation in intervention studies

5. Strengths and Limitations

Strengths: The study included a sampling frame covering all phases of undergraduate medical training and clinical internship, achieved a high overall response rate, used a pilot-tested instrument, prespecified the primary knowledge outcome, and applied multivariable analysis.

Limitations:

- Single institution: generalisability is limited.
- Self-report: vaccination status and attitudes were self-reported, with possible recall and social-desirability bias.
- Non-response: non-response bias cannot be excluded.
- Cut-off: the 80% threshold is a conventional but arbitrary cut-off.
- Confounding: training phase is closely linked to age and other unmeasured differences, so residual confounding is likely.
- Subgroup precision: the sample size was calculated to estimate a single proportion in the whole population, so comparisons within individual strata are less precise.
- Design: the cross-sectional design permits assessment of associations but not causal inference.

6. Conclusion

Medical students demonstrated favourable attitudes towards HPV vaccination, but substantial knowledge gaps persisted regarding male vaccination, non-cervical cancers, spontaneous clearance, and the preventive rather than therapeutic role of vaccination. Personal uptake was also low, and nearly two-thirds reported inadequate preparedness to counsel vaccine-hesitant patients. Strengthening vaccinology education, communication-skills training, and affordable access to vaccination may help address these gaps. Prospective educational and service-delivery interventions are needed to determine whether these measures improve knowledge, counselling competence, and vaccine uptake.

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7. Declarations

Item	Statement
Ethical approval	Institutional Ethics Committee approval was obtained before commencement of the study.
Informed consent	Obtained from all participants before they accessed the survey; responses were anonymous.
Funding	None.
Conflict of interest	None declared.
Author contributions	Both authors contributed to study design, data collection, analysis, and manuscript preparation and approved the final version.
Data availability	The dataset is available from the corresponding author on reasonable request, subject to applicable institutional and ethical restrictions.
Acknowledgements	None.

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