

Sociocultural Issues in the Introduction of Human Papillomavirus Vaccine in Low-Resource Settings

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Objectives: (1) To synthesize sociocultural results from diverse populations related to vaccine decision-making, understanding of cervical cancer and its etiology, experience with previous vaccinations, human papillomavirus (HPV) vaccine concerns, and information needed to foster acceptance; (2) to contextualize findings in light of recent studies; and (3) to discuss implications for communication strategies to facilitate vaccine acceptance.

Design: Descriptive qualitative synthesis of sociocultural studies in 4 countries using iterative theme-based analyses.

Setting: Four developing countries: India, Peru, Uganda, and Vietnam.

Participants: Criterion-based sample of 252 focus-group discussions and 470 in-depth interviews with children, parents, teachers/administrators, health workers/managers, and community/religious leaders. A knowledge, attitudes, and practices survey was administered to 879 children and 875 parents in Vietnam.

Results: We found that vaccine decision-making was primarily done by parents, with children having some role. Understanding of cervical cancer and HPV was limited; however, the gravity of cancer and some symptoms of cervical cancer were recognized. Vaccination and government-sponsored immunization programs were generally supported by respondents. Sentiments toward cervical cancer vaccines were positive, but concerns about quality of delivery, safety, adverse effects, and the effect on fertility were raised. Communities requested comprehensive awareness-raising and health education to address these concerns.

Conclusion: Sociocultural studies help elucidate the complexities of introducing a new vaccine from the perspective of children, parents, and communities. Strategies for introducing the HPV vaccine should address community concerns through effective communication, appropriate delivery, and targeted advocacy to make the program locally relevant.

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SINCE THE ADVENT OF commercially available effective vaccines against human papillomavirus (HPV),^{1,2} the primary cause of cervical cancer,³ countries have begun to debate whether and how to introduce HPV vaccines.^{4,5} Among early-adopting developed countries, recommendations for delivery have been primarily for girls prior to being sexually active, usually between the ages of 10 and 14 years,⁶ as the vaccine has the highest efficacy in populations naive to the virus subtypes included in the vaccine.^{7,8} Delivering the HPV vaccine to girls in this age group requires innovative strategies that depart from traditional infant and child immunization program models.⁹ This may be particularly challenging for low-resource countries where 85% of deaths due to cervical cancer occur¹⁰⁻¹² because this age

group is typically neglected regarding targeted health interventions and tends to fall through the cracks in the health delivery system at a time of vulnerability and intense transition.^{13,14}

*For editorial comment
see page 487*

Understanding local perceptions of need, the process of health decision-making, and concerns and considerations of local and acceptable vaccine delivery practices are key components for vaccine introduction¹⁵⁻¹⁷; failure to do so may result in low acceptability and suboptimal coverage.^{16,18-22} Successful planning for HPV vaccine introduction in developing country settings requires an integrated and comprehensive approach that addresses factors influencing acceptance or willingness to support vac-

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Table 1. Study Populations and Data Collection Methods in India, Peru, Uganda, and Vietnam

	Study Populations			
	India	Peru	Uganda	Vietnam
Children/adolescents	Adolescent girls (aged 10-14 y): 26 FGDs	Boys and girls aged 9-12 y and adolescents aged 13-16 y: 36 FGDs, 52 IDIs	Boys and girls aged 10-12 y, both in and out of school: 15 FGDs	Adolescent girls aged 11-14 y: 879 KAP surveys, 8 FGDs, 16 IDIs
Parents or guardians	Parents: 42 FGDs, 6 IDIs; grandparents: 2 FGDs	Mothers: 23 IDIs, 13 FGDs; fathers: 22 IDIs	20 FGDs	Mothers: 8 FGDs, 16 IDIs, 756 KAP surveys; fathers: 8 FGDs, 16 IDIs, 119 KAP surveys
Community or civil society	Anganwadi workers: 1 FGD; peer educators: 1 FGD, 2 IDIs; community leaders: 20 FGDs; Sarpanch: 11 IDIs; religious leaders: 5 IDIs; NGO representatives: 4 IDIs	NGO, church, mass media representatives: 36 IDIs	Community leaders: 5 FGDs; district political leaders: 10 KIs	Community leaders, authorities, Women's Union members: 32 IDIs
School system (teachers, administrators)	Teachers: 18 FGDs; headmasters: 3 IDIs	Teachers, head teachers: 1 FGD, 72 IDIs	Teachers: 10 FGDs	Teachers: 8 FGDs, 16 IDIs
Health system (health providers, administrators)	Health providers: 10 FGDs, 1 IDI; physicians: 12 IDIs	Health authorities, providers: 44 IDIs	Health service and technical managers: 25 KIs; providers: 30 KIs	Health managers, workers: 16 IDIs

Abbreviations: FGDs, focus-group discussions; IDIs, in-depth interviews; KAP, knowledge, attitudes, and practices; KIs, key informant interviews; NGO, nongovernmental organization.

cine delivery at multiple levels,⁹ and formative research has been recognized to provide critical information at the beginning of the planning process for vaccine introduction.^{23,24}

PATH recently completed formative research in India, Peru, Uganda, and Vietnam as one part of its larger HPV Vaccines: Evidence for Impact project, which aims to identify information needs and generate evidence for decision-making and operational planning relevant to HPV vaccine introduction in low-resource settings. The research was organized into 3 components: sociocultural studies, health systems assessments, and policy reviews. This article synthesizes sociocultural results, focusing on similarities and differences between the 4 countries included.

This summary assembles voices from the community and presents their perspectives in the following 5 thematic areas: (1) vaccine decision making; (2) understanding of cancer, cervical cancer, disease burden, and disease etiology; (3) experiences with previous vaccine campaigns; (4) specific HPV vaccine concerns; and (5) information needed to foster acceptance. We contextualize these findings in light of recent HPV vaccine sociocultural studies and discuss the implications of our results for a comprehensive communication strategy to facilitate vaccine acceptance at the individual, interpersonal, and community levels.

METHODS

This descriptive qualitative study analyzes the results of formative research on sociocultural aspects of HPV vaccine introduction in 4 developing countries. The research was conducted from 2006 to 2008 by multidisciplinary research teams in each country and, following a team-based approach, research teams participated in all aspects of the research.²⁵ A global conceptual framework that assumed 5 levels of influence on individual health behavior—individual, interpersonal, com-

munity, institutional, and policy²⁶—helped define the study populations and data themes and provide comparability across sites. The full methodology of formative research is published elsewhere.²⁷

SITE SELECTION

Research sites were selected based on ethnic/linguistic diversity, topographic diversity, socioeconomic characteristics, school attendance, documented experience with vaccination, and urban/rural representation. Each country's research team also used its own criteria for site selection that were locally relevant.²⁷⁻²⁹

STUDY POPULATIONS

The criteria that guided sampling in all countries were developed to engage the stakeholders required to assess a country's readiness for HPV vaccine introduction according to the conceptual framework described above. Teams also sought to obtain a wide range of experiences to capture the greatest variability.³⁰ Local research teams further defined specific criteria to select study populations for their context, as reported elsewhere.²⁷⁻²⁹ Groups included children (mainly girls aged 10-14 years); parents of target-age girls; teachers and school administrators; influential community, civil society, and religious leaders; and health professionals (**Table 1**).

DATA COLLECTION AND SOURCES

Our primary data sources were the complete formative research technical reports prepared by each country's research team.³¹⁻³⁶ Data collection methods included focus-group discussions, in-depth interviews, and a knowledge, attitudes, and practices survey of girls and parents (Vietnam only) (Table 1). Methods were combined as appropriate to each research setting to build on and complement each other. Topics covered using each method varied by country and are presented elsewhere.^{28,29} Discussion guides for focus-group discussions and interview questionnaires covered 11 key areas of inquiry²⁷ including understanding of cervi-

Table 2. Thematic Areas Explored in Cross-Site Analysis

Theme	Key Subthemes
Vaccine decision-making	Who are the primary decision-makers for young female adolescent health care needs? Who else influences health decision-making for girls in this age range? Parental roles. Children as their own health decision-makers. Role of schools. Role of health providers. Role played by other household members or community-level influencers. Who makes a decision that a girl will be vaccinated?
Understanding of cancer, cervical cancer, disease burden, and disease etiology	Experience with, perceptions of, and knowledge of cancer. Experiences with, perceptions of, and knowledge of cancer of the cervix (causes, signs and symptoms, diagnosis and treatment options). Understanding of disease burden and who is at risk/vulnerable. Understanding of HPV and the link with cervical cancer.
Experiences with previous vaccine campaigns	How is local experience with immunization programs for children generally characterized? Knowledge of vaccination in general (What do vaccines do? How do they work?). What vaccines do communities have experience with? What are the perceived benefits and concerns people have? Any associated fears or complications associated with past immunization campaigns? Who gives vaccines and how they are given? How can immunization delivery for children be improved? What works well?
HPV vaccine concerns	Thoughts about a new cervical cancer vaccine and its introduction. Primary concerns about the new vaccine. Recommendations for introduction. Accepting the vaccine. Reaching out-of-school girls.
Information needs and other planned action needed to foster acceptance	Potential social and cultural barriers to introduction. Stated information needs for introducing the new vaccine. Existing sources of health information. Preferred sources of information on health issues/recommended means of informing audiences about the new vaccine. Training needs for vaccine teams.

Abbreviation: HPV, human papillomavirus.

cal cancer and its etiology, prevention, and treatment; the well-being and health of girls; local experiences with vaccination programs and general perceptions about vaccines; primary decision-makers and influencers related to the health and well-being of young girls; perceptions of the risks and benefits of the HPV vaccine; and how best to create awareness among parents and girls about the HPV vaccine.

ANALYSIS OF DATA

For this 4-country comparative analysis, a table matrix technique was used to review and manually categorize data from the technical reports according to the 5 themes outlined in **Table 2**. Additional subthemes were added as they emerged from the data. The table matrix technique organizes text segments according to theme or topic and unit of analysis (eg, girl, parent).³⁷ It is a recommended technique in communication research where audience segmentation for developing focused messaging is one aim of the analysis.³⁸ While the broader sociocultural study covered a range of topics (discussed earlier), this study focuses on results covering the 5 themes outlined in Table 2.²⁷ At a 2007 workshop, the research team from each country highlighted these 5 themes as the most useful for HPV vaccine preintroduction planning of the 11 topical areas covered in the study.

RESULTS

A total of 252 focus-group discussions, 470 in-depth interviews, and 1754 surveys were administered across the

4 project countries (Table 1). There were no reported refusals to participate by children, parents, teachers, community and civil society leaders, or health care providers in any country.

VACCINE DECISION-MAKING

In all 4 countries, most respondents reported that decision-making for vaccination takes place within the family unit, generally by one or both parents. In Peru and Uganda, and to a lesser extent in India and Vietnam, children and parents reported that the mother has primary responsibility for vaccination decision-making, although involvement by the father also was acknowledged. A teacher in Vietnam stated, "It is probably the role of mothers as they usually take more care of their daughters."

India and Vietnam, particularly, noted the fathers' roles in decision-making as crucial if decisions included finances or a critical health event. Depending on the particular family configuration, joint parental decision-making also may occur, a point mentioned frequently by respondents in India and Vietnam and occasionally in Uganda.

There was a common view among parents and girls in all countries that discussions related to vaccination occur within the family, but only in Peru and Uganda, and to a lesser extent in India, did parents mention the specific role of girls to decide for themselves. Parents in Vietnam expressed less permissiveness for girls to decide on

their own. A mother in Uganda explained, "Parents may refuse to let children go to a film, but if the children are interested they will surely escape through the windows and go out. Similarly, if children choose to be vaccinated at school, while their parents are busy attending to their farms, they will get home and refuse to entertain questions from their parents about immunization."

In Peru, Uganda, and Vietnam, respondents generally shared the view that in school-based vaccinations, decision-makers also could include teachers and headmasters. Across settings, there was some indication that passive acceptance of vaccination at the household and community levels is more likely to be the norm unless there are active objections owing to external factors such as cost, access, or cultural constraints such as parental, religious, or social objections. For example, in Peru, many children emphasized the role of government in determining which children receive which vaccines and minimized the roles of themselves and their parents in making vaccination decisions.

Additional external influencers in health decisions included extended family members, school administrators, and health workers at the community level. In India in particular, an array of people beyond the immediate family context is recognized as having input regarding girls' health and well-being and parental decision-making.

UNDERSTANDING OF CANCER, CERVICAL CANCER, DISEASE BURDEN, AND DISEASE ETIOLOGY

In all countries and among the different study groups, there was a common understanding that cancer in general is a serious problem, a financial and emotional burden on families and communities, and often fatal (a "death sentence"). However, cervical cancer was rarely brought up when study participants in all countries were asked to identify types of cancer. Among children, parents, and teachers in India and Uganda, there was little recognition of the term *cervical cancer*. Awareness of the term was greater among children and parents in Vietnam as well as among teachers, health workers, civil society representatives, and authorities in Peru. There was some confusion between cervical cancer and other reproductive cancers such as uterine cancer. A Ugandan mothers' group participant expressed, "Cancer of the cervix? We thought it was the same as that of the uterus. In both cases the uterus is affected. . . ."

Though not directly linked to the term *cervical cancer*, respondents in all countries were fairly consistent in identifying vaginal bleeding and foul-smelling vaginal discharge as symptoms of cervical cancer. Furthermore, the link between HPV and cervical cancer was poorly understood among children, parents, teachers, community leaders, and to a large extent, even health service providers. Survey data from Vietnam showed that less than 25% of parents had any awareness that cervical cancer is caused by a virus. However, a sexual connotation in the etiology of cervical cancer was suggested by the types of risk factors respondents mentioned in all countries such as multiple sex partners, poor personal hygiene of private parts, early onset of sexual activity, history of abortions, and promiscuity.

EXPERIENCE WITH PREVIOUS VACCINE CAMPAIGNS

Participants in all countries reported that vaccines in general are important to public health because they protect children and help them to avoid illness later in life. In India and Vietnam, many people commented that vaccination also reduces the need for costly treatment. At the community level, however, what a vaccine does was sometimes poorly understood. In Peru, vaccination, or an *inyección*, was spoken of both in terms of promoting health before sickness and a cure after disease or illness strikes. In India, Uganda, and Vietnam, people shared their personal observations of the dramatic declines of diseases like measles and/or polio owing to vaccination.

In all countries, positive sentiments were expressed regarding national government-sponsored Expanded Programs on Immunization (EPI programs) and recent experiences with the programs. In India and Vietnam, health providers and administrators felt there was already confidence in the EPI program in communities and that this has led to increased acceptance of vaccination. Parents, teachers, health providers, and civic leaders from these 2 countries consistently voiced the opinion that the HPV vaccine should be introduced and managed through the existing national EPI structure (for which a high trust and confidence level already exists among communities).

Despite these positive sentiments overall, participants in all countries also shared concerns that they attributed to previous vaccination experiences. These included concerns about vaccinators' ability to interact effectively with girls (Peru); injection safety practices including insufficiently trained vaccinators, infections from accidentally reused needles, and use of expired vaccines (Peru, Uganda); quality of the vaccine itself (Vietnam); and ensuring a consistent supply of vaccines (India).

HPV VACCINE CONCERNS

Specifically in relation to a vaccine against cervical cancer, most respondents reacted positively. However, favorable sentiments toward a cervical cancer vaccine often came with concerns (**Table 3**). Respondents from all countries wondered about the safety and side effects of HPV vaccines. A district People's Committee member in Hanoi, Vietnam stated, "It's quite good if this vaccine can help eliminate the risk of contracting cervical cancer. What we do need to consider is whether it causes any side effects and how it affects our health and our reproductive health."

Concern about the effect of HPV vaccination on future fertility was mentioned in all countries, seemingly owing to the fact that the vaccine would only be given to girls. In Peru, government policies that led to coercive sterilizations during the 1990s seem to have exacerbated the fear that the vaccines are a means of sterilizing women. Some Peruvian parents also worried that the vaccine could actually accelerate girls' development owing to the fact that it is administered when girls are young (in some cases prior to first menstruation).

A final concern about the vaccine that was explicitly expressed only in Vietnam was duration of protection.

Table 3. Thematic Area 4: Summary of HPV Vaccine Concerns

India	Peru	Uganda	Vietnam
Stories of adverse effects could start a negative campaign.	Pain of the needle prick and entry of the liquid.	Poorly informed about what vaccine does, its safety, and what to expect.	Vaccine safety (eg, adverse or long-term effects on girls' reproductive health, death, other physical problems).
Lack of awareness about vaccination may inhibit program.	Giving expired vaccine.	Use of expired vaccines during campaigns.	Vaccine quality because it is being used for the first time.
Inconsistent vaccine supply.	Needle reuse and risk of catching an infection.	Complications (eg, risk of infertility, paralysis, swelling, bleeding, death, overdosing).	Program is a clinical trial and sent by "rich" countries to be tested on the poor.
Cost of the vaccine.	Quality of vaccination delivery raises vaccine safety concerns.	Use of untrained vaccinators.	Cost of vaccine.
Religious communities may have resistance.	Vaccine might result in sterilization or affect reproductive development. Suspicion that girls will be used as guinea pigs (vaccine comes from United States and is so new).	Why this is only for young girls and whether girls are being used as guinea pigs. Has vaccination been carried out elsewhere? Campaigns should not be perceived as being for political gain.	Long-term vaccine effect may not last and who is accountable if it does not last.

Abbreviation: HPV, human papillomavirus.

In particular, policymakers who had heard that data are still being collected on the long-term effectiveness of the vaccine expressed concerns about this and the implications for vaccination programs.

INFORMATION NEEDED TO FOSTER ACCEPTANCE

In all countries, study participants expressed the need for more information if a new vaccine such as HPV were to be introduced. In addition to requests for basic information regarding HPV and cervical cancer, many requests centered around and expanded on specific concerns about the HPV vaccine. The importance of early and comprehensive awareness-raising and health education efforts prior to vaccine introduction, accompanied by endorsement of the new vaccine by the national government and its health administrators, were suggested as ways to keep parents and communities informed, address specific concerns about the vaccine, and reassure communities that the vaccine is safe and girls are not being used in a trial or experiment.

Respondents also wanted assurances about the motivations for introducing the HPV vaccine. The fact that the vaccines come from "rich" countries aroused explicit suspicions in all countries. As a child in Peru expressed, "Perhaps they're actually giving us the cancer. Perhaps they're lying to us and the person injecting us isn't really a doctor . . . It's sent by the gringos . . ." A religious leader in Uganda also expressed the following point: "As leaders we will need to know where the vaccine is coming from, whether the vaccine has side effects or not, whether it is not just being tried on people, where it has worked, and all the other details pertaining to it like has it been approved by [the World Health Organization]."

Communities also requested assurances that the vaccine is not a form of population control that causes sterility or long-term fertility problems.

Although participants in each country made various recommendations regarding delivery and dissemination of information about HPV vaccine introduction, many focused on who would be providing the information. In Peru, the involvement of civil society leadership in publicizing the vaccination program was considered essential to garner community acceptance, as was using participatory and interactive methods. In Vietnam, communities emphasized the importance of involving trusted leaders in provision of information about vaccination, although the focus was more on health workers as well as women's unions and the People's Committees. Ugandan community leaders emphasized that communities will need specific assurances that vaccine campaign efforts are not being politicized or tied to any specific politician's interests. In India, Peru, and Uganda, civil society leaders underscored the need to include key religious leaders to assure communities that the vaccine was safe and beneficial for young girls.

COMMENT

Our findings illustrate the complex sociocultural factors influencing vaccine acceptance, including who makes decisions regarding vaccination, understanding of the condition the vaccine aims to prevent, experience with previous vaccination campaigns, and specific concerns about the HPV vaccine. Decisions were largely made within the family, jointly by parents, with initial decisions by mothers and affirmation of those decisions by fathers and the occasional involvement of children. Though knowledge of cervical cancer and the link with HPV was limited across our study populations in all 4 countries, awareness that cancer can be fatal along with generally positive attitudes about the benefits of vaccination could serve as a solid foundation on which to build future HPV vaccine communication campaigns. In spite of the link that many

participants made between cervical cancer and sexual behavior, anxiety that HPV vaccination may promote early onset of sexual activity was rarely mentioned by respondents in our study. This is in contrast to findings by adolescent sexual health researchers in other settings.^{24,39,40} Many other concerns related to vaccines (injection safety, adverse effects, adequate supply), vaccine administration (quality of delivery), and the potential effect on fertility were mentioned by respondents.²² Respondents offered recommendations for the type of information, channels for information, and key communication strategy elements to address these concerns.

The complex nature of decision-making for a child to be vaccinated has been recently noted by researchers working on the Diseases of the Most Impoverished childhood vaccine introduction program. Kaljee et al¹⁹ found that high levels of child vaccination coverage were possible when a child's primary caretaker recognized the need for the vaccine. Similar sentiments were expressed in another recent article that argues that to achieve high coverage, parents need to understand the vaccine's benefit to a child's overall well-being and feel assured that she will grow up healthy and be protected against cancer.²² Additional factors found to facilitate coverage from other studies include caretaker recognition of the value of vaccination for disease prevention,^{41,42} community confidence in vaccination technology and quality of delivery,^{16,17,43} understanding of the perceived benefits and costs of the vaccine when compared with other prevention options,^{15,24,42,44} and confidence that the vaccine will not harm the child.²²

Our findings largely support, and in some cases add to, these observations. Parents and others who voiced willingness to have their child vaccinated or to support vaccination efforts focused on the need for such health interventions to fight against cancer, on the value of vaccination for disease prevention, and on their confidence in vaccine technology. Even with a limited understanding of cervical cancer and HPV, the idea that vaccines protect and that cancer kills were powerful enough to convince those at the community level of the importance of the HPV vaccine. Study participants who cited the need for more information tended to focus on the factors cited above, including questions regarding perceived benefits and costs, potential adverse effects and health implications of the vaccine (with an emphasis on long-term reproductive health implications), and especially the quality of vaccine delivery to children.

Addressing community concerns prior to introduction of a new vaccine should be done through a comprehensive communication strategy.²⁰ Research suggests that a well-planned adequately funded strategic communication plan builds trust for vaccine acceptance and can facilitate achievement of coverage targets.^{21,24,26,45} However, as others have noted, previous vaccine communication plans have either focused only on biomedical aspects of disease and vaccines (which may not affect coverage) or were developed without formative research to identify community knowledge and attitudes and to ensure that communication messages were specific to community concerns.^{16,17,22} Our results clearly uncovered issues important to diverse audiences for acceptance of HPV vaccines. With-

out addressing these specific concerns and providing the reassurances communities need, introduction of the HPV vaccine may be difficult.

Based on our findings, a communication strategy that incorporates simple evidence-based information on HPV and cervical cancer and truthful reassurances regarding the specific concerns raised might include key messages like the following:

- Girls can be protected from a cancer, cervical cancer, through HPV vaccination.
- The vaccine is safe, used widely around the world (including in countries in your region), and has been approved for use in your country.
- Reported adverse effects of the vaccine have been relatively minor, with injection site pain and swelling being those most commonly reported.
- The vaccine will not affect girls' ability to get pregnant or have healthy babies in the future.
- The vaccine is given only to girls primarily because they are most affected by cervical cancer.
- All health workers administering HPV vaccines will receive adequate training to deliver the vaccine in a respectful manner and with the highest quality of care.
- The government and other prominent groups and individuals endorse HPV vaccination.

Communication strategies have been developed by each country project team, are being evaluated in demonstration projects, and will be analyzed once all demonstration activities have been completed.

The results of this study represent a further synthesis and summary of detailed technical reports from country-level formative research rather than an analysis of the original raw data from focus-group discussions, in-depth interviews, and knowledge, attitudes, and practices surveys. However, the reports contained ample narrative data and illustrative examples and comprehensively covered similar thematic areas. The countries included in this study were selected based on the representativeness of their regions, burden of cervical cancer, health system infrastructure, and potential to adopt HPV vaccines, but they may not be fully representative of all low-resource settings. Lastly, the study participants included in our research were selected using criterion-based sampling but may not be representative of overall populations; the overall aim of the formative research was to capture the range and variation among and within respondent groups rather than to sample for representativeness.

Our research demonstrates the importance of socio-cultural studies in understanding the complex environment of new vaccine introduction from the perspective of children, parents, and the wider array of community members. The primary objective of any new HPV vaccine introduction strategy should be to make the program relevant for communities. This is best achieved by engaging in formative research to unearth specific concerns that communities have about the prospect of a new cervical cancer vaccination program, then using the findings during introduction planning to allay concerns and reassure communities.²⁶ A vaccine introduction strategy that consists of an effective communication strategy, an appropriate vaccine delivery strategy, and a tar-

geted advocacy strategy that address specific concerns and provides reassurances has the best chance of being successful.^{20,45} Communication strategies were developed from the findings of our formative research and are being used in conjunction with HPV vaccine delivery demonstration projects in our 4 study countries; careful evaluation will determine whether community concerns have indeed been successfully addressed.

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