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Using an implementation research framework to identify potential facilitators and barriers of an intervention to increase HPV vaccine uptake

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Abstract

Background—Although incidence of cervical cancer has been decreasing in the United States over the last decade, Hispanic and African American women have substantially higher rates compared to Caucasian women. The human papillomavirus (HPV) is a necessary, although insufficient, cause of cervical cancer. In the U.S. in 2013, only 37.6% of girls 13–17 years old received the recommended three doses of a vaccine that is almost 100% efficacious for preventing infection with viruses that are responsible for 70% of cervical cancers.

Implementation research has been underutilized in interventions for increasing vaccine uptake. The Consolidated Framework for Implementation Research (CFIR), an approach for designing effective implementation strategies, integrates five domains that may include barriers and facilitators of HPV vaccination. These include the innovative practice (Intervention), communities where youth and parents live (Outer Setting), agencies offering vaccination (Inner Setting), healthcare staff (Providers), and planned execution and evaluation of intervention delivery (Implementation Process).

Methods—Secondary qualitative analysis of transcripts of interviews with 30 community healthcare providers was conducted using the CFIR to code potential barriers and facilitators of HPV vaccination implementation.

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Results—All CFIR domains except Implementation Process were well-represented in providers' statements about challenges and supports for HPV vaccination.

Conclusion—A comprehensive implementation framework for promoting HPV vaccination may increase vaccination rates in ethnically diverse communities. Further research is needed to determine if identifying implementation barriers and facilitators in all five CFIR domains as part of developing an intervention contributes to improved HPV vaccination rates.

Introduction

Although incidence of cervical cancer has been decreasing in the United States(US) over the last decade,¹ Hispanic and African American women continue to have substantially higher rates of disease. In 2011 incidence rates were 11.3/100,000 for Hispanic women and 9.9/100,000 for African American women, in contrast to 7.4/100,000 among White women.² Since 2006, HPV vaccines have been approved that protect against most types of HPV that are responsible for cervical cancers in the US.^{3,4} The Advisory Committee on Immunization Practices (ACIP)⁵ recommends that one of the HPV vaccines be offered to all 11- and 12-year old girls and boys, and to females aged 13 to 26 years and males ages 13–21 years who have not previously been vaccinated.

In the U.S, the number of 13–17 year-old females who received three doses of the HPV vaccine increased from 2007 through 2011 and then nearly plateaued, with only 37.6% of girls receiving all three doses in 2013.⁶ This is far below the Healthy People 2020 goal of 80% for teens 13–15 years of age,⁷ indicating a gap in implementation of the recommended HPV vaccine schedule. Completion rates of the recommended three doses of vaccine among African American and Hispanic female youth and young adults ranged from about half to 75% of White adolescent females the same age.^{8,9}

An extensive literature describes overall low rates and disparities in HPV vaccination uptake,^{9–10} possible reasons for these gaps in prevention services,^{8,9,11–12} and recommendations and interventions for increasing vaccine uptake.^{11–13} Systematic reviews related to HPV vaccination uptake and completion that have been published in the last decade reflect a wide range of potentially helpful activities, and yet leave many questions unanswered. Brewer¹¹ noted that differences in healthcare systems and cultural factors may compromise synthesis of studies from different countries, although a number of reviews have included reports of interventions on several continents (e.g.,^{14,15,16}). Reviewers have focused on the perspectives of parents, adolescents, and sometimes young adults, such as their knowledge and attitudes, information needs, or perceived barriers to HPV vaccination,^{16,17,18,19,20} with Garcini²¹ describing methods used to obtain information about parents' points of view about HPV vaccine. Others aimed to synthesize evidence of correlates of positive attitudes toward vaccination, vaccination initiation or completion, reviewing studies that included information about the setting where vaccine is delivered,^{14,15,22,20} public policies related to vaccination,¹⁷ and the impact of training and feedback to physicians.²³

However, implementation research, which provides guidance for integrating evidence-based interventions into community settings,²⁴ has rarely been utilized to address this public health

problem. Potential outcomes of implementation research-guided programs include design or selection of more feasible and appropriate community interventions for specific clinics and communities, and greater acceptability and adoption of vaccination protocols by healthcare providers,²⁵ contributing to an increased level of HPV vaccination adoption by parents and patients.

The Consolidated Framework for Implementation Research (CFIR)²⁶ offers a comprehensive “meta-theoretical” approach for improving implementation of evidence-informed practices that can be particularly helpful for increasing HPV vaccination rates. The CFIR, a synthesis of concepts described in 19 implementation models, organizes 37 constructs across five domains that can guide the work involved in changing a system to improve intervention outcomes. Table 1 illustrates potential application of CFIR domains to HPV vaccination implementation.

The HPV vaccination intervention includes the vaccine itself, printed information about HPV vaccine, provider education and counseling about HPV vaccine, and three doses of vaccine delivered to a patient at the recommended intervals. Educational materials and face-to-face counseling constitute what is referred to in the CFIR as the “adaptable periphery” of the intervention, meaning they can and should be modified across patient populations in order to improve implementation and intervention outcomes. Printed educational information delivered to patients and content of patient-provider conversation about HPV vaccine have been found to vary considerably^{27–28} with one reviewer noting that most print materials are designed for well-educated audiences.¹¹

Clinic-level factors are referred to as the Inner Setting in the CFIR. Examples are categorization of a visit as “problem-focused”,¹⁰ and daily volume of patients seen,²⁹ both of which have been identified as reasons for missing opportunities for vaccination. Javanbakht et al.¹² noted that staffing patterns and workflow in their study settings meant that “medical assistants and case managers ... play a critical role” in determining which patients are assessed and recommended for, as well as receive, all three doses of vaccination; however these staff are seldom mentioned in efforts to increase vaccination rates.

Other frequently studied aspects of HPV vaccination implementation are factors characterized within the Individual Provider domain of the CFIR. These include provider attitudes and practices related to HPV vaccination,^{12,30–31} including their attitudes about vaccinating their own children.³² Some investigators have examined providers’ HPV vaccination-related communications with parents and patients^{33–34} and recommended education and support to improve provider knowledge, skills, and comfort related to discussing HPV vaccination with patients.

Combinations of factors that reflect multiple CFIR domains have been described in some studies. For example, investigators questioned parents (Outer Setting) and providers (Individual Providers) to obtain guidance for developing HPV vaccine educational programs.³² Feemster and colleagues³⁵ surveyed pediatricians about barriers to vaccination, eliciting information about benefits and costs of vaccine (Intervention); supply of vaccine in their clinic (Inner Setting); physicians’ knowledge and attitudes regarding HPV vaccine

(Individual Providers); and parents' concerns (Outer Setting). In another study, school policies that require HPV vaccination combined with a regional immunization registry (Outer Setting), communication patterns within the clinic (Inner Setting), and kinds of information presented by medical assistants and case managers (Intervention) were examined as facilitators of HPV vaccination.¹² However, most interventions to increase vaccination rates and reduce disparities have tended to be piecemeal, and research-based implementation models or frameworks have generally not been applied in these efforts.

The current study was part of a community-based participatory research (CBPR) project designed to develop a culturally-appropriate patient education intervention delivered by healthcare providers to increase HPV vaccination among African American and Hispanic youth ages 9–18 years and appropriate cervical cancer screening among mothers. In the formative phase of research, qualitative interviews were conducted with clinical staff who could potentially provide HPV vaccine or cervical cancer counseling to elicit input for designing a patient education intervention. The current study, a post-hoc analysis of the provider interview data, used the CFIR to categorize potential barriers and facilitators of vaccination identified during provider interviews.

Methods

Most of the individual healthcare providers (n=30) working in a convenience sample of three federally-qualified health centers in Tennessee and a minority-serving academic medical center clinic were interviewed between August 2009 and July 2010. These clinics are typical of settings that offer HPV vaccine to low-income families in the US. Trained study staff used a discussion guide to conduct 20–30 minute interviews in person or via telephone, asking providers about their perspectives on HPV vaccine, patients in their clinic communities, barriers to HPV vaccination, and suggestions for a culturally-appropriate educational intervention that could increase HPV vaccine acceptance by patients and their parents. The interviews were audio-recorded and transcribed.

The first two authors independently examined interview transcripts using thematic narrative analysis,³⁶ and coded segments of text using four CFIR domains. The fifth CFIR domain, Implementation Process, was not used because interviews were conducted prior to developing the intervention to increase HPV vaccination, and no comments were found that fit this domain. The two authors periodically compared quotes coded as examples of specific CFIR domains, and resolved discrepancies by referring back to the Additional File 4 accompanying Damschroder et al.²⁶ This study was reviewed and approved by the Meharry Medical College Institutional Review Board and received exempt status from the Tennessee State University Institutional Review Board.

Results

Demographics

Thirty providers, including 22 females and 8 males, responded to interview questions. Half identified themselves as African American, and English was the primary language of the

vast majority (n=25), with other languages including Spanish, Akan, and Korean. Additional demographics are provided in Table 2.

Characteristics of the Intervention

Table 3 summarizes implementation facilitators and barriers identified for each domain in the CFIR model. Implementation facilitators associated with the intervention include seeing HPV vaccine as “a great medical development,” “a very important and useful vaccine,” and “a worthwhile and cost-effective vaccine.” Some noted it provides “a great way to educate girls about their health and ... prevent cervical cancer in the future.” While many providers stated that they have no concerns about the vaccine, some expressed mixed feelings, such as: “I think anything that can help prevent cancer is wonderful and with any vaccine there are risks.”

Potential intervention-related barriers included uncertainty regarding the vaccine’s long-term effects such as its “efficacy and safety going forward,” as well as “unintentionally ... [sending] the wrong message” to adolescents about “what the vaccine is for and what other things [they] need to do in order to protect [themselves].” A number of comments illustrated the overlap between CFIR Individual Provider and Outer domains, such as this one: “My concerns are when talking to ... their mothers, or the mothers’ concern on how it will affect their daughters long-term.” Several providers mentioned the required three doses and potential discomfort associated with vaccination as barriers. Suggesting a change in dosage, one said, “I think it would be easier to administer as a single injection, and especially with our population, just getting patients back for the subsequent doses can be an obstacle.” One provider indicated that girls might not get all three doses “because it hurts,” while another reassured her patients that the vaccine is “relatively painless.”

The CDC’s Vaccines for Children (VFC)³⁷ program provides free vaccine for eligible youth up to age 18; however some providers were not clear about this. One said, “[for] girls, I think under 16, there was no charge maybe.” The cost of, and access to vaccine for VFC-ineligible youth was mentioned by some providers as a barrier to vaccination. “The only other thing is when they are over 18 and they don’t qualify for VFC, if they are uninsured, it’s a little expensive ... Even if they do have insurance, we do not have a stock that we can use in the clinic,” noted one provider.

Implementing the intervention may involve the providers discussing sexual transmission of HPV, which requires sensitivity to family and cultural contexts. Only a few providers reported they explicitly describe HPV as a sexually transmitted virus. One nurse practitioner recommends the HPV vaccine at age 11 when other routine vaccines are administered “so it makes it a lot less dramatic.” Several providers noted their responsibility for providing safe sex counseling for their patients, including discussing HPV as a sexually transmitted infection (STI). A physician explained, “I will usually discuss the HPV vaccine in the same breath as ... tetanus and then I’ll talk about dental care and exercise and diet and then I’ll talk about sexual activity and contraception.” Some providers said they are uncomfortable, or perceive parents to be uncomfortable, with HPV vaccination for children under 11 years of age because it involves discussing sexual behaviors. A pediatrician said “most of the time [with] the 9 year-olds, the parents don’t do it. They want to wait.”

Most providers describe sources of educational information they offered to patients, including HPV vaccine manufacturers, the American Congress of Obstetricians and Gynecologists (ACOG), and Centers for Disease Control and Prevention (CDC). However, many reported they have no print educational materials to offer to their patients. All providers responded to requests for suggestions for improving educational materials and recommended incorporating dimensions of Hispanic and African American culture (reflective of the Outer Setting), including materials in Spanish and other languages. Some suggested pictures that reflect their patient populations, with one stating, “It’s always helpful to have someone like you on the paperwork.” Several advised that patient education materials reflect sensitivity to cultural nuances in mother-daughter relationships related to healthcare decisions.

Printed materials containing visuals were also suggested to cater to those individuals who have “limited literacy.” An internist said, “If you cannot find a way to put it in terms that are understood ... then you will lose the patient. The patient won’t understand the importance or the need for care.” One provider noted that Spanish language materials are sometimes written at a reading level beyond the comprehension of his patients.

A number of providers recommended non-print media in the clinic and community, such as waiting room videos, or “something small ... like an iPhone [application]” that is “simple, and to the point.” Another provider suggested development of “an interactive program ... with ... [an] incentive,” as well as shorter videos that can be accessed through You Tube.

Outer Setting

Providers estimated Spanish is the primary language for one-third to more than half of their clinic patients. One provider said that “if [patients] don’t understand English ... they might not ever hear about [the HPV vaccine]” outside of their clinic visit. Some providers indicated that their perceptions of patient social and cultural influences guide their conversations with patients; however, most providers stated that they do not approach families of varying ethnicities in different ways other than providing printed information in Spanish if it is available.

Public media messages included both facilitators and barriers to vaccination. Several providers described a television Gardasil commercial as increasing knowledge and awareness of the HPV vaccine in the community. Some expressed frustration about messages such as those from “religious groups protesting the administration of the vaccine for young girls because they don’t think we should be talking to young girls about sexuality.”

Inner Setting

Most providers indicated that free vaccine is available in their clinic while some described logistical barriers to providing the vaccine for patients over 18 years, because there was no free vaccine, or vaccine on hand was only for patients younger than 17 years. One noted “There is a patient assistance program through Merck but we haven’t quite figured out the best way of getting patients enrolled as well as eventually obtaining the vaccine for them and administering it. So there seems to be just a lot of logistical hoops to jump through for those

patients who might qualify for the patient assistance.” This illustrates an overlap between Inner and Outer Setting Domains in that securing patient assistance sometimes requires effective communication between clinic staff and employees of a pharmaceutical company.

Many clinics do not have efficient methods in place to provide clinic-based reminders of appointments for follow-up shots, which could facilitate vaccination. One provider noted, “In terms of getting [patients] back for the subsequent doses, I would say that we are not very good at all about reminding them ... we have a very high no-show rate.” Also, one provider perceived clinic hours of operation as a barrier, stating, “If you are only open during school hours then it is going to be hard for children to get in with their parents.”

Some providers stated they could be more successful if they had opportunities to talk with young people without their parents present; however some providers thought parental presence was required for discussion of a vaccine. Most indicated that adolescents can be seen alone “for diagnoses related to birth control, sexually transmitted diseases, and women’s health issues,” while others thought this was prohibited, or were unsure of the policy. All providers reported seeing Spanish-speaking patients, and several commented that interpreters are not always readily available. They noted that they could not be confident about what information was shared when young patients interpreted for their parents.

Individual Provider Characteristics

Strong provider support for the HPV vaccine was based on beliefs regarding the vaccine’s effectiveness and respect for organizations and agencies that recommend HPV vaccination. One provider said, “I think that we should be advocates for it ... we can prevent cancer, which decreases the morbidity and mortality of our patients.” Many providers indicated they have no concerns about the vaccine’s safety, and one nurse practitioner stated, “At this point, I have more reservations about not giving it to [patients.]” Provider knowledge about HPV vaccine and self-efficacy for communicating effectively with parents and patients varied. One family medicine physician said, “I don’t know much about it.” A resident described uncertainty about how many doses are required for effective prevention.

Provider self-efficacy for communicating with patients and youth about HPV vaccine ranged from high to low levels. A number of providers expressed confidence in their knowledge about the vaccine and ability to explain HPV vaccine to facilitate parents’ and patients’ understanding and acceptance. One said, “It depends on me ... I think it is my job as a provider to figure out whether they understand or not.” However, many providers reported having a difficult time explaining HPV and the vaccine to their patients due to limited parent and patient health literacy, and because it is associated with sexual behavior.

Discussion

The CFIR’s comprehensive approach to identifying elements of HPV vaccination implementation can improve appropriateness, acceptability, and adoption among healthcare providers, patients and youth in specific clinics and communities.. Whereas most HPV vaccination interventions described in the literature involve only one or two implementation domains, the results of this study indicate that more implementation factors may need to be

addressed in order to improve HPV vaccination outcomes and improve minority health. Suggestions for mitigating barriers to HPV vaccine implementation are presented in Table 4.

Some authors have noted that behavioral theories strengthen HPV program development and research,^{11,17} observing a lack of theoretical bases for some interventions.²¹ While theories that have a narrow focus, such as the Health Belief Model (Brewer 2007) are compatible with an implementation framework, a broader behavioral theory such as the Social Ecological Model as used by Ferrer¹⁷ or the Theoretical Domains Framework³⁸ will show more overlap with one such as the CFIR.

Outer Setting factors such as attitudes and beliefs of parents, youth or young adults about HPV vaccination, and patient characteristics such as race/ethnicity, socioeconomic status, and access to healthcare have received a fair amount of attention. These have been investigated as predictors of vaccine uptake,^{11,39,40} as well as addressed in educational intervention design^{11,27,41} However, Fu et al.¹⁸ found no specific educational program that has been particularly effective in increasing HPV vaccination rates, while reporting that some studies involved too few participants to fairly test their impact. Providers in this study expressed concern about their Spanish-speaking patients' health literacy levels, suggesting there may be opportunities to improve vaccination rates with provider training using a culture-centered approach.⁴² Within the CFIR such training could be prompted by attention to Inner Setting or Implementation Process domains.

Suggestions associated with the Inner Setting include changes in support staff activities and infrastructure development to increase the routine delivery of text message reminders for follow-up vaccination appointments. For example, text message reminders as part of the intervention, which have been recommended to increase HPV vaccine coverage,^{31,43,44,45} must involve clinic staff electronic record keeping and other aspects of infrastructure critical for consistent delivery.

Holman et al.²² categorized research related to efforts to increase HPV vaccination rates published since 2009 in terms of barriers associated with healthcare providers, parents, and populations at higher risk due to minority status, lack of health insurance, and low income. Their results can also be described in terms of the CFIR domains. For example, they concluded that verbal and printed information for parents needs to clearly describe the benefits and safety of HPV vaccine, and the recommended ages for receiving it (Intervention). They noted that policies to reduce or eliminate cost of vaccine is critical, and that school- and pharmacy-based vaccination may be a way to reach more at-risk youth (Outer Setting). Clinic staff could embed cues in electronic medical records to send text messages (Inner Setting) to parents and patients to increase the likelihood that follow-up doses will be completed. The authors endorsed continuing education of healthcare providers to increase skills for effectively communicating with parents and youth about the need for vaccination prior to onset of sexual activity (Individual Providers).

Their review was notable for the lack of attention to factors included in the CFIR domain of Implementation Process. These include involving stakeholders (such as clinic staff, healthcare providers, parents and youth) in advocating for and planning an HPV vaccine

promotion campaign, executing the plan according to its timeline, collecting quantitative and qualitative data about progress towards specific goals and reporting it back to stakeholders for evaluation and revision.

One limitation of this study is that interviews were not originally designed with the CFIR model in mind, so investigators did not have the opportunity to probe further about its domains. At the same time, the study demonstrated that domains proposed by the CFIR coding lens were represented in providers' comments as expected. Another limitation is that a convenience sample of clinics was selected for provider interviews, and the providers who were interviewed may not be representative of staff in a variety of settings. It may be that in some settings a smaller proportion of providers are female, and similar interview questions may have yielded different results. In addition, this study did not include data collection during or following implementation of an intervention so provider perception of the Implementation Process domain was not evident. Of note, few details regarding implementation process were mentioned in the systematic reviews cited earlier in this paper.

A strength of the study is that interviews reflected perspectives of providers in community settings which might parallel those of many non-academically-affiliated providers. Although the focus of the initial study that collected data was on improving patient education (an element of the Intervention), providers' comments referred to three other CFIR domains as well, indicating that their perceptions of facilitators and barriers of HPV vaccination include a range of factors addressed in implementation research.

In conclusion, implementation research offers a variety of frameworks for improving the appropriateness, acceptance, and adoption of innovative HPV vaccination programs.^{46–47} These and other implementation outcomes²⁵ mediate the degree to which efforts to increase rates of completed HPV vaccination will be successful. The CFIR provides an integrated range of factors to be considered when developing, selecting, or implementing an intervention to increase HPV vaccination rates. These include developing or adapting HPV counseling and education for a particular group of potential beneficiaries, understanding the social and political forces in a particular community that can be used to increase awareness and acceptance of the vaccine, addressing factors within a clinical setting that may interfere with effective delivery, introducing HPV vaccination to healthcare providers in ways that address their questions and concerns, and increase their self-confidence for discussing it with parents and youth. Further research is needed to examine the extent to which using a model such as the CFIR to design and implement an intervention improves HPV vaccination rates in community settings.

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TABLE 1

Factors that may affect HPV vaccine implementation organized by CFIR²⁶ domains

Domain	Description
<i>Characteristics of the Intervention</i>	Three dose requirement; recommendations by national public health authorities; strength of evidence supporting benefits of vaccination; its cost, expectation of pain and adverse side effects; printed educational materials for parents and patients that reflect their culture and health literacy level (overlaps with Outer Setting domain)
<i>Outer Setting</i>	Policies that support free or low-cost vaccine (overlaps with Inner Setting); media campaigns and pharmaceutical advertising promoting HPV vaccine; agency staff contact with other agencies that implement HPV vaccine, and perceptions regarding peer professionals' attitudes about vaccination; community ethnicity and languages spoken by parents and patients; cultural pressures related to HPV vaccine on parents and youth
<i>Inner Setting</i>	Number of clinical staff; reminders to providers to offer patients second and third doses; formal and informal communication among staff about vaccine; clinic norms and climate related to HPV vaccine; perception of pressure to increase vaccination rate (overlaps with Implementation Process); perceived importance of vaccination relative to other clinician duties; existence of vaccination goals and feedback to providers regarding progress toward goals; clinic leadership attitudes toward increasing vaccination rate; access to training to improve provider knowledge, skills, and self-efficacy; availability and location of educational materials; policies and support regarding providers seeing adolescents without parents; access to interpreters on site
<i>Individual</i>	Provider knowledge and skills related to delivering HPV vaccine and communicating with parents and patients (overlaps with Characteristics of the Intervention); self-efficacy related to delivering vaccine and counseling parents and patients regarding vaccine; attitudes and beliefs regarding HPV vaccination, and about educating and counseling parents and patients about HPV (overlaps with Outer Setting)
<i>Implementation Process</i>	Involvement of providers in planning and designing introduction of HPV vaccination to parents and youth; dedicated key individuals who encourage and support others in providing intervention; appointed internal leader of team to increase vaccination rates; respected outsiders who provide support, such as a provider from another setting where vaccination rates have been increasing; an implementation plan that includes steps and a timeline and provides benchmarks to determine progress; feedback to staff about progress regarding implementation goals (overlaps with Individual Providers and with Inner Setting)

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TABLE 2

Provider demographics

Variable	N (total=30)	%
<i>Provider's Age</i>		
<25–35	14	47
36–45	8	27
46–55	4	13
56+	4	13
<i>Provider Type</i>		
Physician	22	74
Physician's Assistant	2	7
Nurse Practitioner	5	17
Not reported	1	3
<i>Specialty</i>		
Family Medicine	12	40
Obstetrics-Gynecology	8	27
Pediatrics	5	17
Internal Medicine	1	3
Women's Health	2	7
Not reported	2	7
<i>Ethnicity</i>		
African-American	14	47
Caucasian	9	30
Hispanic	3	10
Other (African, Asian, Indian, Romanian)	4	13

TABLE 3

Facilitators and barriers of implementation reported by providers, organized by CFIR domains

Facilitators	Barriers
<i>Characteristics of Intervention</i>	
<ul style="list-style-type: none"> Effectiveness of vaccine for preventing cervical cancers and genital warts Considered to be very safe, with only temporary side effect of injection pain Free vaccine for certain patients Culturally-relevant patient education materials Advocated by respected agencies/organizations 	<ul style="list-style-type: none"> Seen as relatively new and lacking evidence regarding long-term safety Pain associated with injection Three dose requirement Involves discussion of sexual health Lack of culturally tailored educational materials Lack of educational materials at appropriate reading level Cost of vaccine
<i>Outer Setting</i>	
<ul style="list-style-type: none"> Patients' trust in providers Publicity via vaccine commercials State policies that support free vaccine for certain patients 	<ul style="list-style-type: none"> Patient-provider language barriers Limited health literacy among parents and patients Religious leaders speaking out against vaccination
<i>Inner Setting</i>	
<ul style="list-style-type: none"> Readily available vaccine Professional interpreters on site Clinic policies that allow providers to talk to teens alone 	<ul style="list-style-type: none"> Lack of patient appointment reminders Inconvenient clinic hours Limited access to professional interpreters
<i>Individual Providers</i>	
<ul style="list-style-type: none"> Strong support for HPV vaccine Confident about conveying relevant information Familiar with sources of information about HPV and vaccine Respect for organizations/agencies that recommend HPV vaccination 	<ul style="list-style-type: none"> Uncertainty about long-term safety of vaccine May see no need for, or have no time for tailoring communication for ethnically diverse patients Lack of comfort discussing sexual nature of HPV transmission with parents of pre-teens

TABLE 4

Strategies to mitigate barriers to HPV vaccine implementation organized by CFIR domains

CFIR Domain	Strategies
<i>Characteristics of Intervention</i>	<ul style="list-style-type: none"> • Address potential concerns about long-term safety of HPV vaccine with updated evidence from clinical studies for parents and patients. • Provide current information about evidence that HPV vaccine prevents several types of cancer and genital warts to parents and patients; consider messages that emphasize health maintenance which may be more persuasive for some youth. (Alexander 2012) • Provide printed educational materials for parents and patients that reflect their culture and health literacy level. • Offer topical numbing for patients who are concerned about vaccination pain.
<i>Outer Setting</i>	<ul style="list-style-type: none"> • Develop alliances with culture-specific health promotion groups in the community. • Partner with faith communities to educate parents and youth about benefits and safety of vaccine. • Advocate for policies that allow for vaccines to be delivered in schools. (Cook 2010)
<i>Inner Setting</i>	<ul style="list-style-type: none"> • Routinely identify sources of vaccine at no or low cost. • Send patients reminders of appointment for second and third doses. • Remind medical staff to inform parents and patients of vaccine eligibility at every visit until all three doses are administered. (Dempsey 2011) • Ensure access to interpreters and appropriate educational materials in provider exam and consultation rooms.
<i>Individual Providers</i>	<ul style="list-style-type: none"> • Provide continuing education for providers to address evidence that their recommendations can be critical for improving vaccination rates, importance of vaccination prior to onset of sexual activity, and effective culturally-tailored communication strategies related to sexual transmission of HPV (Brewer 2007; Ylito 2013) • Encourage providers to recommend vaccine even if they think cost might be a burden for families (Ylito 2013) (and address cost pro-actively as part of Inner Setting domain).
<i>Implementation Process</i>	<ul style="list-style-type: none"> • Engage clinic staff and providers in identifying clinic structures and resources that facilitate HPV vaccination, and strategies for addressing barriers that are simple and require fewest changes. • Develop an HPV vaccination campaign planning team that includes parents and youth, providers and clinic staff, establishes a timeline for implementation, evaluates progress, and provides feedback to clinic staff and providers. (Damschroder 2009)