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HPV Vaccination Barriers in Pakistan: Reflections from a Resource-Limited Setting and a U.S. Academic Cancer Center: A Narrative Review

Rida Asghar[1], Annekathryn Goodman[2*], Aqsa Aman[1], Naseem Saba[1], Hina Ayub[1]

[1]Department of Obstetrics and Gynecology, Gomal Medical College, Dera Ismail Khan, Pakistan
[2]Massachusetts General Hospital, Boston, USA
Email: *agoodman@mgh.harvard.edu

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Abstract

Cervical cancer remains a significant public health challenge in Pakistan. According to the Global Cancer Observatory (GLOBOCAN 2024), there were 2722 new cervical cancer cases and 1640 deaths in Pakistan in 2024, with an age-standardized incidence rate (ASR) of 3.0 per 100,000 women and a five-year prevalence of 6642 cases. Despite the proven efficacy of human papillomavirus (HPV) vaccination in preventing cervical cancer, Pakistan's vaccination coverage remains critically low at approximately 3.1% of the adult population. This estimate reflects a pre-rollout study calculation defined by a small regional subset of the population. Mixed age groups were evaluated and reflected at least one dose of vaccine. The geographic scope was localized to specific urban samples rather than complete national implementation. Thus, data is sparse about HPV vaccination in Pakistan as a whole. This narrative review examines the multifaceted barriers to HPV vaccination in Pakistan through the dual lens of a Pakistani doctor from a resource-limited peripheral city and current observership experience at Massachusetts General Hospital's Division of Gynecologic Oncology. Drawing from recent literature, this review systematically analyzes socio-cultural, religious, knowledge-based, structural, and healthcare system barriers that impede vaccine uptake in Pakistan. In contrast, the review explores evidence-based strategies employed in U.S. academic cancer centers, including provider education, electronic health record (EHR)-based reminder systems, patient navigation, and multidisciplinary quality improvement initiatives. Comparative reflections highlight critical lessons that Pakistan can adapt from high-resource settings, while acknowledging the necessity for context-sensitive implementation. Evidence-based recommendations

are proposed for Pakistan, including integration of HPV vaccination into the national Extended Immunization Program, school-based delivery models, culturally sensitive community engagement, provider training, and strategic partnerships with international organizations. This review underscores that while resource disparities are substantial, targeted interventions informed by global best practices can significantly improve HPV vaccination coverage and ultimately reduce cervical cancer mortality in Pakistan.

Keywords

HPV Vaccination, Cervical Cancer, Pakistan, Barriers, Academic Cancer Center, Health Disparities, Implementation Strategies

1. Introduction

As a Pakistani doctor practicing in a peripheral city with limited resources in the department of obstetrics and gynecology, the principal author has witnessed firsthand the devastating impact of cervical cancer on women who present at advanced stages, often when curative treatment is no longer feasible. The lack of preventive infrastructure, coupled with profound gaps in public awareness about human papillomavirus (HPV) and its vaccine, creates a perfect storm for preventable mortality. An observership at Massachusetts General Hospital (MGH), Division of Gynecologic Oncology, provided a glimpse into a healthcare ecosystem where prevention is systematically prioritized, where electronic health records prompt providers to offer HPV vaccination, and where multidisciplinary teams coordinate seamlessly to ensure no eligible patient is missed.

This dual perspective, rooted in the realities of a resource-constrained Pakistani setting and informed by observations at a leading U.S. academic cancer center, forms the foundation of this narrative review. Pakistan faces an enormous cervical cancer burden, with approximately 73.8 million women at risk [1]. According to GLOBOCAN 2024, Pakistan records approximately 2722 new cervical cancer cases and 1640 deaths annually, with an age-standardized incidence rate (ASR) of 3.0 per 100,000 women and a 5-year prevalent case count of 6642. Cervical cancer does not rank among the top five female cancers in Pakistan by incidence; the leading cancers are breast, corpus uteri, ovary, colorectum, and lip/oral cavity [2] [3]. Despite the availability of highly effective HPV vaccines that can prevent up to 90% of HPV-attributable cancers [4], vaccination coverage in Pakistan remains alarmingly low at approximately 3.1% [5].

In September 2025, Pakistan launched a nationwide HPV vaccination campaign targeting 13 million girls aged 9 - 14 years [6] [7]. However, the campaign has faced significant challenges, including widespread misinformation, cultural taboos, and logistical disruptions [8]. The initial rollout fell short of the ambitious 90% national coverage goal by 2027 [9]. Understanding the multifaceted barriers to HPV vaccination in Pakistan and learning from successful strategies implemented in

high-resource settings like MGH is critical to improving vaccine uptake and ultimately eliminating cervical cancer as a public health threat. Of note, epidemiological framing models rely heavily on clinic or facility notification data. In regions like Pakistan, lower recorded incidence often reflects passive surveillance systems that miss individuals who do not enter the formal health care sector. In contrast, in the United States, the digital registry infrastructure allows for intensive case finding.

This review systematically examines barriers to HPV vaccination in Pakistan across six domains: socio-cultural factors, religious concerns, knowledge gaps, structural limitations, healthcare system deficiencies, and gender-related access issues. It then explores evidence-based strategies employed in U.S. academic cancer centers, drawing lessons that can be adapted to the Pakistani context. Finally, it proposes actionable, context-sensitive recommendations to accelerate HPV vaccination coverage in Pakistan.

2. Methods/Search Strategy

This is a narrative review and does not follow PRISMA or other systematic review protocols. The approach taken reflects the principal author's clinical judgment and thematic synthesis of relevant literature, rather than a comprehensive systematic search with predefined inclusion and exclusion criteria. The goal was to provide a contextually informed overview of HPV vaccination barriers in Pakistan, informed by both local and international evidence, and to draw comparative insights from high-resource academic cancer center settings.

Literature was primarily sourced from PubMed and Google Scholar, which served as the main databases for peer-reviewed publications. Supplementary sources included reports and data from the World Health Organization (WHO), UNICEF, Gavi the Vaccine Alliance, and Pakistan's Ministry of National Health Services. Where available, national cancer registry data and government health policy documents were also consulted to provide epidemiological context and to understand the current state of immunization programs in Pakistan.

Search keywords used to identify relevant literature included HPV vaccination, human papillomavirus, cervical cancer, Pakistan, vaccine hesitancy, barriers to vaccination, HPV vaccine acceptability, low- and middle-income countries (LMICs), Muslim-majority countries, immunization programs, Extended Immunization Program Pakistan, cervical cancer prevention, and HPV epidemiology in Pakistan. These terms were used individually and in combination to capture a broad range of relevant studies addressing the epidemiology, barriers, and implementation strategies related to HPV vaccination in Pakistan and comparable settings.

The types of articles included in this review encompassed peer-reviewed original research articles, systematic reviews, narrative reviews, meta-analyses, qualitative studies, policy reports, public health surveillance data, and gray literature from international health organizations. Both English-language publications and

translated summaries of relevant Urdu-language sources were considered where accessible, recognizing the importance of local perspectives and data that may not be widely available in international databases.

Literature was primarily sourced from 2015 to 2026, with particular emphasis on publications from 2020 onward to reflect the most current evidence on HPV vaccination barriers, implementation strategies, and cervical cancer epidemiology. Older foundational studies were included where they provided essential epidemiological background or contextual understanding of HPV-related disease burden and vaccine development. This temporal focus ensured that the review captured recent shifts in policy, emerging data on vaccine acceptability in Muslim-majority and low-resource settings, and contemporary strategies employed in academic cancer centers.

Articles were selected based on their relevance to HPV vaccination barriers, implementation strategies, and cervical cancer epidemiology in Pakistan and comparable low-resource or Muslim-majority settings. Studies from the United States, particularly those describing programs at academic cancer centers such as Massachusetts General Hospital and other institutions, were included to provide comparative context and to identify evidence-based strategies that might be adapted for resource-limited settings. No formal inclusion or exclusion criteria were applied, and article selection reflects the principal author's clinical judgment and thematic relevance to the review's objectives. This approach allowed for flexibility in synthesizing diverse sources of evidence, including quantitative studies, qualitative research, policy documents, and experiential insights from clinical practice.

2.1. Epidemiology of Cervical Cancer: Pakistan vs. USA

The epidemiological contrast between Pakistan and the United States starkly illustrates the impact of comprehensive prevention strategies. Globally, cervical cancer caused approximately 530,000 new cases and 250,000 deaths in 2020, with 85% of this burden concentrated in low- and middle-income countries (LMICs) [10]. Pakistan exemplifies this disparity. According to GLOBOCAN 2024, Pakistan records 2722 new cervical cancer cases and 1640 deaths annually, with an ASR (World) of 3.0 per 100,000 women and a 5-year prevalence of 6642 cases. Notably, cervical cancer does not rank among the top five female malignancies in Pakistan by incidence; breast cancer (43,721 cases) leads, followed by corpus uteri, ovary, colorectum, and lip/oral cavity cancers [2]. The Karachi Cancer Registry has documented ASIRs of 6.81 (1995-1997), 7.47 (1998-2002), and 6.02 (2017-2019) per 100,000 women, indicating a longstanding burden that the more recent GLOBOCAN estimates may reflect in aggregate at the national level [11]. HPV prevalence in Pakistan is substantial. A study analyzing invasive cervical cancer specimens found HPV-DNA prevalence of 87.5%, with high-risk genotypes HPV-16 and HPV-18 responsible for nearly 90% of cases [12]. Among tested women in Karachi, HPV prevalence was 16.7% [7]. Alarmingly, 94.81% of cervical cancer lesion biopsies in

Punjab tested positive for HPV [13]. Current HPV vaccines could theoretically prevent 78.4% of invasive cervical cancer cases in Pakistan.

In stark contrast, the United States has achieved remarkable success in cervical cancer prevention. Following widespread HPV vaccination implementation, HPV infections declined by 88% in females aged 14 - 19 years and 81% in those aged 20 - 24 years [5]. Organized screening programs and high vaccination coverage have reduced cervical cancer incidence and mortality by nearly 75% over the past 50 years in high-income countries [14]. The median standardized incidence in ultra-high Human Development Index (HDI) countries is 7.3 per 100,000, while in low-HDI countries it is nearly three times higher [10].

The mortality disparity is equally striking. Globally, cervical cancer caused 270,000 deaths in 2015, with 90% occurring in LMICs. The incidence is 15.7 cases per 100,000 women in LMICs versus 9.9 in high-income countries, and cervical cancer is 18 times more morbid in LMICs [15]. Pakistan is projected to experience 129,184 cervical cancer deaths between 2020 and 2070 if current trends continue [13].

During the MGH observership, it was observed how systematic prevention, through routine HPV vaccination of adolescents, catch-up vaccination for young adults, and organized screening programs, has transformed cervical cancer from a common malignancy into an increasingly rare disease in the United States. This transformation is not merely a function of wealth; it reflects deliberate, evidence-based public health strategies that Pakistan must urgently adopt and adapt.

2.2. Barriers to HPV Vaccination in Pakistan

2.2.1. Socio-Cultural Barriers

Socio-cultural factors constitute perhaps the most formidable barrier to HPV vaccination in Pakistan. The association of HPV with sexual transmission creates profound discomfort in a conservative society where discussions about sexual health are deeply taboo [16] [17]. These taboos lead to widespread ignorance about sexually transmitted diseases and cervical cancer prevention. A qualitative study in Karachi found that adolescent girls were unfamiliar with basic female reproductive health concepts, and parental vaccine hesitancy, particularly among fathers who serve as primary decision-makers, was a significant barrier [18].

The stigma surrounding HPV vaccination is multifaceted. It employed an intersectional lens to analyze how mistrust, stigma, and inequity rooted in historical, gendered, religious, and geopolitical power dynamics hinder vaccine acceptance. Moral anxieties surrounding adolescent sexuality create resistance, with many parents fearing that vaccination might encourage sexual activity [9]. This concern is not unique to Pakistan but is amplified by conservative cultural norms.

Gender dynamics further complicate vaccine acceptance. A study in Karachi revealed striking gender bias: 88% of women responded negatively regarding vaccine acceptability for their sons, compared to 37% for their daughters [19]. This disparity reflects deeply ingrained beliefs about gender, sexuality, and vulnerability. Addi-

tionally, fathers are identified as key decision-makers for vaccination, while female relatives are preferred for health discussions, creating a communication gap that impedes informed decision-making [18].

Cultural hesitation extends beyond individual families to community-level resistance. In the principal author's practice in a peripheral Pakistani city, families have been encountered who view HPV vaccination with suspicion, sometimes influenced by rumors spread through social media about alleged side effects, including infertility claims. The Tando Bago incident, where mass psychogenic reactions occurred following vaccination, exemplifies how cultural anxieties can rapidly escalate into public health crises [8].

2.2.2. Religious Concerns and Misconceptions

Religious misconceptions represent another critical barrier. While Islam does not prohibit vaccination, diverse religious interpretations and lack of clear endorsement from religious leaders create hesitancy [9]. Some community members mistakenly believe that HPV vaccination conflicts with Islamic teachings, particularly regarding premarital sexual activity [13]. These misconceptions are often amplified by misinformation circulating on social media platforms [20].

Interestingly, comparative insights from the United Arab Emirates and Saudi Arabia, both Muslim-majority countries with higher vaccination acceptance challenge assumptions about inherent religious resistance [9]. This suggests that the barrier is not Islam itself but rather the absence of culturally sensitive health communication that addresses religious concerns within an Islamic framework. During the MGH observership, it was noted how providers are trained to address vaccine hesitancy by acknowledging patients' values and beliefs while providing evidence-based information, an approach that could be adapted for Pakistan by engaging Islamic scholars and community leaders.

2.2.3. Knowledge and Awareness Gaps

Knowledge and awareness gaps are pervasive across all segments of Pakistani society. Multiple studies document alarmingly low awareness of HPV, cervical cancer, and the preventive vaccine. Only 20.6% of women in Karachi were aware of HPV as a risk factor for cervical cancer, and merely 25.5% knew a preventative vaccine existed [13]. Among female undergraduate students in Karachi, 69.9% were aware of the HPV vaccine, but only 19.3% were vaccinated [21]. Another study found that 36.09% of young female students had no prior knowledge of HPV vaccines [16].

Even among healthcare providers, knowledge gaps are concerning. A study of female healthcare providers at a public sector hospital aimed to assess knowledge, attitudes, and vaccination frequency, revealing significant deficiencies [22]. Another study of physicians in a teaching hospital in Karachi highlighted that successful vaccination programs require primary care physician recommendations, yet many physicians lack adequate knowledge to provide strong recommendations [23].

The lack of information is consistently cited as the primary reason for non-vaccination. In one study, 58.8% of women reported lack of knowledge as the main barrier [17], while another found that 58% cited lack of information [24]. This knowledge deficit extends beyond awareness of the vaccine's existence to understanding its mechanism, safety profile, and importance for cancer prevention. Only 40.2% of women in one Karachi study were familiar with HPV vaccination's ability to prevent cervical cancer [17].

In the principal author's clinical practice, even educated women have been observed to confuse HPV with HIV or remain unaware that HPV is sexually transmitted. This fundamental knowledge gap makes it nearly impossible for women to appreciate the vaccine's value. During the MGH observership, the routine integration of HPV education into adolescent well-visits was particularly striking, with providers using age-appropriate language and visual aids to explain the vaccine's cancer-prevention benefits, a practice virtually absent in most Pakistani healthcare settings.

2.2.4. Structural and Infrastructural Barriers

Structural and infrastructural deficiencies pose formidable challenges to HPV vaccination in Pakistan. Until the September 2025 launch of the national campaign, HPV vaccination was not included in any national immunization program [1]. The vaccine remains unavailable in most regions, and where available, it is prohibitively expensive [25]. Nearly half of respondents in one study perceived the vaccine as overpriced (46.8%) [26], and only 12% of women were willing to pay for vaccination themselves [19]. Even among those willing to accept vaccination, 49% would only do so if it were free [17].

Rural healthcare infrastructure is particularly inadequate. Pakistan's peripheral cities and rural areas lack the cold chain logistics necessary for vaccine storage and distribution [13]. Healthcare facilities are often understaffed and under-resourced, making it difficult to add new vaccination programs. The recent nationwide campaign has been disrupted by natural calamities, including floods, which have damaged infrastructure and displaced populations [8].

The cost-intensive nature of HPV vaccination for large-scale populations, given Pakistan's limited health budget, creates a significant barrier. While international organizations like Gavi, the Vaccine Alliance, have provided support for the 2025 campaign [8], sustained funding and infrastructure development are essential for long-term success. The vaccine delivery model, whether clinic-based, school-based, or community-based, requires careful planning and resources that are currently insufficient.

In contrast, during the MGH observership, a robust infrastructure was witnessed where vaccines are readily available, cold chain is meticulously maintained, and multiple delivery points, including primary care clinics, specialty clinics, pharmacies, and mobile vaccination units, ensure accessibility. This infrastructure is supported by substantial public health funding and insurance coverage that eliminates cost barriers for patients.

2.2.5. Healthcare System Barriers

Healthcare system barriers compound the challenges of vaccine delivery. Inadequate training of healthcare professionals is a critical issue [13]. Many physicians and nurses lack confidence in discussing HPV vaccination, addressing parental concerns, or providing strong recommendations. Studies have shown that physician recommendation is a powerful predictor of vaccine acceptance, yet many Pakistani healthcare providers do not routinely recommend the vaccine [21].

The absence of systematic reminder systems and electronic health record prompts means that vaccination opportunities are frequently missed. Unlike the U.S. system, where EHR alerts notify providers when patients are due for HPV vaccination, Pakistani healthcare settings rely on paper records or fragmented electronic systems that do not support population health management. This lack of systematization results in inconsistent vaccine delivery.

Healthcare provider attitudes also play a role. Some providers view HPV vaccination as unacceptable or unnecessary, reflecting their own knowledge gaps and cultural biases [17]. The perception that vaccination is time-consuming (41.8% of respondents) further discourages providers from prioritizing it in busy clinical settings [26].

The healthcare system's focus on curative rather than preventive care is another barrier. In the principal author's experience practicing in Pakistan, preventive services are often deprioritized in favor of treating acute illnesses. There is little institutional incentive or accountability for vaccination coverage, unlike in U.S. academic centers, where quality metrics and pay-for-performance models incentivize preventive care.

2.2.6. Gender and Access Barriers

Gender-related barriers are deeply intertwined with socio-cultural factors but merit separate attention. Women in Pakistan face multiple access barriers, including limited autonomy in healthcare decision-making, restricted mobility, and economic dependence [9]. In many families, women require permission from male relatives to seek healthcare, creating delays and missed opportunities for vaccination.

Socioeconomic disparities exacerbate these barriers. Women from lower socioeconomic backgrounds have less access to health information, are less likely to attend schools where vaccination campaigns might occur and face greater financial constraints [9]. The presumption among some women that they do not need the vaccine "right now" reflects both lack of urgency and limited understanding of the vaccine's preventive nature [17].

Geographic disparities also affect access. Urban women, particularly those in major cities like Karachi and Lahore, have better access to healthcare facilities and information compared to women in rural and peripheral areas. However, even in urban settings, women from marginalized communities face barriers. The intersectionality of gender, socioeconomic status, geography, and education creates compounded disadvantages that must be addressed through targeted interventions.

3. HPV Vaccination in the U.S. Academic Cancer Center

3.1. Provider Education and Communication Training

One of the most striking features of HPV vaccination programs in U.S. academic cancer centers is the emphasis on provider education and communication training. At MGH and similar institutions, providers receive structured training on how to deliver strong, presumptive recommendations for HPV vaccination. A study described a locally adapted quality improvement program involving physician training facilitated by local physicians with high HPV vaccination rates [27]. This training included didactic instruction and video vignettes modeling effective communication techniques.

The communication approach emphasizes a "presumptive" rather than "participatory" style, where providers announce the vaccine as part of routine care rather than asking if parents are interested [27]. This subtle shift in framing significantly increases acceptance rates. Providers are also trained to address common concerns about vaccine safety, efficacy, and necessity using evidence-based talking points.

A provider-level intervention used Intervention Mapping to strengthen provider recommendations in a Federally Qualified Health Center [28]. The intervention included didactic instruction, interactive role-play with tailored messages, and take-home materials such as fact sheets and clinical guidelines. This comprehensive approach ensures that providers are not only knowledgeable but also confident and skilled in vaccine communication.

During the MGH observership, gynecologic oncologists were observed routinely recommending HPV vaccination to eligible patients during visits for HPV-related dysplasia or cancer, recognizing these as teachable moments [29]. This practice extends cancer prevention beyond the primary care setting into specialty care, maximizing opportunities for vaccination.

3.2. Electronic Health Record Systems and Reminder Mechanism

Electronic health record (EHR) systems are central to HPV vaccination success in U.S. academic centers. EHR-based alerts and reminders ensure that no eligible patient is overlooked. The 4 Pillars™ Program, which includes documenting vaccination in the electronic medical record, reviewing and updating accurate records, and using EHR prompts to alert providers when patients are due for vaccination [30].

One study implemented a multicomponent, systems-based intervention at a sexual and reproductive health clinic that included electronic health record prompts, in-clinic education, and scheduling of the next visit at the current visit [31]. This approach significantly increased catch-up HPV vaccination rates. Similarly, U.S. healthcare settings utilized EHR systems for vaccination reports and gave provider prompts as part of quality improvement interventions [32].

The integration of immunization registries with EHR systems allows for population-level tracking of vaccination coverage and identification of patients who are

overdue for vaccination. While EHR and immunization registry data are used to monitor rates, interoperability issues and staffing needs can limit effective implementation, highlighting ongoing challenges even in well-resourced settings [33].

At MGH, EHR alerts were observed to appear automatically when a patient's chart is opened, prompting providers to discuss HPV vaccination if the patient is eligible. This systematization removes the burden of remembering from individual providers and ensures consistent vaccine delivery across the institution.

3.3. Patient Navigation and Multidisciplinary Approaches

Patient navigation and multidisciplinary approaches are hallmarks of U.S. academic cancer centers' vaccination programs. Patient navigators help address barriers to vaccination by providing education, scheduling appointments, arranging transportation, and following up with patients who miss appointments. This personalized support is particularly valuable for underserved populations.

Multidisciplinary teams involving physicians, nurses, pharmacists, community health workers, and quality improvement specialists collaborate to design and implement vaccination programs. A study described how the University of Texas MD Anderson Cancer Center, an NCI-designated cancer center, developed an institutional framework to increase adolescent HPV vaccination by assembling a transdisciplinary team and constructing a portfolio of collaborative multi-sector initiatives [34]. This resulted in an implementation community of 78 institutions collaboratively implementing 12 initiatives within a shared measurement framework.

Mobile vaccination programs extend access beyond traditional clinical settings. It was evaluated by an HPV Vaccination Van Program established by the Medical University of South Carolina Hollings Cancer Center, which provided mobile HPV vaccinations in school districts and health clinics, and focused on children aged 9 - 18 [35]. The program emphasized a vaccine-bundling approach, offering all recommended adolescent vaccines, and involved partnerships with school districts and community organizations.

A multilevel pilot intervention guided by evidence-based approaches and community input, involving parents, primary care teams, and clinics, increased HPV vaccination among rural adolescents aged 11 - 17. This multilevel approach significantly increased both initiation and completion rates [36].

During the MGH observership, the seamless coordination between different departments and the availability of patient navigators who ensure that vulnerable patients do not fall through the cracks were particularly impressive. This level of coordination and support is largely absent in Pakistani healthcare settings.

3.4. Quality Improvement Initiatives

Quality improvement (QI) initiatives are systematically employed in U.S. academic centers to continuously enhance HPV vaccination rates. These initiatives involve setting measurable goals, tracking progress, providing staff feedback, and imple-

menting iterative improvements based on data.

Quality improvement leaders in healthcare systems endorsed HPV vaccination as beneficial, with facilitators for implementing HPV vaccine QI programs including automation and standardization in QI efforts and passionate vaccine champions [37]. Almost all QI leaders reported future plans to implement HPV vaccine QI projects.

The 4 Pillars™ Program described includes tracking progress, setting goals, and providing staff feedback as core quality improvement components. A study used weekly audits to track data and identify eligible students for vaccination in a university student health clinic, demonstrating how regular monitoring drives improvement [38].

A study implemented a quality improvement initiative involving counseling and offering HPV vaccination to eligible postpartum patients aged 26 years or younger [39]. Physicians were surveyed to assess clinician-reported patient screening for HPV vaccine eligibility, which significantly increased during the initiative.

At MGH, quality metrics for HPV vaccination are regularly reviewed at departmental meetings, and providers receive feedback on their vaccination rates compared to institutional benchmarks. This culture of continuous improvement, supported by data transparency and accountability, drives sustained high performance.

4. Comparative Reflections: Resource-Limited vs. High-Resource Settings

The contrast between clinical experiences in Pakistan and observations made during the MGH observership illuminates both the challenges and opportunities for improving HPV vaccination in resource-limited settings. The disparities are not merely financial; they reflect fundamental differences in healthcare system organization, public health infrastructure, provider training, and cultural approaches to prevention.

Infrastructure and Resources: The most obvious difference is infrastructure. MGH benefits from robust cold chain systems, reliable electricity, well-maintained facilities, and abundant supplies. In contrast, many Pakistani healthcare facilities struggle with basic infrastructure, including unreliable power supply that jeopardizes vaccine storage. However, this does not mean that effective vaccination programs are impossible in Pakistan. School-based delivery models, which have achieved 80% - 95% coverage in demonstration projects in Peru, Uganda, India, and Vietnam, offer a scalable solution that bypasses some infrastructure limitations [40].

Systematization vs. Opportunism: U.S. academic centers employ systematic approaches with EHR prompts, standing orders, and population health management tools that ensure consistent vaccine delivery. Pakistani healthcare, by contrast, relies on opportunistic vaccination providers who must remember to offer vaccines

during clinical encounters. While Pakistan cannot immediately replicate sophisticated EHR systems, simpler systematization strategies such as standing orders, provider checklists, and paper-based reminder systems can improve consistency.

Provider Training and Confidence: The comprehensive provider training programs in U.S. settings equip clinicians with communication skills and evidence-based knowledge to address vaccine hesitancy. Pakistani providers often lack such training, leading to weak or absent vaccine recommendations. Adapting U.S. training models to the Pakistani context using local champions, culturally relevant scenarios, and Urdu-language materials could significantly enhance provider confidence and recommendation strength.

While U.S. providers are trained to address vaccine hesitancy by acknowledging patient values, the cultural context differs markedly. In Pakistan, addressing religious concerns requires engagement with Islamic scholars and framing vaccination within Islamic principles of disease prevention and protection of life. The success of HPV vaccination programs in the UAE and Saudi Arabia demonstrates that Muslim-majority countries can achieve high coverage when religious leaders endorse vaccination and culturally sensitive messaging is employed [9].

Community Engagement: U.S. programs increasingly recognize the importance of community engagement, particularly for underserved populations. However, the depth of community engagement required in Pakistan is greater, given the profound cultural barriers and misinformation. Pakistan must invest in grassroots community mobilization, involving not only healthcare providers but also teachers, religious leaders, community elders, and women's groups.

Cost and Sustainability: U.S. vaccination programs benefit from insurance coverage and public funding that eliminate cost barriers for patients. Pakistan's reliance on external funding from organizations like Gavi is necessary but raises sustainability concerns. Long-term success requires Pakistan to allocate domestic resources to HPV vaccination and integrate it permanently into the national immunization program.

Lessons for Pakistan:

- Strong provider recommendations are critical: Training providers to deliver presumptive recommendations can significantly increase acceptance.
- Systematization improves consistency: Even simple reminder systems and standing orders can reduce missed opportunities.
- Multidisciplinary collaboration enhances reach: Engaging schools, community organizations, and non-traditional healthcare settings expand access.
- Data-driven quality improvement drives progress: Regular monitoring and feedback create accountability and continuous improvement.
- Addressing barriers requires tailored interventions: One-size-fits-all approaches fail; interventions must be adapted to local contexts.
- Sustainability requires institutional commitment: Vaccination programs succeed when they are embedded in organizational priorities and supported by leadership.

5. Recommendations for Pakistan

Public health interventions and the changes they bring occur slowly. National programs must start with a small set of immediate implementation actions that will make the transition from campaign delivery to routine immunization more operational. Overall, based on the barriers identified and lessons learned from U.S. academic cancer centers, the following evidence-based recommendations are proposed for Pakistan.

5.1. Integration into National Extended Program on Immunization (EPI)

- Permanent inclusion: Ensure HPV vaccination is permanently integrated into Pakistan's EPI, not treated as a temporary campaign.
- Two-dose schedule: Adopt the WHO-recommended two-dose schedule for girls aged 9 - 14 years, which is more cost-effective and logistically feasible than three-dose regimens.
- Catch-up vaccination: Develop strategies for catch-up vaccination of older adolescents and young women who missed the primary target age.
- Sustainable funding: Allocate domestic budget resources to HPV vaccination to reduce dependence on external donors and ensure long-term sustainability.

5.2. School-Based Delivery Model

- Primary delivery platform: Implement school-based HPV vaccination as the primary delivery model, leveraging existing school health infrastructure.
- High coverage potential: School-based programs have demonstrated 80% - 95% coverage in demonstration projects globally.
- Parental consent mechanisms: Develop streamlined parental consent processes that balance autonomy with accessibility, using opt-out rather than opt-in models where culturally appropriate.
- Out-of-school girls: Establish complementary community-based vaccination sites for out-of-school girls, partnering with community health workers and local organizations.

5.3. Culturally Sensitive Community Engagement

- Religious leader engagement: Partner with Islamic scholars and religious leaders to develop religiously endorsed messaging that frames HPV vaccination within Islamic principles of disease prevention and protection of life.
- Community mobilization: Conduct grassroots community mobilization involving teachers, community elders, women's groups, and local influencers.
- Culturally tailored messaging: Develop messaging that emphasizes cancer prevention rather than sexual transmission, reducing stigma and moral anxieties.
- Address misinformation: Implement proactive strategies to counter misinformation on social media and in communities, using trusted local voices.

- Male engagement: Recognize fathers and male family members as key decision-makers and develop targeted engagement strategies for men.

5.4. Provider Training and Education

- Comprehensive training programs: Develop and implement comprehensive training programs for healthcare providers (physicians, nurses, vaccinators) on HPV vaccination, covering vaccine science, communication skills, and addressing hesitancy.
- Presumptive recommendation training: Train providers to deliver strong, presumptive recommendations for HPV vaccination as part of routine care.
- Continuing medical education: Integrate HPV vaccination into continuing medical education requirements for relevant specialties (pediatrics, family medicine, obstetrics-gynecology).
- Provider champions: Identify and support local provider champions who can serve as trainers and advocates within their communities.
- Medical school curriculum: Integrate HPV vaccination education into undergraduate and postgraduate medical curricula.

5.5. Simplified Reminder and Tracking Systems

- Paper-based reminder systems: Implement simple paper-based reminder systems (checklists, standing orders) in healthcare facilities to prompt providers to offer HPV vaccination.
- Immunization registries: Develop or strengthen immunization registries to track vaccination coverage at district and national levels.
- Mobile health (mHealth) solutions: Explore low-cost mHealth solutions (SMS reminders, mobile apps) to remind parents of vaccination appointments and due dates.
- School vaccination records: Maintain school-based vaccination records that can be integrated with national immunization registries.

5.6. Public Awareness Campaigns

- Mass media campaigns: Launch sustained mass media campaigns using television, radio, print, and social media to raise awareness about cervical cancer and HPV vaccination.
- Celebrity and influencer engagement: Engage Pakistani celebrities, sports figures, and social media influencers to promote HPV vaccination.
- Survivor testimonials: Feature testimonials from cervical cancer survivors to personalize the disease burden and emphasize prevention.
- Educational materials: Develop age-appropriate, culturally-sensitive educational materials in Urdu and regional languages for parents, adolescents, and communities.
- School-based education: Integrate age-appropriate reproductive health education into school curricula to improve health literacy among adolescents.

5.7. Addressing Cost Barriers

- Free vaccination: Ensure HPV vaccination is provided free of charge to all eligible girls through the national program.
- Gavi support: Continue partnership with Gavi, the Vaccine Alliance, to access subsidized vaccines during the initial scale-up phase.
- Domestic resource allocation: Gradually increase domestic budget allocation to HPV vaccination to ensure sustainability beyond Gavi support.
- Private sector engagement: Engage the private healthcare sector to offer HPV vaccination at subsidized rates for families who prefer private care.

5.8. Strengthening Infrastructure

- Cold chain enhancement: Invest in cold chain infrastructure, including solar-powered refrigerators for areas with unreliable electricity.
- Vaccine supply chain management: Strengthen vaccine supply chain management to prevent stockouts and wastage.
- Healthcare facility readiness: Ensure healthcare facilities have adequate staffing, supplies, and training to deliver HPV vaccination.
- Mobile vaccination units: Deploy mobile vaccination units to reach remote and underserved areas.
- Disaster preparedness: Develop contingency plans to maintain vaccination programs during natural disasters and emergencies.

5.9. Quality Improvement and Monitoring

- Coverage monitoring: Establish robust systems for monitoring vaccination coverage at district, provincial, and national levels.
- Data-driven decision-making: Use coverage data to identify low-performing areas and implement targeted interventions.
- Quality improvement initiatives: Implement quality improvement initiatives in healthcare facilities to continuously enhance vaccination rates.
- Adverse event surveillance: Establish active surveillance systems for adverse events following immunization to ensure vaccine safety and maintain public confidence.
- Regular evaluation: Conduct regular program evaluations to assess implementation fidelity, identify barriers, and adapt strategies.

5.10. Multisectoral Collaboration and Partnerships

- Government coordination: Ensure coordination between the Ministry of Health, Ministry of Education, and provincial health departments.
- International partnerships: Strengthen partnerships with WHO, UNICEF, Gavi, and other international organizations for technical and financial support.
- Academic partnerships: Partner with Pakistani and international academic institutions for research, training, and program evaluation.

- Civil society engagement: Engage non-governmental organizations, women's rights organizations, and community-based organizations in program implementation.
- Private sector collaboration: Collaborate with pharmaceutical companies for vaccine supply and with private healthcare providers for service delivery.
- Regional learning: Participate in regional networks to share experiences and learn from successful HPV vaccination programs in other Muslim-majority countries (e.g., UAE, Saudi Arabia, Malaysia).

6. Conclusions

Cervical cancer is a preventable tragedy. The stark contrast between Pakistan's high cervical cancer burden and the near-elimination of the disease in countries like the United States underscores the transformative potential of HPV vaccination. The principal author's dual perspective as a Pakistani obstetrician-gynecologist from a resource-limited setting and as an observer at Massachusetts General Hospital has reinforced the conviction that while the challenges are substantial, they are not insurmountable.

Pakistan faces multifaceted barriers to HPV vaccination, including socio-cultural taboos, religious misconceptions, profound knowledge gaps, inadequate infrastructure, healthcare system deficiencies, and gender-related access barriers. However, the September 2025 launch of the national HPV vaccination campaign represents a historic opportunity to change the trajectory of cervical cancer in Pakistan. Success will require sustained commitment, adequate resources, culturally sensitive implementation, and adaptation of evidence-based strategies from high-resource settings. A limitation of the narrative review is that data comes mostly from big cities like Karachi and Punjab with little data from rural areas. Thus, this analysis may not fully represent rural, provincial, or national vaccine attitudes.

The lessons from U.S. academic cancer centers, strong provider recommendations, EHR-based systematization, multidisciplinary collaboration, patient navigation, and quality improvement offer valuable insights that can be adapted to the Pakistani context. School-based delivery models, community engagement, provider training, and strategic partnerships with international organizations are particularly promising strategies for Pakistan. A caveat to attributing advances in the United States to HPV vaccination alone is that long-term declines in the U.S. cervical cancer burden are primarily driven by decades of widespread cytologic screening. The impact of HPV vaccination on reducing specific infections, preinvasive disease and cervical cancer is a recent phenomenon.

Ultimately, eliminating cervical cancer in Pakistan is not merely a technical challenge; it is a moral imperative. Every woman who dies from cervical cancer represents a failure of prevention. As healthcare providers, policymakers, and community members, we have the knowledge, tools, and evidence to prevent these deaths. What is required now is the collective will to act to invest in prevention, to challenge cultural taboos, to educate communities, to train providers, and to ensure that every

Pakistani girl has access to life-saving HPV vaccination.

The observership at MGH demonstrated what is possible when prevention is prioritized and systematically implemented. This experience, juxtaposed against the realities of clinical practice in Pakistan, underscores the urgent need for transformation. The path forward is clear: Pakistan must learn from global best practices, adapt them to local contexts, and commit to sustained action. The lives of millions of Pakistani women depend on it.

Declaration

The observership experiences at the Division of Gynecologic Oncology, Massachusetts General Hospital, described throughout this review are those of the **Principal Author** (RA).

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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