Published in final edited form as:
Cancer Epidemiol Biomarkers Prev. 2011 July ; 20(7): 1463–1472. doi:10.1158/1055-9965.EPI-11-0267.

Understanding sub-optimal HPV vaccine uptake among ethnic minority girls

Roshan Bastani[1], **Beth Glenn**[1], **Jennifer Tsui**[1], **L. Cindy Chang**[1], **Erica Marchand**[1], **Victoria M. Taylor**[2], and **Rita Singhal**[3]

[1] UCLA School of Public Health and Jonsson Comprehensive Cancer Center, Los Angeles, CA

[2] Fred Hutchinson Cancer Research Center, Seattle, WA

[3] Los Angeles County Department of Public Health, Office of Women's Health, El Monte, CA

Abstract

Background—The introduction of HPV vaccines represents a breakthrough in the primary prevention of cervical cancer. However, little is known about vaccination uptake and correlates among U.S. low-income, ethnic minority and immigrant populations who may benefit most from the vaccine.

Methods—Telephone interviews (N=490) were conducted in six languages between January and November 2009 among mothers of vaccine-eligible girls (ages 9–18) using the Los Angeles County Department of Public Health, Office of Women's Health service referral hotline. HPV and vaccine awareness, knowledge, beliefs, barriers, and daughter's vaccine receipt were assessed.

Results—The sample consisted of low-income, uninsured, ethnic minority and immigrant women. Only 29% of daughters initiated the vaccine and 11% received all three doses. No ethnic differences were observed in initiation or completion rates. Ethnic differences were observed in HPV awareness, perceived risk, and other immunization related beliefs. The strongest predictor of initiation was vaccine awareness (OR=12.00). Daughter's age and reporting a younger acceptable age for vaccination were positively associated with initiation. Mothers of unvaccinated girls reported lacking information about the vaccine to make a decision (66%) and not knowing where they could obtain the vaccine (74%).

Conclusion—Vaccination rates in this sample were lower than state and national estimates, and were associated with low levels of vaccine awareness. Interventions, including culturally targeted messaging, may be helpful for enhancing HPV vaccine knowledge, modifying vaccine-related beliefs and increasing uptake.

Impact—Our findings provide valuable guidance for developing interventions to address sub-optimal HPV vaccination in high risk groups.

Keywords

HPV vaccine; cervical cancer prevention; minorities; health disparities; low-income

CORRESPONDING AUTHOR: Roshan Bastani, PhD, Division of Cancer Prevention & Control Research, UCLA School of Public Health & Jonsson Comprehensive Cancer Center, 650 Charles Young Drive South, Room A2-125 CHS, Box 956900, Los Angeles, CA 90095-6900, Phone: (310) 206-9266 Fax: (310) 206-3566, bastani@ucla.edu.

CONFLICTS OF INTEREST: The authors declare that there are no conflicts of interest.

INTRODUCTION

Disproportionate burden of cervical cancer

Cervical cancer disproportionately affects ethnic minority, immigrant, and low income women in the United States (U.S.) and remains a significant source of cancer morbidity and mortality in these groups (1, 2). In Los Angeles (L.A.) County, cervical cancer incidence is higher than the national average (10.0/100,000 vs. 8.7/100,000 respectively) with Latina and Asian/Pacific Islander women having the highest rates (3–5). More than a third of all women in L.A. County (41%) between age 18 and 49 are foreign-born (6), many carrying elevated risk from their home countries where cervical cancer remains the one of the most frequent causes of cancer morbidity and mortality (7).

The HPV Vaccine

The introduction of HPV vaccines represents a breakthrough in the primary prevention of cervical cancer. Two available HPV vaccines protect against HPV types 16 and 18 which currently account for 70% of all cervical cancer (8). The quadrivalent vaccine, which additionally protects against two HPV types (6 and 11) linked to genital warts, was first approved for use in the U.S. in 2006, while the bivalent vaccine (types 16 and 18 only) became available in late 2009 (9, 10). Vaccination is one of the most successful and least costly of all public health interventions. However, widespread adoption of the vaccine, particularly among the highest risk groups, will be critical for realizing the full potential of the vaccine in reducing cervical cancer burden.

HPV vaccine uptake to date

Recent data from nationally representative samples indicate that uptake rates are low among U.S. girls. The National Immunization Survey found that only 44% of 13–17 year old girls had received at least one dose of the vaccine in 2009 (11). Uptake rates reported from smaller studies on specific subgroup populations have varied widely (e.g., 26–47%) depending on sample characteristics, recruitment methods, and the timing of data collection but still reflect sub-optimal utilization (12–14).

Correlates of Uptake

Given the low uptake, it is important to understand factors that influence vaccine receipt such as demographics, health care access, and psychosocial factors. Ethnic differences have been examined in a number of studies, with mixed findings. Some have found evidence for ethnic differences in vaccine initiation (15, 16) while others report no differences (17, 18). Even when ethnic differences are reported, the direction of the reported relationship has not been consistent. For example, Pruitt & Shootman, (2010) showed that ethnic minority girls were less likely to have received the HPV vaccine than non-Latino whites while Chao et al. (2010) and Yaganeh et al. (2010) report that Latina girls were more likely to receive the vaccine compared to other ethnic groups. With respect to income, an inverse relationship was reported in two recent studies (11, 16). Similarly, Chao and colleagues (2010) found that girls with public compared to private insurance were more likely to have been vaccinated. Access to free or very low cost vaccine services among low income girls eligible for the Vaccines for Children (VFC) Program may explain these inverse relationships. Having a recent primary care provider office visit (15, 18) has also been associated with a greater likelihood of vaccine uptake in age-eligible girls.

Relatively few studies have examined psychosocial factors as correlates of uptake. In several small clinic-based studies, parental vaccine attitudes and knowledge and physician recommendation were associated with higher vaccination rates in girls (12, 13, 19). Only two recent studies sampled populations at higher risk for cervical cancer. Yegeneh and

colleagues (2010) found that among low income, primarily Latina, mothers, those who believed the vaccine was safe and effective were more likely to have vaccinated their daughters than mothers who did not share these beliefs (14). Brewer and colleagues (2010) found that parental intentions to vaccinate and anticipated regret were associated with greater vaccine uptake, while needing more information, being born-again Christian, and higher perceived barriers to access were associated with lower uptake among mothers in North Carolina counties with elevated cervical cancer rates (20).

The purpose of the current study was to assess HPV vaccine uptake and correlates (demographic, health care access, psychosocial) among low income, ethnic minority girls in Los Angeles County. This report adds to the current knowledge on HPV vaccine uptake by examining a wider range of correlates than those reported in the literature to date. In addition, this study makes a unique contribution to the literature in that it includes low income girls from multiple ethnic groups (Latino, African American, Chinese, Korean, Other Race) in the same study, allowing for direct ethnic group comparisons.

MATERIALS AND METHODS

Study Setting

The study was a collaborative project between the UCLA and the Los Angeles County Department of Public Health, Office of Women's Health (OWH). The OWH operates a multi-language hotline that serves low income, ethnic minority women. The hotline conducts over 10,000 calls per year and specifically targets low income women (≤200% of federal poverty level) eligible for county services, such as appointment scheduling for preventive services (e.g., cervical and breast cancer screening). Services are provided in 6 languages: English, Spanish, Chinese (Mandarin and Cantonese), Korean, and Armenian.

Data for this study were obtained by interviewing hotline users who were mothers or primary caregivers of girls who were eligible for the study. Hotline operators received special training on study protocols and content including: information on cervical cancer and the HPV vaccine, telephone interviewing techniques for research studies, study protocol and eligibility criteria, data collection instruments, and confidentiality and human subjects' protection.

Procedures (Eligibility, Recruitment, Data Collection)

Between January and November 2009, operators screened all hotline callers for eligibility after performing routine hotline services. At the time of the study, the quadrivalent vaccine (protecting against HPV types 6, 11,16, and 18) was approved for use in girls and young women ages 9 to 26 years (9). Eligibility criteria for the study included being 18 years of age or older, primary medical decision-maker for a girl 9 to 18 years old (consistent with the Advisory Committee on Immunization Practices (ACIP) recommendations and age eligibility criteria for the VFC Program) (9, 21), and a speaker of one of the hotline languages. Callers who were medical decision-makers for more than one girl were asked to provide data for the girl with the earliest birth month. Participants completed the interview immediately following eligibility confirmation unless they requested another time. All participants were mailed an HPV vaccine fact sheet developed by the CDC and translated by study staff, and a $10 grocery card incentive. The study protocol was approved by the institutional review boards of both UCLA and the Los Angeles County Department of Public Health.

Conceptual Framework & Survey Instrument

The Health Behavior Framework (HBF; Figure 1) (22, 23) guided the development of the data collection instrument. The HBF is a conceptual framework that synthesizes constructs from several theoretical models such as Social Cognitive Theory (24, 25), the Theory of Planned Behavior (26–28), and the Health Belief Model (29, 30). Items in the current questionnaire were adapted from prior intervention and survey studies using this framework and from ongoing population-based surveys (31, 32). The instrument was adapted from English into Spanish, Chinese (Mandarin, Cantonese), Korean and Armenian using methodology employed in prior studies (23, 33, 34) to assure parallel versions in all languages. OWH operators provided additional input to ensure appropriateness for the target population.

The 75-item instrument assessed: HPV vaccine uptake (i.e., initiation and completion) among eligible girls, HPV awareness and knowledge, beliefs about HPV and the vaccine (e.g., perceived vaccine effectiveness, daughters' perceived risk for HPV, perceived severity of HPV infection), general immunization attitudes, demographics, and health care access. Additional items administered to caregivers of unvaccinated girls assessed barriers to vaccine uptake. Note that only the quadrivalent vaccine was approved for use in the U.S. at the time of data collection. Closed-ended, single item measures were used in this study considering that the survey was administered by telephone to a very low literacy population (33, 34).

Statistical Analysis

Descriptive statistics were used to profile the study sample with regard to demographics and health care access, other HBF variables, and vaccine uptake. Fisher's Exact Test was used to examine differences in vaccine awareness and uptake, HBF variables, and general vaccine beliefs by race/ethnicity. Next, binary logistic regression analyses were used to examine relationships between demographics, health care access, other HBF factors and vaccine initiation, defined as receiving at least one dose of the vaccine. Results of the binary logistic regression analyses and tests of multicollinearity were used to determine the independent variables included in the final multivariate logistic regression model. Finally, Fisher's Exact Test was used to compare perceived barriers to HPV vaccine initiation by race/ethnicity among caregivers of unvaccinated girls. All analyses were conducted using SAS v10 software. Due to small sample size issues, similar analyses examining HPV vaccine completion (3 doses) were not performed.

RESULTS

Sample Characteristics

Of 2,146 hotline callers invited to complete the eligibility screener, only 18 refused (<1%). Of the remaining 2128 callers, 24.8% (n= 528) met eligibility criteria. The most common reason for ineligibility (97% of ineligible) was not being the caregiver for a girl between the ages of 9–18 years. Of those eligible, 93% (n=490) provided data. The majority (85%) of respondents were mothers of vaccine-eligible girls, with the remaining caregivers being grandmothers, stepmothers, aunts or older sisters. For simplicity, we refer to study participants as mothers for the remainder of this article.

Demographic characteristics of respondents and girls are shown in Table 1. The vast majority of participants were ethnic minorities (93%), immigrant women (88%) with low levels of income and education. Over half (52%) of participants were Latina; the remaining mothers were Chinese (20%), Korean (14%), African American (8%) or another race/ethnicity (7%; non-Hispanic white, multi-racial or from other Asian subgroups). Three-

fourths of mothers were uninsured and daughters were mainly on public insurance (61%) or uninsured (26%). The average age of respondents was 44 years and that of daughters was 14 years.

HPV vaccine awareness and uptake

Table 2 presents HPV vaccine awareness and uptake for the total sample and by race/ethnicity. Overall, 63% of respondents had heard of HPV and 61% had heard of the HPV vaccine, but statistically significant ethnic differences were observed. For example, 46% of Korean mothers were aware of HPV compared to about 65% of Latina, Chinese and African American mothers. In the total sample, 29% of mothers reported their daughter had initiated the vaccine (i.e., received at least one dose), including 33% of Latina mothers, 25% of Chinese, 24% of Korean, and 24% of African Americans mothers. Among all girls, 12% (n = 56) had completed the three dose regimen. No ethnic differences were observed in vaccine initiation or completion rates. Vaccine initiation rates were also examined among 13–17 year olds to allow comparisons with national data. In the total sample, 36% of girls in this age range had received at least one dose of the vaccine (data not in table).

Health Behavior Framework Constructs

Table 2 also presents HBF factors that may be correlates of vaccine initiation: perceived severity of HPV, perceived HPV risk of daughter, and perceived effectiveness of the vaccine. Most mothers perceived their daughters' risk for HPV to be the same or less than that of other girls their daughters' age (84%). Perceived severity of HPV was generally high, with 87% of mothers agreeing that HPV would be a serious problem for their daughters. About one third of mothers (33%) believed the vaccine was very effective against HPV and another third gave a "don't know" answer to this question. Statistically significant ethnic differences were observed only for perceived risk. Twenty percent of Latino and 11% of African American mothers thought their daughters were at greater risk for HPV compared to other girls, while not a single (0%) Chinese or Korean mother endorsed this category.

General Vaccine Attitudes and Opinions about School Mandates

Vaccine attitudes and opinions about school mandates for the vaccine differed by ethnicity (Table 2). The majority of mothers overall (92%) agreed that "immunization against disease is a good thing" but African American and Chinese mothers were less likely to endorse this statement compared to other groups. While mothers on average reported 13.9 years old was the youngest age acceptable for HPV vaccination (participants were told that the vaccine was approved for girls 9–26 and then asked at what age they thought the vaccine should be given), Chinese and Korean mothers on average believed their daughters should be vaccinated at older ages (15 years and 14.6 years respectively). Only 36% of respondents agreed that the HPV vaccine should be required for school entry and 53% of Koreans and 44% of Latinas were much more likely to supportive of mandates compared to 19% of African Americans and 16% of Chinese mothers.

Predicting Vaccine Initiations: Bivariate Analyses

The following were associated with greater odds of vaccine initiation (Table 3) in bivariate analyses: Latina ethnicity, daughter having an usual source of care, older age of daughter, having heard of HPV, believing it is acceptable for the HPV vaccine to be given at younger ages, higher perceived severity of HPV, higher perceived HPV vaccine effectiveness, holding favorable vaccine attitudes, agreement with school mandates for the HPV vaccine and believing that the vaccine should be given at a younger versus older ages.

Predicting Vaccine Initiation: Multivariate Analyses

Table 3 also presents results of multivariate logistic regression analyses to identify factors independently associated with HPV vaccine initiation. Variables included in the multivariate analyses were those found significant in bivariate associations (at $p<0.05$) and after taking into account issues of multicollinearity. Although not significantly associated with vaccination in bivariate analyses, respondent age and education were included in the model. Income was not included do to its correlation with education. A strong relationship between daughter's insurance status and usual source of care was observed; therefore, only usual source of care was included in multivariate analyses.

The first multivariate model included: ethnicity (Latina vs. non-Latina), education level of respondent, age of respondent, heard of HPV, daughter's usual source of care, daughter's age, perceived vaccine effectiveness, perceived severity of HPV, general vaccine attitudes, agreement with HPV vaccine school mandates, and youngest acceptable age for HPV vaccination. The strongest independent predictor of vaccine initiation was having heard of HPV (OR 12.8; 95% CI: 6.01, 27.2), older age of daughter (OR 1.23, 95% CI: 1.11, 1.36) and belief that vaccination is acceptable at younger ages (OR 1.19, 95% CI: 1.09, 1.29). No other variables were associated with vaccine initiation in this model.

The second multivariate model omitted HPV awareness to determine whether additional factors might emerge after removing awareness and its very strong association with vaccine initiation (data not shown). Results of the second model were similar to the first, except that higher perceived vaccine effectiveness emerged as an additional variable associated with greater odds of vaccine initiation (OR 1.81, 95% CI: 1.03 3.20).

Barriers to uptake among unvaccinated girls by race/ethnicity

Barriers to vaccine uptake were assessed among mothers of unvaccinated girls (n=345; Table 4). Two-thirds of these mothers (66%) reported needing more information about the vaccine before making a decision. Significant ethnic differences were observed, with 81% of Chinese, 66% of Korean, 64% of Latina, and 41% of African American mothers needing more information. The majority of women (74%), regardless of ethnicity, reported that they did not know where their daughter could get the vaccine.

A sub-set of participants (N=164) were administered an additional module of the questionnaire to assess concerns about the vaccine's potential impact on daughters' fertility, future health, and sexual behavior (Table 4). These items were added to the survey near the end of the data collection period. No differences in demographic variables (e.g. mother's race/ethnicity, marital status, income, education, age, years in the U.S., daughter's age, insurance status) were observed between the early and late cohorts. Relatively few mothers expressed concerns that the HPV vaccine would cause fertility problems (17%), negatively affect their daughter's health in the future (15%), or increase likelihood of sexual activity (13%). Ethnic differences were observed for concerns about future health problems and sexual behavior, but these estimates may be unstable given the very small sample sizes within ethnic groups.

DISCUSSION

Our study focused on daughters of low income, uninsured, ethnic minority, immigrant women who are at elevated risk for cervical cancer and yet vaccine uptake rates among these vulnerable girls were unacceptably low. Overall, only 29% of girls in our study had received at least one dose of the HPV vaccine. This rate is substantially lower than rates observed in the 2009 National Immunization Survey for L.A. County (63.5%) and the U.S. overall (44%) (11). Even the 36% vaccine initiation rate we found among girls 13–17 years of age is

lower than national rates reported for this age group (11). This suggests that national and regional data may overestimate vaccine initiation rates among the most vulnerable segments of our population. Our study was unique in that it included women and girls from multiple ethnic groups (Latino, African American, Chinese, Korean) and conducted interviews in five languages. Despite adequate sample sizes for comparisons across ethnic groups, no ethnic differences were observed in vaccine initiation or vaccine completion rates. This lack of ethnic differences may be due to the homogeneity of our sample with regard to the variables (e.g., income, education, insurance) that are generally associated with vaccine uptake in more heterogeneous samples.

The low vaccine initiation rate in our study may be partially explained by the fact that compared to national samples, awareness of HPV and the HPV vaccine were lower among our respondents. A little over 60% of our respondents had heard of the virus or the vaccine, compared to 78% of women in a representative U.S. sample (35). Awareness differed by ethnicity. While over 60% of Latino, Chinese, and African American mothers were aware of the HPV vaccine, only 44% of Korean mothers had heard of it. Results also revealed ethnic differences in beliefs relevant to vaccination, including daughters' perceived risk, beliefs about HPV vaccine mandates, and general vaccine attitudes. For example, 8% of Latina and 10% of African American mothers believed that their daughters at higher risk for HPV infection compared to other girls, while no Chinese or Korean mothers shared this belief. Ethnic differences in vaccine awareness and beliefs may be attributable to a variety of factors including lack of in-language materials about HPV and the vaccine, or cultural beliefs about teen sexual activity. While uptake is expected to increase as more mothers learn about the vaccine, it is unclear how ethnic differences in beliefs about HPV and the vaccine may affect uptake over time.

The strongest predictor of vaccine initiation in both bivariate and multivariate analyses was having heard of the HPV vaccine (OR=12.00). This suggests that for highly disadvantaged groups, the biggest payoff in the short run may come from raising awareness of the availability of the vaccine. Among mothers of unvaccinated girls, who made up the majority of our sample (69%), need for more information about the vaccine and not knowing where to go to get the vaccine were the most commonly reported reasons for why their daughters had not received the vaccine. This reinforces the need for in-language, culturally appropriate information dissemination regarding the vaccine as well as local information regarding where low cost or free vaccines are available.

We queried a sub-set of mothers about potential concerns about the vaccine that have received substantial attention in the lay press. Relatively few mothers were concerned that the vaccine would affect their daughter's fertility (17%), cause health problems in the future (15%) or lead to promiscuity (13%). Our findings suggesting that there may be ethnic differences in concerns about future health problems and promiscuity require cautious interpretation given the very small cell sizes for some groups.

Besides vaccine awareness, several other factors were associated with vaccine uptake in our study. Older daughters were more likely to have received the vaccine which is consistent with other reports in the literature (18, 36). This hesitation to vaccinate at younger ages, when the vaccine is likely to be the most beneficial, may have consequences for population-wide benefits that can ultimately be derived from increasing vaccine uptake. Future education efforts should focus on the benefits of vaccination of younger girls with respect to future cervical cancer risk. That such a focus may be valuable is suggested by our finding that mothers who endorsed vaccination at younger ages were more likely to have vaccinated daughters. Several other factors from the HBF were related to vaccine uptake. Higher perceived severity of HPV infection and higher perceived effectiveness of the vaccine were

associated positively with vaccine initiation. Although these factors did not emerge as significant in multivariate analyses (likely due to shared variance with other variables) they represent potential targets for intervention efforts. They are factors that are mutable and therefore viable mediators for achieving higher vaccine uptake.

Several limitations should be noted. Participants were all users of the L.A. County Office of Women's Health hotline, and are not representative of the general population of low income, ethnic minority mothers. Although the sample was large, ethnically diverse, and representative of hotline users, some between-group comparisons may have been underpowered due to small cell sizes. Additionally, self-reported vaccine initiation was not verified via medical records and therefore may overestimate (e.g., positive reporting bias) or underestimate (e.g., mother not aware that daughter received the vaccine) vaccine uptake in this population. Future research with similar populations should attempt to verify self-reports through medical record reviews.

This study makes important contributions to the literature regarding HPV vaccine initiation and its correlates. It is one of few studies focusing exclusively on low income ethnic minority girls, who may be at increased risk for cervical cancer. It is also unique in that it recruited a large sample of foreign-born women and administered surveys in several Asian languages as well as Spanish and English. Immigrant and non-English-speaking women may experience elevated risk for cervical cancer due in part to lack of access to Pap screening in their home countries and difficulties in navigating medical systems in the United States. Immigrant women may also be unfamiliar with guidelines and medical practices in the U.S. that can protect them and their daughters against cervical cancer.

Interventions are needed to educate low income, immigrant, ethnic minority mothers about the benefits of the HPV vaccine and link them to clinics where their daughters can obtain the vaccine free or at low cost. Culturally targeted messaging may also be important to modify vaccine-related beliefs and enhance uptake of the vaccine.

Acknowledgments

GRANT SUPPORT: CDC/NCI UCLA Cancer Prevention and Control Research Network (U48 DP000056/SIP 16-04)

We would like to thank our collaborators at the Office of Women's Health (Ellen Eidem, Susana Sevilla, and Hotline Operators).

References

1. Miller BA, Chu KC, Hankey BF, Ries LA. Cancer incidence and mortality patterns among specific Asian and Pacific Islander populations in the U. S Cancer Causes Control. 2008; 19:227–56.
2. SEER. SEER Cancer Statistics Review, 1975–2006. 2009. [cited 2010; Available from: http://seer.cancer.gov/csr/1975_2006/
3. Cockburn, M.; Liu, L.; Deapen, D. Cancer in Los Angeles County: Trends by Race/Ethnicity, 1976–2006. Los Angeles, CA: 2009.
4. LACDPH. Mortality in Los Angeles County 2005: Leading causes of death and premature death. Los Angeles County Department of Public Health, Office of Health Assessment and Epidemiology; 2008.
5. NCI. State Cancer Profiles: Incidence Rates for California, 2002–2006, Cervix, All Races (including Hispanic). 2010. [cited 2010 01–25]; Available from: www.statecancerprofiles.cancer.gov
6. LACDPH. Health Indictors for Women in Los Angeles County: Highlighting Disparities by Ethnicity and Poverty Level. Los Angeles, CA: Los Angeles County Department of Public Health, Office of Women's Health; 2010 February.

7. Ferlay, J.; Shin, HR.; Bray, F.; Forman, D.; Mathers, C.; Parkin, DM. GLOBOCAN 2008: Cancer Incidence and Mortality Worldwide. Lyon, France: International Agency for Research on Cancer; 2010.
8. Munoz N, Bosch FX, de Sanjose S, et al. Epidemiologic classification of human papillomavirus types associated with cervical cancer. N Engl J Med. 2003; 348:518–27. [PubMed: 12571259]
9. CDC. Quadrivalent Human Papillomavirus Vaccine: Recommendations of the Advisory Committee on Immunization Practices (ACIP). Centers for Disease Control and Prevention; 2007.
10. ACIP. ACIP Provisional Recommendations for HPV Vaccine. ACIP Meeting, October, 21, 2009; 2009 December 1, 2009; Atlanta, GA. 2009.
11. CDC. National, state, and local area vaccination coverage among adolescents aged 13–17 years - United States, 2009. 2010.
12. Gerend MA, Weibley E, Bland H. Parental response to human papillomavirus vaccine availability: uptake and intentions. J Adolesc Health. 2009; 45:528–31. [PubMed: 19837361]
13. Rosenthal SL, Rupp R, Zimet GD, et al. Uptake of HPV vaccine: demographics, sexual history and values, parenting style, and vaccine attitudes. J Adolesc Health. 2008; 43:239–45. [PubMed: 18710678]
14. Yeganeh N, Curtis D, Kuo A. Factors influencing HPV vaccination status in a Latino population; and parental attitudes towards vaccine mandates. Vaccine. 2010; 28:4186–91. [PubMed: 20417261]
15. Chao C, Velicer C, Slezak JM, Jacobsen SJ. Correlates for human papillomavirus vaccination of adolescent girls and young women in a managed care organization. Am J Epidemiol. 2010; 171:357–67. [PubMed: 20047978]
16. Pruitt SL, Schootman M. Geographic disparity, area poverty, and human papillomavirus vaccination. Am J Prev Med. 2010; 38:525–33. [PubMed: 20409501]
17. Allen JD, Othus MK, Shelton RC, et al. Parental decision making about the HPV vaccine. Cancer Epidemiol Biomarkers Prev. 2010; 19:2187–98. [PubMed: 20826829]
18. Reiter PL, Cates JR, McRee AL, et al. Statewide HPV vaccine initiation among adolescent females in North Carolina. Sex Transm Dis. 2010; 37:549–56. [PubMed: 20414146]
19. Dempsey AF, Abraham LM, Dalton V, Ruffin M. Understanding the reasons why mothers do or do not have their adolescent daughters vaccinated against human papillomavirus. Ann Epidemiol. 2009; 19:531–8. [PubMed: 19394865]
20. Brewer NT, Gottlieb SL, Reiter PL, et al. Longitudinal Predictors of Human Papillomavirus Vaccine Initiation Among Adolescent Girls in a High-Risk Geographic Area. Sex Transm Dis. 2010
21. CDC. Vaccines for Children Program. 2010 April 13. [cited 2010; Available from: http://www.cdc.gov/vaccines/programs/vfc/default.htm
22. Bastani R, Glenn B, Taylor VM, et al. Integrating theory into community interventions to reduce liver cancer disparities: The Health Behavior Framework. Preventive Medicine. 2010; 50:63–7. [PubMed: 19716379]
23. Maxwell AE, Bastani R, Chen MS, Nguyen TT, Stewart SL, Taylor VM. Constructing a theoretically-based set of measures for liver cancer control research studies. Preventive Medicine. 2010; 50:68–73. [PubMed: 19883680]
24. Bandura A. Human agency in social cognitive theory. Am Psychol. 1989; 44:1175–84. [PubMed: 2782727]
25. Bandura A. Health promotion by social cognitive means. Health Educ Behav. 2004; 31:143–64. [PubMed: 15090118]
26. Ajzen I. Perceived behavioral control, self-efficacy, locus of control, and the Theory of Planned Behavior. J Applied Soc Psychol. 2002; 32:665–83.
27. Ajzen I, Madden TJ. Prediction of goal-directed behavior: Attitudes, intentions, and perceived behavioral control. J Exp Soc Psychol. 1986; 22:453–74.
28. Fishbein, M.; Ajzen, I. Belief, attitude, intention and behavior: An introduction to theory and research. Reading, MA: Addison-Wesley; 1975.

29. Becker M, Maiman L. The Health Belief Model: Origins and correlates in psychological theory. Health Ed Monographs. 1974; 2:336–53.
30. Rosenstock IM, Strecher VJ, Becker MH. Social learning theory and the Health Belief Model. Health Educ Q. 1988; 15:175–83. [PubMed: 3378902]
31. CHIS. California Health Interview Survey, 2007, Adult Questionnaire. Version 51. Los Angeles, CA: UCLA Center for Health Policy Research; 2007.
32. CDC. National Health Interview Survey 2008. 2008. [cited 2010; Available from: http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm
33. Bastani R, Gallardo NV, Maxwell AE. Barriers to colorectal cancer screening among ethnically diverse high and average risk individuals. J Psychosocial Oncol. 2001; 19:65–84.
34. Bastani R, Glenn BA, Maxwell AE, Jo AM. Hepatitis B among Korean Americans: finding ways to improve testing, vaccination, and better health outcomes. Ethn Dis. 2007; 17:416–7. [PubMed: 17684794]
35. Jain N, Euler GL, Shefer A, Lu P, Yankey D, Markowitz L. Human papillomavirus (HPV) awareness and vaccination initiation among women in the United States, National Immunization Survey-Adult 2007. Prev Med. 2009; 48:426–31. [PubMed: 19100762]
36. Gottlieb SL, Brewer NT, Sternberg MR, et al. Human papillomavirus vaccine initiation in an area with elevated rates of cervical cancer. J Adolesc Health. 2009; 45:430–7. [PubMed: 19837348]

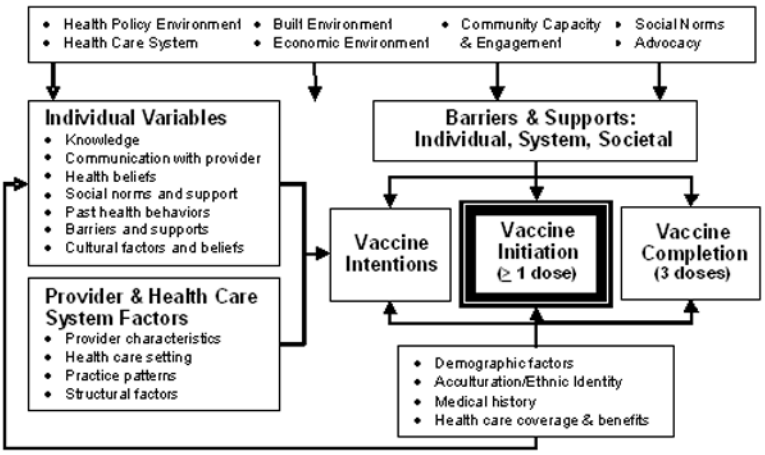

Figure 1.
Health Behavior Framework

Table 1

Sample Characteristics (n=490)

Caregiver Characteristics	%	N
Age (mean)	43.8	481
Race/Ethnicity		
Latina	52.0	255
Chinese	20.0	98
Korean	13.5	66
African American	7.8	38
Other*	6.7	35
Interview Language		
Spanish	47.3	232
Chinese	18.6	91
Korean	13.7	67
Armenian	1.6	8
English	18.8	92
Income (per year)		
<$12,000 or unemployed	35.6	162
$12,000 up to $24,000	38.5	175
$24,000 or over	25.9	118
Education		
Less than high school diploma	47.0	223
High school diploma	27.8	132
Any college or more	25.2	120
Marital Status		
Married or living as married	69.4	340
Nativity		
Foreign Born	88.2	432
U.S. Born	11.8	58
Years in U.S. among foreign-born (mean)	18.0	422
Insurance Status**		
Uninsured	75.2	366
Medicaid	15.2	74
Other Insurance	10.9	53
Usual Source of Care		
No	49.4	247
Yes	50.6	241
Adolescent Girl Characteristics		
Age (mean)	13.9	487

Caregiver Characteristics	%	N
Insurance Status **		
Uninsured	26.0	127
Medicaid or Healthy Kids	61.2	299
Other Insurance	18.2	89
Usual Source of Care		
No	71.2	349
Yes	28.8	141

* Other includes other Asian, Non-Latino White, Multi-race

** Not mutually exclusive

Table 2

HPV awareness, vaccine uptake and Health Behavior Framework constructs by race/ethnicity

	Total		Latina		Chinese		Korean		African American		Other		Fisher's Exact Test
	%	N	%	N	%	N	%	N	%	N	%	N	
Awareness													
Heard of HPV	63	306/489	64	163/255	66	65/98	46	30/66	68	26/38	69	22/32	**P=0.021**
Heard of HPV vaccine	61	294/485	62	158/255	64	63/98	44	27/62	65	25/38	66	21/32	**P=0.029**
Uptake													
Received ≥ 1 dose of HPV vaccine	29	139/484	33	84/255	25	24/97	24	15/62	24	9/38	22	7/32	P=0.295
Received all 3 doses	12	56/484	13	33/255	9	9/97	13	8/62	3	1/38	16	5/32	P=0.305
Health Behavior Framework Constructs													
Perceived Severity: Agrees HPV would be a serious problem for daughter	87	417/482	87	218/252	93	90/97	84	53/63	74	28/38	88	28/32	P=0.059
Perceived Risk: Daughter's risk for HPV compared to other girls their age													
More risk	6	28/480	8	20/252	0	0/95	0	0/63	11	4/38	13	4/32	**P< 0.001**
The same risk	19	89/480	22	55/252	21	20/95	3	2/63	13	5/38	22	7/32	
Less risk	65	311/480	62	155/252	61	58/85	86	54/63	68	26/38	56	18/32	
Don't know	11	52/480	9	22/252	18	17/95	11	7/63	8	3/38	9	3/32	
Perceived Effectiveness: HPV Vaccine's effectiveness against HPV is…													
Very effective	33	159/482	41	103/252	6	5/97	39	25/64	43	16/37	31	10/32	P=0.085
Somewhat Effective	28	137/482	23	58/252	47	46/97	33	21/64	16	6/37	19	6/32	
Not Effective	4	17/482	3	8/252	3	3/97	2	1/64	11	4/37	3	1/32	
Don't know	35	169/482	33	83/252	44	43/97	27	17/64	30	11/37	47	15/32	
General Vaccine Beliefs, Attitudes & Mandates													
General Vaccine Attitudes: Agrees immunization against disease is a good thing	92	446/485	98	248/254	77	75/97	97	64/66	87	33/38	87	26/30	**P=<0.001**
Youngest Acceptable Age for Vaccination: Age parents reported as acceptable for HPV vaccination (mean)	13.9	429	13.4	237	15.0	81	14.6	57	13.8	30	13.3	24	**P=0.002**

	Total		Latina		Chinese		Korean		African American		Other		Fisher's Exact Test
	%	N	%	N	%	N	%	N	%	N	%	N	
School Mandates: HPV vaccine should be required for school entry	36	176/484	44	111/253	16	15/97	53	35/66	19	7/37	26	8/31	**P<0.001**

Table 3

Bivariate and Multivariate Correlates of HPV Vaccine Initiation (Received ≥ 1 dose of HPV vaccine)

	Bivariate Analysis	Multivariate Model
	OR (95% CI)	OR (95% CI)
Demographics		
Caregiver Characteristics		
Age (Continuous)	0.99 (0.97, 1.02)	0.99 (0.95,1.02)
Race/ethnicity		
Latina	**1.57 (1.06, 2.33)**	
Chinese	0.78 (0.47, 1.30)	
Korean	0.74 (0.40, 1.36)	
African American	0.73 (0.34, 1.58)	
Other	0.68 (0.29, 1.61)	
Race/ethnicity (Ref: non-Latina)		
Latina		0.84 (0.41,1.71)
Income (Ref: <$24,000 or unemployed)		
$24,000 or more per year	0.82 (0.52, 1.29)	
Education (Ref: <HS Diploma)		
HS Diploma or more	1.38 (0.94, 2.04)	0.71 (0.37,1.39)
Marital Status (Ref: Not Married)		
Married	1.16 (0.76, 1.77)	
Nativity (Ref: Foreign-Born)		
U.S. Born	0.73 (0.39, 1.38)	
Years in U.S. among Foreign Born (Continuous)	1.11 (0.99, 1.04)	
Adolescent Girl Characteristics		
Daughter's Age (Continuous)	**1.13 (1.06, 1.22)**	**1.23 (1.11, 1.36)**
Insurance Status of Daughter (Ref: Uninsured)		
Insured	1.61 (0.99, 2.60)	
Usual Source of Care for Daughter (Ref: No)		
Yes	**1.95 (1.21, 3.14)**	1.76 (0.95, 3.30)
HPV and HPV Vaccine Related Factors		
Heard of HPV virus (Ref: No)		
Yes	**12.25 (6.40, 23.4)**	**12.8 (6.01, 27.23)**
Perceived Severity of HPV Infection (Ref: Disagree/Not Serious)		
Agree/Serious	**2.01 (1.02, 3.99)**	1.61 (0.66, 3.92)
Perceived Risk (Ref: Less Risk/Don't Know)		
Daughter at same risk or more risk than other girls	1.02 (0.64,1.62)	
Perceived Effectiveness of Vaccine (Ref: Not effective/Don't Know)		
Very Effective/Somewhat Effective	**2.87 (1.81, 4.53)**	1.41 (0.75, 2.66)
Immunization against disease is good (Ref: Disagree/Neither agree not disagree)		

	Bivariate Analysis	Multivariate Model
	OR (95% CI)	**OR (95% CI)**
Agree	**2.97 (1.14, 7.75)**	1.88 (0.60, 5.85)
School mandate for HPV vaccine (Ref: Disagree/Neither agree not disagree)		
Agree	**1.78 (1.19, 2.66)**	1.38 (0.81, 2.34)
Youngest acceptable age for HPV vaccination (Continuous)	**1.18 (1.10, 1.26)**	**1.19 (1.09, 1.29)**

Table 4

Barriers to HPV vaccine uptake among unvaccinated girls by race/ethnicity

Barriers	Total (n=345)		Latina (n=171)		Chinese (n=73)		Korean (n=47)		African Am. (n=29)		Other (n=25)		Fisher's Exact Test
	%	N	%	N	%	N	%	N	%	N	%	N	
Need more info to make a decision (n=341)	66	225/341	64	107/168	81	59/73	66	31/47	41	12/29	67	16/24	**P<0.001**
Do not know where to go to get the vaccine (n=322)	74	238/322	68	107/157	84	58/69	81	38/47	68	17/25	75	18/24	P=0.071
Thinks HPV vaccine may cause problems getting pregnant in the future (n=161)*	17	28/161	16	13/79	19	7/37	4	1/23	56	5/9	15	2/13	P=0.230
Thinks HPV vaccine may cause health problems in the future (N=164)*	15	26/164	11	9/79	24	9/38	4	1/24	44	4/9	21	3/14	**P=0.042**
Believes daughter may think it's okay to have sex after getting the HPV	13	22/164	11	9/79	15	6/38	0	0/24	11	1/9	43	6/14	**P=0.002**

Barriers	Total (n=345)		Latina (n=171)		Chinese (n=73)		Korean (n=47)		African Am. (n=29)		Other (n=25)		Fisher's Exact Test
	%	N	%	N	%	N	%	N	%	N	%	N	
vaccine (N=164)*													

*Note: Items added to the survey near the end of data collection thus administered only to a portion of mothers of unvaccinated girls.