ABSTRACT

Title of Document: FACTORS ASSOCIATED WITH COMPLETION OF THE HUMAN PAPILLOMAVIRUS VACCINE SERIES AMONG HISPANIC AND NON-HISPANIC WHITE ADOLESCENT GIRLS IN THE UNITED STATES

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Despite recommendations of three Human Papillomavirus (HPV) vaccine shots for all adolescent girls, only 29.1% of non-Hispanic Whites and 23.4% of Hispanics achieve completion. This study describes factors associated with completion of the HPV vaccine series among Hispanic and non-Hispanic White 13-17 year old girls who initiated the series. A secondary data analysis was performed of the cross-sectional 2009 National Immunization Survey–Teen survey. Despite similar initiation rates (one in five), Hispanic girls who had initiated the series (59.9%) were less likely to complete the series than non-Hispanic Whites (76.4%). After accounting for poverty status and home ownership, Hispanics were less likely to complete the HPV vaccine series. Factors associated with HPV vaccine series initiation were age at interview and age at HPV vaccine series initiation for Hispanics; and continuous health insurance since age of 11, mother's marital status, and number of children in the household for non-Hispanic Whites.

FACTORS ASSOCIATED WITH COMPLETION OF THE HUMAN PAPILLOMAVIRUS VACCINE SERIES AMONG HISPANIC AND NON-HISPANIC WHITE ADOLESCENT GIRLS IN THE UNITED STATES

By

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Table of Contents

List of Tables

List of Figures

Glossary of terms

ACIP	Advisory Committee on Immunization Practices
AHRQ	Agency for Healthcare Research and Quality
CDC	Centers for Disease Control and Prevention
HepB	Hepatitis B
HPV	Human Papillomavirus
IRB	Institutional Review Board
LEP	Limited English language proficiency
MenACWY	Meningococcal conjugate
MMR	Measles, mumps, rubella
MPH	Master of Public Health
NHIS	National Health Interview Survey
NCHS	National Center for Health Statistics
NCI	National Cancer Institute
NCIRD	National Center for Immunization and Respiratory Diseases
NIS-Teen	National Immunization Survey – Teen
SCHIP	State Children's Health Insurance Program
SES	Socio-economic status
SGO	Society of Gynecologic Oncologists
Tdap	Tetanus, diphtheria, acellular pertussis
UMCP	University of Maryland College Park
VAR	Varicella
VFC	Vaccine for Children
VLP	Virus-like particles
WHO	World Health Organization

Chapter I: Introduction

Background

Human Papillomavirus (HPV) is the most common sexually transmitted infection in the United States, (CDC, 2007). It affects 6.2 million persons 15 to 44 years of age annually, and an overall high-risk HPV prevalence of 23% was reported in 2003-2005, (CDC, 2007; Datta, et al., 2008). Prevalence varies by age group: 35% in persons 14 to 19 years of age, 29% in those 20 to 29, 13% in those 30 to 39, 11% in those 40 to 49, and 6.3% in those 50 to 65, (Datta, et al., 2008). Since the majority of HPV infections are asymptomatic and most infected individuals are unaware of their infection, transmission occurs frequently without knowledge of either partner, (Giuliano, 2007). HPV types 6 and 11 account for 90% of genital warts, and types 16 and 18 are responsible for 70% of cervical cancer in women, (CDC, 2007). HPV is associated with cervical cancer and less common anogenital cancers such as cancer of the vulva, vagina, penis, and anus, (CDC, 2007). Given the established causal association between HPV and cervical cancer, prophylactic HPV vaccination represents a potential means of lowering the chances of both cervical cancer and precursor lesions, (Stanley, 2007).

While implementation of cytologic screening programs with Pap screening has achieved dramatic decreases in both incidence and mortality from cervical cancer, in the U.S. 12,200 women were diagnosed with cervical cancer, and 4,210 women died from the disease in 2010, (NCI, 2010). Since HPV is a requisite for the development of invasive cervical cancer, strategies involving HPV testing have been incorporated into primary screening programs to allow for the detection and subsequent eradication of pre-invasive cervical dysplasia, (SGO, 2006).

Substantial racial, ethnic, and socioeconomic disparities exist for HPV infection, cervical cancer incidence, cervical cancer mortality, stages of diagnosis, and five-year survival rates, (Downs, Smith, Scarinci, Flowers, & Parbam, 2008). Cervical cancer incidence rates per 100,000 people in the U.S. are 7.5 for non-Hispanic Whites, 10.2 for non-Hispanic Blacks and 11.5 for Hispanics, (U.S. Cancer Statistics Working Group, 2010). Similarly, cervical cancer mortality rates per 100,000 people in the U.S. are 2.2 for non-Hispanic Whites, 4.3 for non-Hispanic Blacks, and 4.0 for Hispanics, (U.S. Cancer Statistics Working Group, 2010).

The main public health goals of developing an HPV vaccine are to reduce the incidence of cervical cancer and its precursor lesions, and to reduce the incidence of other HPV associated cancers and the benign conditions caused by HPV, (SGO, 2006). Two prophylactic vaccines, a bivalent (HPV-16 and HPV-18) vaccine and a quadrivalent (HPV-16, -11, -6, -18) vaccine have been developed, (Rambout, 2007). In June 2006, the U.S. Food and Drug Administration (FDA) approved Merck's Gardasil, a quadrivalent HPV vaccine containing virus-like particles of types 6,11,16,18, (CDC, 2007).[1] Clinical trials of the quadrivalent HPV vaccine have demonstrated 90%-100% efficacy in preventing precancerous cervical lesions attributable to HPV-16 and HPV-18 and anogenital disease caused by HPV-6 and HPV-11 among women who were uninfected before vaccination and who received all three vaccine doses, (Rambout, 2007; Fernandez, Allen, Mistry, & Kahn, 2010).

[1] The bivalent Cervarix vaccine by GalaxoSmithKline was approved by FDA in October 2009 (FDA, 2009). Since data collection for this study occurred between January 2009 and May 2010 it is less likely that females in this sample received the bivalent vaccine than the quadrivalent.

The Centers for Disease Control and Prevention (CDC) in the United States and the World Health Organization (WHO) Global Advisory Committee on Vaccine Safety have concluded that clinical trials data support the safety and efficacy of HPV vaccines, (CDC, 2007; WHO, 2006). Since efficacy is substantially lower among women who may be HPV-infected at the time of vaccination, the HPV vaccine had the most significant impact if vaccination is targeted to young adolescents, prior to sexual initiation and thus before HPV acquisition, (Paavonen, Jenkins, Bosch, Naud, & Salmeron, 2007).

In 2007, the Advisory Committee on Immunization Practices (ACIP) recommended that three doses of quadrivalent HPV vaccination (administered at 0, 2 and 6 months) be targeted to girls ages 11 or 12 years, with catch-up immunization recommended for ages 13-26, (CDC, 2007). In the case of boys, the ACIP has recommended against the routine use of HPV vaccine but leaves decisions on whether to immunize males ages 9-26 up to their health care professionals, (CDC, 2007).

Since ACIP recommendations for HPV vaccination were published, many policy and regulatory activities have been implemented to promote uptake of the vaccine among girls. These activities have focused on: financing HPV vaccination (particularly though the Vaccine for Children (VFC) program, Medicaid, and private insurance), mandating HPV vaccination for school age girls, and educating about HPV vaccination, (Fernandez, Allen, Mistry, & Kahn, 2010).

Despite the ACIP's recommendations and the government's support in making HPV vaccine series available, the reported rates of HPV vaccination remain low. In 2008, 44.3% of adolescent females (aged 13–17) had initiated the HPV vaccine series, and only 26.7% of the adolescent females had completed the series, (CDC, 2009). Great variability

in initiation of the HPV vaccine series was observed throughout the different states, ranging from 30.2% in Idaho to 69.0% in Massachusetts, (CDC, 2009). There were significant differences in initiation of the series among those above poverty level (51.9%) and those at or below poverty level (42.5%), but no statistically significant differences in initiation were observed for racial/ethnic minorities, (CDC, 2009). However, significant disparities exist in completion of the series: (29.1% of non-Hispanic Whites, 23.4% of Hispanics, and 23.1% of non-Hispanic Blacks complete the series), (CDC, 2009).

Despite similar completion rates between Hispanics and non-Hispanic Blacks, this study focused on examining factors associated with completion of the HPV vaccine series among adolescent Hispanics and non-Hispanic Whites who initiated the series. According to the Agency for Healthcare Research and Quality (AHRQ), Latinos are particularly at risk because they are less likely to have health insurance, less likely to have a usual source of care, less likely to be health literate, and more likely to have poor patient-provider communication in comparison to non-Hispanic Whites and non-Hispanic Blacks, (AHRQ, 2009).

While many studies have documented factors affecting initiation of the series, very few studies have examined correlates for completion of the HPV vaccination series among 9-26 year old girls and young women who initiated the series. Table 1 summarizes key factors associated with initiation and completion of HPV vaccine series based on previous literature, (Conroy, et al., 2009; Cook, et al., 2010; Jain, Euler, Shefer, Lu, Yankey, & Markowitz, 2009; Baker, Dang, Ly, & Diaz, 2010; Brewer & Fazekas, 2007). Access to health care services and socio-economic status (SES) were positively correlated with both initiation and completion of the series. Race/ethnicity also plays a

role for completion of the series, with non-Hispanic Whites being more likely to achieve completion.

Studies addressing characteristics that play a role in HPV vaccine series completion have focused on socio-demographic variables to identify some of the barriers in achieving higher vaccination rates among adolescents who initiated the series, (Chao, Velicer, Slezak, & Jacobsen, 2009; Dempsey, Cohn, Dalton, & Ruffin, 2010; Neubrand TP, 2009; Tan, Viera, Rowe-West, Grimshaw, Quinn, & Walter, 2011). Being an ethnic minority, living in areas with lower neighborhood educational level, and living far from a metropolitan statistical area were associated with poor HPV vaccine completion among girls who had initiated the series, (Chao, Velicer, Slezak, & Jacobsen, 2009; Tan, Viera, Rowe-West, Grimshaw, Quinn, & Walter, 2011). Health insurance coverage was found to be the strongest predictor of series completion among those who had received the first shot. Girls with private health insurance had the highest rates of completion among those who initiated the series, and girls with public health insurance were twice as likely to complete the series compared to girls without health insurance, (Widdice, Bernstein, Leonard, Marsolo, & Kahn, 2011). While the number of previous primary care provider visits was positively associated with completion of the series among those who initiated it, the number of prior hospitalizations and emergency department visits were negatively associated with completion, (Chao, Velicer, Slezak, & Jacobsen, 2009). While series initiation was more common at preventive care visits, series completion was most common at immunization-only visits, (Dempsey, Cohn, Dalton, & Ruffin, 2010).

Factors affecting compliance with medical treatment in the general population include side effects, fear of future risk of the disease, cost, negative health experience,

illness beliefs, and acceptability, (Elliott, Ross-Degnan, Adams, Safran, & Soumerai, 2007). Infant vaccination compliance has been shown to be unusually high due to routine well-child visits, a good understanding of universally recommended vaccination schedules by pediatric medical providers, high parental awareness of the importance of vaccination, and external requirements such as school entry laws, (Nelson, et al., 2009). However, vaccination compliance among adolescents is hindered by additional barriers.

Multiple factors contribute to difficulties immunizing adolescents. First, adolescents do not seek preventive health care, decreasing the likelihood that they will be immunized using new vaccines and that they will come back for multiple doses, (Society for Adolescent Medicine, 2006). Second, there is a general lack of awareness among parents and adolescents about the risk and severity of infectious diseases and the need for immunization, leading to a lack of prioritization of vaccination relative to other medical care, (Nelson, et al., 2009). Third, some studies reveal misconceptions among health care workers about new vaccines, resulting in suboptimal compliance, (Lehmann & Benson, 2009). Fourth, parents are often misinformed about which vaccines their adolescents should receive and when due to the frequent updates and changes to the adolescent vaccine schedule, (Nelson, et al., 2009). Fifth, time constraints may play a role in compliance to multi-dose vaccines with rigid schedules, (Society for Adolescent Medicine, 2006). Finally, the cost of immunization is still an obstacle for immunization adherence, (Lehmann & Benson, 2009).

ACIP recommends that the following vaccines are included in adolescent females immunization schedules: meningococcal conjugate (MenACWY, 1 dose); tetanus, diphtheria, acellular pertussis (Tdap, 1 dose); and for females human papillomavirus

(HPV, 3 doses), (CDC, 2009). Adolescents are also advised to receive any of the recommended childhood vaccinations they might have missed. These include: measles, mumps, rubella (MMR, 2 doses); hepatitis B (HepB, 3 doses); and varicella (VAR, 2 doses), (CDC, 2010). Based on 2009 NIS-Teen data, while childhood immunization coverage is high (MMR: 89.1%, HepB: 89.9%; and VAR: 75.7%), vaccines targeted for adolescents show much lower coverage rates for the recommended doses (Tdap: 55.6%; MenACWY: 53.6%; and HPV: 26.7%), (CDC, 2009). The only recommended vaccine that showed a statistically significant difference in coverage between Hispanics and non-Hispanic Whites was HPV vaccine (≥3 doses), (CDC, 2009).

In the case of the HPV vaccine, additional barriers need to be overcome. Since HPV is a sexually transmitted disease, some parents may be uncomfortable with perceived implications of HPV vaccine administration. Some have cited religious concerns about sexual behavior and fears that immunization may lead to promiscuity, while others have mentioned feeling no need to immunize because they trusted their children, (Constantine & Jerman, 2007). Some physicians have also expressed reservations about discussing sexuality before vaccination and feel more comfortable administering the vaccine to older rather than younger adolescents, (Daley, Liddon, Crane, & al, 2006).

High cost is a particularly important barrier to obtaining HPV vaccination and lack of health insurance coverage is a frequently cited barrier to delivery of adolescent immunization, (American Academy of Pediatric Comm Adolesc, 2009; Dempsey, Cohn, Dalton, & Ruffin, 2010; Downs, Smith, Scarinci, Flowers, & Parbam, 2008). The quadrivalent HPV vaccine is one of the most costly of all available pediatric and adult

vaccines, with an estimated cost of US$130 per dose (US$390 for three doses) for the private sector, and US$105 per dose for the public sector after CDC negotiations, (CDC, 2007; Gerend, Lee, & Shepherd, 2007). In the United States, the cost of vaccination is covered for many girls with private insurance and is also covered for many low-income girls by public financing, (Medicaid and the VFC program), (Adams, Newacheck, Park, Brindis, & Irwin, 2007). However, not all private insurance plans cover the cost of vaccination and adolescents from low-income families may not qualify for public financing, (Adams, Newacheck, Park, Brindis, & Irwin, 2007). In addition to those gaps, private insurance coverage and coverage through federal and state programs only partially address the cost barrier, since they do not account for the costs associated with clinic visits and the time spent in obtaining the HPV vaccine, (Wooten, Luman, & Barker, 2007).

Compliance with multidose adolescent-targeted vaccines like HPV requires a shift in parental expectations for the frequency of adolescent preventive health visits. While vaccine-related visits could potentially be used to augment adolescent preventive care services by providing additional opportunities for screening and counseling, there is concern that parents may find it difficult to bring their adolescent to the medical office so frequently, which could result in underutilization of vaccines, (Dempsey, Singer, Clark, & Davis, 2009).

Public Health significance

HPV vaccination has been acknowledged as a priority by the U.S. Department of Health and Human Services through the inclusion of three objectives (IID-11.4, C-10, and STD-9) in the Healthy People 2020 agenda, (USDHHS, 2010). Under the topic of Immunization and Infectious disease, we find objective IID-11.4: 3 doses of Human Papillomavirus vaccine for females by age 13 to 15 years. The baseline for this objective is 17% of females aged 13 to 15 years reported being vaccinated with 3 doses of the HPV vaccine in 2008, according to NIS-Teen, (CDC, 2009). The target for this objective is 80% of females 13-15 receiving 3 doses of the vaccine, in consistency with national programs. Related objectives include a 10% reduction of invasive uterine cervical cancer (C-10), and reduction of the proportion of females with HPV infections of types 6, 11, 16, and 18 (STD-9).

The few existing publications that analyze the correlates for HPV vaccine completion among teenage girls in the Unites States conclude that the rates of completion differ between non-Hispanic Whites and Hispanics but further research is needed to explore barriers to completion among Hispanics (CDC, 2009; Chao, Velicer, Slezak, & Jacobsen, 2009; Tan, Viera, Rowe-West, Grimshaw, Quinn, & Walter, 2011). While socio-demographic factors and access to health care services might play a role, the reasons underlying racial disparities in completion of the series are unclear.

Disparities in rates of completion among Hispanics are particularly concerning given the higher incidence and mortality rates from cervical cancer in this population. A genuine public health concern in the United States is the possibility of exacerbating these racial disparities in cervical cancer by non-completion of the vaccine series.

Research Question/Specific Aims

The overall goal of this study is to describe factors associated with completion of the HPV vaccine series among adolescents who initiated the series to better understand the impact of health care access and utilization as well as socio-demographic factors in continuity of care.

This study aims to:

1. Identify factors associated with completion of the HPV vaccine series among Hispanic and non-Hispanic White teens ages 13 to 17 who have received one dose of HPV vaccine.

   Descriptive statistics on selected variables provide information on the impact of race/ethnicity, SES, access and use of health care services, health insurance coverage, and geographic mobility on completion of the series.

   Our hypotheses were that the lowest rates of completion would occur among Hispanics, those with lower SES, those with more limited access and use of health care services, those who are uninsured, and those with more geographic mobility[2].
2. Examine variations by race/ethnicity in the factors associated with completion of the HPV vaccine series among teens ages 13 to 17 who have received one dose of HPV vaccine.

   Our hypothesis was that, when considering stratified models by race/ethnicity, the factors associated with completion of the series would be different for Hispanics and for non-Hispanic Whites.

[2] Geographic mobility is defined as state of residence at birth different from current state of residence

Chapter II: Methods

Study Design

We conducted a cross-sectional study using a subset of data reported by the 2009 National Immunization Survey – Teen (NIS-Teen), sponsored by the National Center for Immunization and Respiratory Diseases (NCIRD) and conducted jointly by NCIRD and the National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention (CDC). This survey collects data from telephone interviews with randomly selected households in all 50 States, the District of Columbia, and selected areas for oversampling. Consent is obtained from the parents or guardians of eligible adolescents to contact their vaccination providers. Mail surveys are then sent to healthcare providers to collect immunization data that assures the accuracy and precision of the vaccination coverage estimates.

The target population for the NIS-Teen is adolescents between the ages of 13 and 17 years living in non-institutionalized households in the United States at the time of the interview. Data from the NIS-Teen are used to produce timely estimates of vaccination coverage rates for all teen vaccinations recommended by the Advisory Committee on Immunization Practices (ACIP).

The 2009 NIS-Teen collected household data from January 6, 2009 to February 10, 2010, and provider data from January 2009 to May 2010. A total sample of 3.3 million telephone numbers yielded household interviews for 35,637 teens, 20,399 of whom had provider data adequate to determine whether the teen was up-to-date with respect to the recommended immunization schedule.

The overall response rate was 58.0% following the methodology of the Council of American Survey Research Organization (CASRO). This rate takes into account the resolution rate (82.7%), screening completion rate (85.0%) and interview completion rate (82.5%).

Study population

Given the purpose of this study to describe factors associated with completion of the HPV vaccine series among adolescents Hispanic and non-Hispanic White girls ages 13 to 17 who initiated the series, we restricted analyses to 13 to 17 year old Hispanic and non-Hispanic White females who initiated the HPV vaccine series at least a year prior to interview, who had complete provider data and sampling weights.

While NIS-Teen had data on immunization for both males and females, given that the HPV vaccine has only been recommended for females, NIS-Teen only asked about HPV vaccination to female participants.

Since Hispanics and non-Hispanic Whites show similar initiation rates but significantly different completion rates for the HPV vaccine series in the literature, our analysis was restricted to Hispanics and non-Hispanic Whites only, excluding non-Hispanic Black only and non-Hispanic other. Based on our focus to assess the differences in completion, only those participants who had initiated the HPV vaccine series at least a year prior to the interview date were included. Those participants who initiated the series less than a year prior to the interview were excluded based on the assumption that they might not have had enough time to complete the series. Participants who never initiated the series were also excluded.

Data on immunization were obtained directly from the providers' immunization records due to the higher reliability of this source compared to self-report. Our sample was then restricted to subjects with adequate provider data (57.4% of all age-eligible teens with completed household interviews). Since we conducted a weighted analysis accounting for clustering to better estimate associations in the entire population, only participants with appropriate sampling weights were included in the sample. After all exclusion criteria were met, the subjects included in our sample were 3,292 girls (560 Hispanics and 2,732 non-Hispanic Whites).

Human subjects

We completed the *Biomedical Research Basic Course* offered by the Collaborative Institutional Training Initiative in 2010. Study protocols were submitted for approval by the Institutional Review Board (IRB), University of Maryland College Park (UMCP) prior to data analysis. Since we used non-personally identifiable data collected by NIS-Teen and released for public use, our study was classified in the exempt category number 4 (research involving the collection or study of existing data, documents or records, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects). No additional data were collected for this study. We certify that all applicable institutional and governmental regulations concerning the ethical use of human subjects have been followed during this research project.

Prior to data collection, NIS-Teen interviewers introduced the telephone survey and obtained oral consent from the respondents, assuring confidentiality of the responses,

and informing them of the voluntary nature of the survey. Informed consent was obtained from the person in the household most knowledgeable about the eligible teen's immunization history. Informed consent to contact the teen's vaccination provider was obtained at the end of the interview.

Information in the NIS-Teen was collected and processed under strict confidentiality and can be used only for research. Prior to public release, the contents of the public use data file went through review by the NCHS Disclosure Review Board to protect participant privacy as well as data confidentiality.

Measurements

Dependent variable

The outcome of interest is "Completion of the HPV vaccine series," analyzed as a binary (yes/no) outcome. Completion of the series was defined as documentation of 3 separate vaccine doses, and it was measured using provider-reported data in the 2009 NIS-Teen. Information for this variable was obtained using the age in years of provider-reported HPV shot #3. The total number of teens in this category made up the "yes" category for the variable of interest. The category "no" was reconstructed subtracting the total number of those with 3 shots from the total number of those with at least 1 shot. Provider-reported data reflect vaccinations given both before and after the Household interview date and are considered the gold standard for immunization records given the reliability of the source.

Independent variable

The main exposure variable was race/ethnicity, assessed through the variable labeled as "Race/ethnicity of teen with multi-race category". This is a categorical variable with values: Hispanic and Non-Hispanic White[3] only. All other races were excluded from the sample population for the purpose of this analysis.

Potential confounders/ effect modifiers

Figure 1 outlines the selected factors potentially associated with completion of the Human Papillomavirus vaccine series in this study.

Socioeconomic status was assessed through three variables. First, "Poverty status" (categorized into: below poverty, above poverty ≤$75,000, and above poverty >$75,000), taking into account the number of people in the household. The second variable was "Home ownership" (categorized into: owned/ being bought, or rented/other arrangement). The third variable was "Mother's education" (categorized into: <12 years, 12 years, >12 years, and college graduate).

Use/access to health care was assessed through three variables: "In the past 12 months, has the teen seen a doctor or other health care professional?" (categorized into Yes and No); "Since age 11, has there been any time when the teen was not covered by any health insurance?" (categorized into Yes and No); and "Hepatitis B vaccine[4] series completion determined from provider info" (categorized into Yes and No).

[3] "Non-Hispanic White" was the terminology used on NIS-Teen methods of data collection

[4] Hepatitis B vaccination was included in this study based on similarities with the HPV vaccine: 3 dose schedule, used to prevent STI transmission, and relatively recent approval by FDA

Age was a potential confounder in this study given that 13 year old girls are less likely to have had the time to complete the HPV vaccine series than 17 year olds. Age at time of interview, labeled "Age", was analyzed as a categorical variable with possible values 13, 14, 15, 16, and 17. "Age at first shot" was also included in the model, categorized into values ≤13, 14, 15, 16, and 17.

Other socio-demographic variables of interest based on the literature were "Mother's marital status" (categorized into: Single and Married, with single including never married, widowed, divorced, separated, deceased), and "Number of children under 18 years of age in the household" (categorized into: 1, 2-3, ≥4), and "Geographic mobility status" defined as the state of residence at birth being different from current state of residence (categorized into Yes and No).

Statistical analysis

Descriptive statistics were calculated to provide a quantitative description of the study population in terms of race/ethnicity, SES, access/use of health care services, and other socio-demographic variables. Chi-square tests were performed to look for significant differences between those who have completed the HPV vaccine series and those who have not completed it.

A series of logistic regression models examined the independent effects of race/ethnicity (exposure) on HPV vaccine series completion (outcome). The results of the logistic regressions were used to estimate the odds ratios. To assess the potential confounders of the association between race/ethnicity and HPV vaccine series completion, bivariate regressions were used and those who produced a change in the

association between exposure and outcome greater than 10% were considered confounders in this study and were included in the final multivariate models. Variables that had an inverse effect for Hispanics and for non-Hispanic Whites were considered effect modifiers.

All p-values were considered significant at ≤ 0.05 and 95% confidence intervals were reported when appropriate. Provider-phase sampling weights of teens with adequate provider data were used to produce national estimates excluding the U.S. Virgin Islands. These weights take into account selection probability, non-response, and non-coverage. All analyses also accounted for the effect of clustering in complex sample designs. SAS version 9.2 was the statistical software used for all analyses.

Chapter III: Results

In 2009, Hispanic 13 to 17 year old girls had similar overall initiation rates as non-Hispanic Whites (Table 2). Compared to non-Hispanic Whites, Hispanic girls were less likely to have completed the HPV vaccine series, have a doctor visit in the past year, have continuous health insurance coverage since the age of 11 years; and were more likely to have completed the Hepatitis B vaccine series, live in households with 4 or more children, live below poverty level, have single mothers with lower educational levels, and be geographically mobile (born in a state different from their current residence). Initiation rates did not show statistically significant variations by any of the variables studied (Table 3).

Further analyses were restricted to 13 to 17 year old Hispanic (n=560, N=737,175) and non-Hispanic White (n=2,732, N=2,411,593) girls who *had initiated the series.* Hispanic 13 to 17 years old girls who had initiated the series were less likely to have completed the HPV vaccine series than non-Hispanic White girls (Table 4). There were significant socio-demographic differences between Hispanic and non-Hispanic White girls in the study sample. Compared to non-Hispanic White girls, Hispanic 13 to 17 year old girls who had initiated the HPV vaccine series were less likely to have had a doctor visit in the previous year, and more likely to have a single mother with lower educational levels, live in households with 4 or more children, live in poverty, and live in a rental home.

While 76.4% of the non-Hispanic White girls who initiated the HPV vaccine series in this sample completed the HPV vaccine series, only 59.9% of Hispanic girls

who had initiated the series achieved completion (Table 4). Among Hispanics, having had a doctor visit in the previous year, being older, and having initiated the series at a younger age were significantly associated with completion of the series (Table 5). Among non-Hispanic Whites, the factors associated with HPV vaccine series completion were: having continuous health insurance coverage since the age of 11, having married mothers, having mothers with higher levels of education, living households with fewer children, and not living in a rental home.

Rates of HPV series completion were different for Hispanics and non-Hispanic White girls ages 13 to 17 years who had initiated the series (Table 6). Non-Hispanic White girls were more likely than Hispanic girls to have completed the series among those who did not have a doctor visit in the previous year, had a single mother with lower levels of education, lived in households with 4 or more children, lived below poverty level, and lived in rental homes. On the other hand, continuity of health insurance coverage since the age of 11 years and geographic mobility acted as effect modifiers, with Hispanics showing inverse trends as those among non-Hispanic Whites. Among those who had not had continuous health insurance coverage since the age of 11 years, Hispanics were more likely than non-Hispanic Whites to have completed the HPV vaccine series, but among those who had continuous health insurance coverage since the age of 11 years, non-Hispanic Whites were more likely to have completed the series. Similarly, geographic mobility was associated with higher rates of completion among Hispanics and lower rates of completion among non-Hispanic Whites.

Out of all the factors included in this study, the ones associated with lower odds of completing the HPV vaccine series were: being Hispanic (reference group: being non-

Hispanic White) [OR= 0.462, 95% CI: 0.321-0.664], having a single mother (reference group: having a married mother) [OR=0.518, 95% CI: 0.336-0.797], living in households with 4 or more children (reference group: living in a household with only one child) [OR= 0.362, 95% CI: 0.188-0.697], living below poverty level (reference group: living above poverty level >$75,000) [OR=0.519, 95% CI: 0.348-0.774], and living in a rental home (reference group: living in an owned property) [OR=0.502, 95% CI: 0.348-0.729] (Table 7). The multivariate model included race/ethnicity, poverty status, and home ownership as potential confounders of the association between race/ethnicity (main exposure) and HPV vaccine series completion (outcome). After adjusting for confounders, only race/ethnicity was associated with series completion [AOR=0.540, 95% CI: 0.371-0.785], while poverty status and home ownership were not statistically significant.

Among Hispanics, the factors associated with series completion were: not having a doctor visits in the previous year (reference group: having a doctor visit in the previous year) [OR=0.470, 95% CI: 0.221-0.997], being 16 years old at the time of HPV vaccine series initiation (reference group: being 13 years old at the time of HPV vaccine series initiation) [OR=0.271, 95% CI: 0.092-0.800], being 16 years old at the time of the interview (reference group: being 17 years old at the time of the interview) [OR=3.491, 95% CI: 1.761-6.921], and being 15 years old at the time of the interview (reference group: being 17 years old at the time of the interview) [OR=0.435, 95%CI: 0.226-0.837], (Table 8). After adjusting for all of these potential confounders, being 16 years of age at the time of interview [AOR=3.079, 95% CI: 1.536-6.170] and being 16 years of age at the time of HPV series initiation [AOR=0.324, 95% CI: 0.107-0.978] were associated

with completion of the series but doctors visits in the last year was not statistically significant.

Among non-Hispanic Whites, the factors associated with series completion were: not having continuous health insurance coverage since the age of 11 years (reference group: having continuous health insurance coverage since the age of 11 years) [OR=0.223, 95% CI: 0.062-0.801], having a single mother (reference group: having a married mother) [OR=0.469, 95% CI: 0.254-0.865], living in a household with 4 or more children (reference group: living in a household with only one child) [OR=0.308, 95% CI: 0.116-0.817], and living in a rental home (reference group: living in an owned property) [OR=0.534, 95% CI: 0.343-0.830], (Table 9). After adjusting for all of these potential confounders, not having continuous health insurance coverage since the age of 11 years [AOR=0.362, 95% CI: 0.160-0.820], living in households with 4 or more children [AOR=0.416, 95% CI: 0.235-0.736], and having a single mother [AOR=0.564, 95% CI: 0.349-0.911] were associated with completion of the series but living in a rental home was not statistically significant.

Chapter IV: Discussion

While Hispanic 13 to 17 year old girls had similar overall initiation rates as non-Hispanic Whites (19.7% and 19.8% respectively), completion rates were significantly different. Seventy six percent (76.4%) of non-Hispanic White girls who had initiated the HPV vaccine series completed the 3-shot schedule, compared to 59.9% of Hispanic girls.

High initiation rates among Hispanics might be a result of targeted cervical cancer prevention programs for the Hispanic population, such as public awareness campaigns to promote the use of the HPV vaccine and support from community health centers. However, these programs might be focusing on reaching as many people as possible without keeping track of those already in the system. It is a challenge for massive campaigns that look for cost-effective and short-term solutions to also provide the guidance and support needed for continuity of health care services. The HPV vaccine series adds new challenges to the existing efforts to reduce health disparities due to the necessity of compliance to treatment and continuity of access to health care services throughout a strict 3-dose schedule. Completion rates could improve by incorporating a tracking system to existing outreach programs and securing the resources needed to follow-up each patient.

In this analysis, race/ethnicity was a significant predictor of HPV vaccine series completion, with Hispanic girls being less likely to complete the series than non-Hispanic White girls. This association between race/ethnicity and completion of the series was confounded by poverty status and home ownership in our analyses. Among Hispanics, while doctor visits in the previous year, age of teen at the time of interview, and at the

time of first HPV shot were associated with completion of the series, none of the SES variables showed a statistically significant association with completion of the series. On the other hand, SES played a stronger role among non-Hispanic Whites with lack of continuous insurance, mother's marital status, number of children in the household, and home ownership being statistically associated with series completion.

Our results show that financial barriers do not appear to fully explain the lower HPV vaccine completion rates among Hispanics, suggesting that non-financial barriers might be a stronger determinant of disparities between Hispanics and non-Hispanic Whites for HPV series completion. As Zambrana and Carter-Pokras have noted, "barriers to healthcare services among Hispanics can be financial, cultural, or structural," (Zambrana & Carter-Pokras, 2004).

Culture and language can add challenges to the use of health care services among Hispanics, (Flores, et al., 2002). Zambrana and Carter-Pokras (2004) further clarify that: "Limited English language proficiency (LEP), often times accompanied with lower educational or literacy levels, can drastically deteriorate the quality of health care services received by Hispanics". It is necessary to address cultural and linguistic differences in clinical settings to reduce the disparities in access and use of health care services among Hispanics to achieve better clinical outcomes and overall health in this population, (Flores, et al., 2002). In order to achieve full understanding of the efficiency of HPV vaccination as a complete series and the importance of compliance among Hispanic girls, initiatives should be promoted at the policy level to support cultural and linguistic competency training among health care professionals.

While there have been federal and state attempts to protect the rights of LEP patients, medical institutions are not supportive of these initiatives due to increases in costs they are not willing to approve, (Flores, et al., 2002). It is important to address the problems faced by LEP Hispanics trying to interpret medical procedure and recommendations by developing measures to improve language access and patient compliance, (Zambrana & Carter-Pokras, 2004). Many programs have taken place to reduce the cost of the HPV vaccine and similar negotiations or subsidies can help finance the care for LEP patients by reimbursing medical centers for medical interpreter services.

Structural barriers such as "place of residence, lack of a regular source of care, distribution of healthcare resources, lack of outreach to potential beneficiaries, transportation problems, and excessive waiting times in clinics" are important factors in the lower quality and frequency of health care services received by Hispanics, (Zambrana & Carter-Pokras, 2004). Given these limitations, outreach programs can be implemented to capture the most vulnerable fragments of the Hispanic population. The HPV vaccine series imposes the burden of a 3-dose strict schedule within a 6 month period. This represents a significant difficulty for parents who might live far from the vaccination center, might not have the financial means to pay for transportation, might not have the opportunity to take time off of work to take their children to vaccination center, and might not have the flexibility in their schedule to accommodate the 3 doses on time. To lessen this burden, efforts should be made to incorporate a variety of health services in the same schedule. Additionally, research on effective HPV immunization through lower number of doses could provide meaningful results.

Strengths

This study has major strengths such as the quality of the data gathered by NIS-Teen. This database strengthened the present study in three ways:

First, 2009 NIS-Teen offers the most up to date immunization data available. Three national surveys provide information on HPV vaccine usage. While the National Health Interview Service (NHIS) has immunization records from 2008 and the National Survey of Children's Health (NSCH) has records from 2007, NIS-Teen has annual surveys and has already released its data for 2009.

Second, 2009 NIS-Teen has an unusually large sample of teens vaccinated against HPV, allowing the analysis of a wide variety of variables. NHIS had a sample of 381 girls vaccinated against HPV, and NSCH had a sample of 3,339 girls. The 2009 NIS-Teen gives us information on 4,746 teens who initiated the HPV vaccine series, and 3,010 who completed it, allowing for a more thorough analysis of factors affecting completion.

The third advantage of the dataset used is that it offers provider reported data, improving the accuracy of the reports on immunizations. Out of the three sources for national data on HPV vaccine uptake, NIS-Teen is the only one that verifies their data through provider reports on immunization records instead of relying on the parents self-report.

The fourth strength of this study is that it is nationally representative and all analyses reported weights and adjustments for clustering.

Finally, this study includes variables that have not been addressed by previous studies on completion of HPV vaccine series, such as having received Hepatitis B vaccination, mother's marital status, and poverty status.

Limitations

This study has several limitations including its cross sectional design. The collection of data at only one point in time limits the ability to make causal inferences and, in this particular case, did not allow us to assess the independent variables at the time of vaccination or during the interval between initiation and completion of the series. The only information available was for the time of the interview and this may or not have represented the situation at the time of vaccination.

The cross-sectional study design presents an extra challenge for this study given that the immunization data is based on medical records and we do not know if the doctors interviewed have information on the complete immunization schedules of the teens or if the records are split between more than one doctor. This is a particularly greater concern for those subjects who were geographically mobile.

Additionally, NIS-Teen did not collect data on subgroups within Hispanics. These factors might limit the generalizability of our results, particularly given our interest in Hispanic populations.

Another limitation is the lack of availability of certain variables of interest in the public dataset for NIS-Teen. Questions regarding place of birth of the teen, having a usual source of care, and not receiving medical treatment due to cost were included in the

original NIHS-Teen 2009 questionnaire but were not available in the public dataset and could not be included in this analysis.

The NIS-Teen 2009 questionnaire did not include behavioral and qualitative variables that have been shown to play an impact on initiation of the series and could be relevant for an analysis of the barriers encountered by Hispanics trying to complete the series. Other variables that, based on previous literature, could have been useful in our analysis but were not available included: area of residence, number of emergency visits in the previous year, type of doctor visits, health status of the teen, language spoken at home, patient/provider concordance, co-payments for health insurance coverage, and other logistic barriers.

Regarding HPV immunization the questionnaire did not specify which HPV vaccine the teens have received. While the probability of a child receiving the bivalent vaccine is low, given that it was FDA approved in October 2009, the possibility does exist. However, the dosage of the bivalent vaccine is identical to that of the quadrivalent vaccine approved in 2006.

The last limitation of this study is that, when adjustments were made to the weighted data in an effort to account for the complex sample design, the statistical power decreased, leading to wider confidence intervals for the odds ratios calculated. This might have influenced our findings making some clinically important factors associated with HPV vaccine completion not to be statistically significant.

Future studies

Since our results suggest that financial barriers might not be the most important barrier in HPV vaccine completion among 13-17 year old Hispanic girls who initiated the series, a qualitative analysis of the reasons why this is the case could provide very meaningful information. Patients, parents, and health care providers could offer insightful perspectives on this disparity. In addition to qualitative analyses, future studies should include additional quantitative information on potential confounders in the association between race/ethnicity and HPV vaccine series completion as well as quantitative information for subgroups of Hispanics. For this purpose, more quantitative data should be gathered to represent a larger Hispanic population to increase the accuracy of further statistical analyses. Ongoing data collection on immunization should incorporate new variables that might help explain vaccination patterns, and should make efforts to include a larger sample of racial/ethnic minorities.

Conclusion

This study confirms previous findings that despite similar initiation rates, Hispanic adolescent girls ages 13 to 17 years have lower overall completion rates of the HPV vaccine series than non-Hispanic White girls. However, financial barriers might not be the main source of these disparities. To reduce these disparities in HPV vaccine completion rates, cultural, linguistic, and structural barriers need to be acknowledged and incorporated into the political agenda. Future qualitative and quantitative studies are necessary to achieve a better understanding of the non-financial barriers to completion of HPV vaccine series among Hispanics.

Table 1. Factors associated with initiation and completion of HPV vaccine series based on previous literature

	Initiation	Completion
Race/Ethnicity*	Being Hispanic was associated with higher initiation rates	Being non-Hispanic White was associated with higher completion rates
Health insurance enrollment*	Being enrolled in a health insurance plan was associated with higher initiation rates	Having private insurance showed highest rates of completion, followed by having public insurance, and being uninsured
Primary care provider visit*	Number of primary care visits was positively associated with initiation of the series	Number of primary care visits was positively associated with completion of the series
Ever received Hep B vaccination*	Teens who had received Hepatitis B vaccination shots had higher initiation rates	Not studied
Emergency visit	Not studied	Number of emergency visits was negatively associated with completion of the series
Type of visit	Initiation of the series happened most often during preventive care visits	Completion of the series happened most often during immunization-only visits
Mother's education*	Teens with mothers with education levels above high school had higher initiation rates	Teens living in neighborhoods with higher area educational levels had higher completion rates
Mother's marital status*	Teens with non-married mothers had higher initiation rates	Not studied
Poverty status*	Living over 200% above the poverty index was associated with higher initiation rates	Not studied
Area of residence	Living in urban or large rural areas was associated with higher initiation rates than living in small rural areas	Living in urban or large rural areas was associated with higher completion rates than living in small rural areas
Age*	13-15 years was the group with highest initiation rates	13-15 years was the group with highest completion rates

* Incorporated in this study

Sources: Baker, et al. 2010, Brewer and Fazekas 2007, Chao, et al. 2009, Conroy, et al. 2009, Cook, et al. 2010, Dempsey, et al. 2010, Jain, et al. 2009, Neubrand 2009, Tan et al. 2011, Widdice, et al. 2011.

Table 2. Sociodemographic characteristics of all **Hispanic and non-Hispanic White girls ages 13 to 17** with adequate provider data, weighted, with sample design

Characteristics	Hispanics (%) (n=2,401, N=3,746,305)	Non-Hispanic Whites (%) (n=13,780, N=12,193,579)
HPV vaccine series initiation		
Initiated	19.7%	19.8%
Not initiated	80.3%	80.2%
HPV vaccine series completion **		
Complete	11.8%	15.1%
Incomplete	88.2%	84.9%
Doctor visits in the last 12 months ***		
No	26.1%	16.5%
Yes	73.9%	83.5%
Hepatitis B vaccine series **		
Complete	74.5%	69.0%
Incomplete	25.5%	31.0%
Any time uninsured since 11 ***		
Yes	12.8%	6.9%
No	87.2%	93.1%
Age in years *		
13	17.9%	19.4%
14	23.6%	18.7%
15	22.8%	21.2%
16	19.9%	21.2%
17	15.7%	19.5%
Mean H:14.9 NHW: 15.0		
Age in years at time of first HPV shot		
13	49.3%	45.1%
14	26.6%	23.8%
15	16.9%	22.5%
16	7.2%	8.6%
Mean H: 13.7 NHW: 13.8		
Mother's marital status ***		
Married	70.2%	82.0%
Single	29.8%	18.0%
Number of children in the household ***		
1	26.8%	32.8%
2-3	55.4%	57.3%
≥4	17.8%	9.8%
Poverty status[2] ***		
Above poverty level >$75K	20.1%	50.3%
Above poverty level ≤$75K	43.4%	42.1%
Below poverty level	36.4%	7.6%
Home ownership ***		
Owned/being bought	59.0%	89.1%
Rented	41.0%	10.9%
Mother's education ***		
<12 years	38.4%	6.3%
12 years	25.3%	27.3%
>12 years	20.5%	25.1%
College graduate	15.9%	41.2%
Geographic mobility[1] ***		
Yes	27.7%	20.8%
No	72.3%	79.2%

[1] Geographic mobility is defined as state of residence at birth different from current state of residence
[2] Taking into account the number of people in the household

NOTE: Comparing Hispanics with non-Hispanic Whites: * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 3: Rates of initiation of the HPV vaccine series among all Hispanic and non-Hispanic White girls ages 13 to 17 with adequate provider data, weighted, with sample design

Characteristics	Hispanics (%) (n=2,401, N=3,746,305)	Non-Hispanic Whites (%) (n=13,780, N=12,193,579)
Total sample	19.7%	19.8%
Doctor visits in the last 12 months		
No	12.9%	10.6%
Yes	22.1%	21.6%
Hepatitis B vaccine series		
Complete	19.2%	20.8%
Incomplete	21.0%	17.5%
Any time uninsured since 11		
Yes	19.2%	18.4%
No	21.0%	20.3%
Age in years		
13	16.6%	15.1%
14	18.6%	17.8%
15	20.7%	18.9%
16	20.1%	25.4%
17	22.7%	21.3%
Mother's marital status		
Married	18.1%	19.0%
Single	23.3%	23.3%
Number of children in the household		
1	21.5%	18.6%
2-3	18.6%	20.6%
≥4	20.2%	18.9%
Poverty status[2]		
Above poverty level >$75K	23.5%	21.3%
Above poverty level ≤$75K	16.6%	17.5%
Below poverty level	20.3%	21.8%
Home ownership		
Owned/being bought	20.6%	20.2%
Rented	18.0%	16.4%
Mother's education		
<12 years	19.3%	16.8%
12 years	19.3%	17.8%
>12 years	19.9%	19.7%
College graduate	21.0%	21.6%
Geographic mobility[1]		
Yes	18.8%	20.8%
No	20.0%	19.5%

[1] Geographic mobility is defined as state of residence at birth different from current state of residence
[2] Taking into account the number of people in the household

NOTE: Comparing Hispanics with non-Hispanic Whites: ***** p<0.05, ** p<0.01, *** p<0.001

Table 4: Sociodemographic characteristics of **Hispanic and non-Hispanic White girls ages 13 to 17 who have initiated the series** at least a year prior to interview and who have adequate provider data, weighted, with sample design

Characteristics	Hispanics (%) (n=560, N=737,175)	Non-Hispanic Whites (%) (n=2,732, N=2,411,593)
HPV vaccine series ***		
Complete	59.9%	76.4%
Incomplete	40.1%	23.6%
Doctor visits in the last 12 months ***		
No	17.2%	8.8%
Yes	82.8%	91.2%
Hepatitis B vaccine series		
Complete	72.9%	72.5%
Incomplete	27.1%	27.5%
Any time uninsured since 11		
Yes	11.8%	6.3%
No	88.2%	93.7%
Age in years		
13	15.1%	14.8%
14	22.4%	16.8%
15	24.0%	20.3%
16	20.4%	27.1%
17	18.2%	21.0%
Mean H: 14.9 NHW: 15.1		
Age in years at time of first HPV shot		
≤13	49.1%	44.8%
14	26.7%	23.9%
15	17.0%	22.6%
16	7.6%	8.6%
Mean H: 13.7 NHW: 13.9		
Mother's marital status ***		
Married	64.7%	78.8%
Single	35.3%	21.2%
Number of children in the household *		
1	29.3%	30.8%
2-3	52.3%	59.8%
≥4	18.3%	9.4%
Poverty status[2] ***		
Above poverty level >$75K	24.5%	54.4%
Above poverty level ≤$75K	37.3%	37.3%
Below poverty level	38.3%	8.4%
Home ownership ***		
Owned/being bought	62.3%	91.0%
Rented	37.7%	9.0%
Mother's education ***		
<12 years	37.6%	5.4%
12 years	24.9%	24.6%
>12 years	20.1%	25.0%
College graduate	16.9%	45.0%
Geographic mobility[1]		
Yes	26.4%	21.8%
No	73.6%	78.2%

[1] Geographic mobility is defined as state of residence at birth different from current state of residence
[2] Taking into account the number of people in the household
NOTE: Comparing Hispanics with non-Hispanic Whites: * p<0.05, ** p<0.01, *** p<0.001

Table 5: Distribution of **factors affecting completion** of the 3-dose HPV vaccine series among Hispanic and non-Hispanic White girls ages 13 to 17 who have initiated the series at least a year prior to interview and who have adequate provider data, weighted, with sample design

Characteristics	Hispanics (%) (n=560, N=737,175)		Non-Hispanic Whites (%) (n=2,732, N=2,411,593)	
	Complete N = 441,739 (59.9%)	Incomplete N = 295,436 (40.1%)	Complete N = 1,842,740 (76.4%)	Incomplete N = 568,853 (23.6%)
Doctor visits in the last 12 months #				
No	12.8%	23.8%	9.0%	8.1%
Yes	87.2%	76.2%	91.0%	91.9%
Hepatitis B vaccine series				
Complete	70.4%	76.6%	72.7%	72.2%
Incomplete	29.6%	23.4%	27.3%	27.8%
Any time uninsured since 11 ^^				
Yes	14.9%	7.2%	3.7%	14.7%
No	85.1%	92.8%	96.3%	85.3%
Age in years ##				
13	15.5%	14.3%	13.5%	18.8%
14	21.6%	23.5%	17.4%	14.9%
15	17.9%	33.3%	20.5%	19.6%
16	27.5%	9.8%	26.2%	30.1%
17	17.6%	19.1%	22.4%	16.6%
Age in years at time of first HPV shot #				
≤13	46.6%	52.8%	46.5%	39.1%
14	30.0%	21.9%	23.2%	26.3%
15	19.8%	12.8%	21.6%	26.0%
16	3.7%	12.4%	8.1%	8.6%
Mother's marital status ^^				
Married	66.4%	62.1%	82.1%	68.2%
Single	33.6%	37.9%	17.9%	31.8%
Number of children in the household ^^				
1	30.1%	28.2%	33.1%	23.4%
2-3	54.5%	49.1%	60.3%	58.0%
≥4	15.4%	22.7%	6.6%	18.6%
Poverty status[2]				
Above poverty level >$75K	26.5%	21.5%	57.1%	45.6%
Above poverty level ≤$75K	38.3%	35.8%	35.3%	43.5%
Below poverty level	35.2%	42.8%	7.5%	10.9%
Home ownership ^^				
Owned/being bought	64.5%	59.0%	92.4%	86.6%
Rented	35.5%	41.0%	7.6%	13.4%
Mother's education ^^				
<12 years	37.0%	38.2%	4.9%	6.8%
12 years	23.7%	26.6%	22.3%	32.0%
>12 years	21.2%	20.0%	24.0%	28.3%
College graduate	18.1%	15.1%	48.8%	32.9%
Geographic mobility[1]				
Yes	29.8%	21.3%	20.4%	26.3%
No	70.2%	78.8%	79.6%	73.7%

[1] Geographic mobility is defined as state of residence at birth different from current state of residence
[2] Taking into account the number of people in the household
NOTE: Comparing Hispanics complete with Hispanics incomplete: # p<0.05, ## p<0.01, ### p<0.001
Comparing non-Hispanic White complete with non-Hispanic White incomplete: ^ p<0.05, ^^ p<0.01, ^^^ p<0.001

Table 6: Rates of completion of the 3-dose HPV vaccine series among Hispanic and non-Hispanic White girls ages 13 to 17 who have initiated the series at least a year prior to interview and who have adequate provider data, weighted, with sample design

Characteristics	Hispanics (%) (n=560, N=737,175)	Non-Hispanic Whites (%) (n=2,732, N=2,411,593)
Total sample	59.9%	76.4%
Doctor visits in the last 12 months***		
No	44.5%	78.4%
Yes	63.1%	76.2%
Hepatitis B vaccine series		
Complete	57.9%	76.5%
Incomplete	65.4%	76.1%
Any time uninsured since 11 *		
Yes	75.9%	45.4%
No	58.2%	78.8%
Age in years***		
13	61.9%	70.0%
14	57.8%	79.1%
15	44.5%	77.1%
16	80.8%	73.8%
17	57.9%	81.4%
Age in years at time of first HPV shot***		
≤13	56.9%	79.4%
14	67.1%	74.1%
15	69.8%	72.9%
16	30.8%	75.3%
Mother's marital status ***		
Married	61.5%	79.6%
Single	57.0%	64.6%
Number of children in the household ***		
1	61.5%	82.1%
2-3	62.4%	77.1%
≥4	50.4%	53.4%
Poverty status[2] *		
Above poverty level >$75K	64.1%	79.7%
Above poverty level ≤$75K	60.7%	71.8%
Below poverty level	54.3%	68.4%
Home ownership ***		
Owned/being bought	61.6%	77.5%
Rented	55.9%	64.8%
Mother's education		
<12 years	50.1%	70.1%
12 years	57.1%	69.3%
>12 years	61.2%	73.3%
College graduate	64.3%	82.8%
Geographic mobility[1] ***		
Yes	67.7%	71.6%
No	57.1%	77.7%

[1] Geographic mobility is defined as state of residence at birth different from current state of residence
[2] Taking into account the number of people in the household
NOTE: Comparing Hispanics with non-Hispanic Whites: * p<0.05, ** p<0.01, *** p<0.001

Table 7: Predictors of completion of the 3-dose HPV vaccine series **among Hispanic and non-Hispanic White girls** ages 13 to 17 who have initiated the series at least a year prior to interview and who have adequate provider data, weighted, with sample design

	Unadjusted OR for series completion	Unadjusted OR 95% Confidence Interval	Adjusted OR for series completion	Adjusted OR 95% Confidence Interval
Race/ethnicity ■▲●				
Hispanic	0.462	0.321-0.664	0.540	0.371-0.785
Non-Hispanic White †				
Doctor visits in the last 12 months				
No	0.697	0.444-1.095		
Yes †				
Hepatitis B vaccine series				
Incomplete	1.077	0.782-1.484		
Complete †				
Any time uninsured since 11				
Yes	0.430	0.150-1.239		
No †				
Age in years				
13	0.776	0.543-1.107		
14	1.026	0.712-1.478		
15	0.776	0.535-1.125		
16	1.192	0.683-2.079		
17 †				
Age in years at time of first HPV shot				
16	0.709	0.431-1.165		
15	0.987	0.548-1.776		
14	0.984	0.682-1.420		
≤13 †				
Mother's marital status ■				
Single	0.518	0.336-0.797		
Married †				
Number of children in the household ■				
≥4	0.362	0.188-0.697		
2-3	1.185	0.832-1.690		
1 †				
Poverty status[2] ■▲				
Below poverty level	0.519	0.348-0.774	0.770	0.497-1.191
Above poverty level ≤$75K	0.780	0.533-1.142		
Above poverty level >$75K †				
Home ownership ■▲				
Rented	0.502	0.346-0.729	0.702	0.470-1.049
Owned/being bought †				
Mother's education				
<12 years	0.587	0.378-0.912		
12 years	0.677	0.424-1.081		
>12 years	0.895	0.633-1.266		
College graduate †				
Geographic mobility[1]				
Yes	0.880	0.637-1.217		
No †				

[1] Geographic mobility is defined as state of residence at birth different from current state of residence
[2] Taking into account the number of people in the household
[†] Reference group
■ Statistically significant before adjustment
▲ Confounder
● Statistically significant after adjustment

Table 8: Predictors of completion of the 3-dose HPV vaccine series **among Hispanic girls** ages 13 to 17 who have initiated the series at least a year prior to interview and who have adequate provider data, weighted, with sample design

	Unadjusted OR for series completion	Unadjusted OR 95% Confidence Interval	Adjusted OR for series completion	Adjusted OR 95% Confidence Interval
Doctor visits in the last 12 months ■▲				
No	0.470	0.221-0.997	0.507	0.237-1.086
Yes †				
Hepatitis B vaccine series				
Incomplete	1.378	0.738-2.571		
Complete †				
Any time uninsured since 11				
Yes	2.264	0.901-5.692		
No †				
Age in years ■▲●				
13	1.104	0.523-2.330		
14	0.893	0.436-1.828		
15	0.435	0.226-0.837		
16	3.491	1.761-6.921	3.079	1.536-6.170
17 †				
Age in years at time of first HPV shot ■▲●				
16	0.271	0.092-0.800	0.324	0.107-0.978
15	1.676	0.821-3.422		
14	1.523	0.764-3.034		
≤13 †				
Mother's marital status				
Single	0.830	0.455-1.516		
Married †				
Number of children in the household				
≥4	0.622	0.306-1.265		
2-3	1.237	0.686-2.231		
1 †				
Poverty status[2]				
Below poverty level	0.701	0.380-1.293		
Above poverty level ≤$75K	1.052	0.575-1.926		
Above poverty level >$75K †				
Home ownership				
Rented	0.790	0.433-1.444		
Owned/being bought †				
Mother's education				
<12 years	0.946	0.506-1.770		
12 years	0.858	0.440-1.671		
>12 years	1.070	0.534-2.144		
College graduate †				
Geographic mobility[1]				
Yes	1.574	0.875-2.830		
No †				

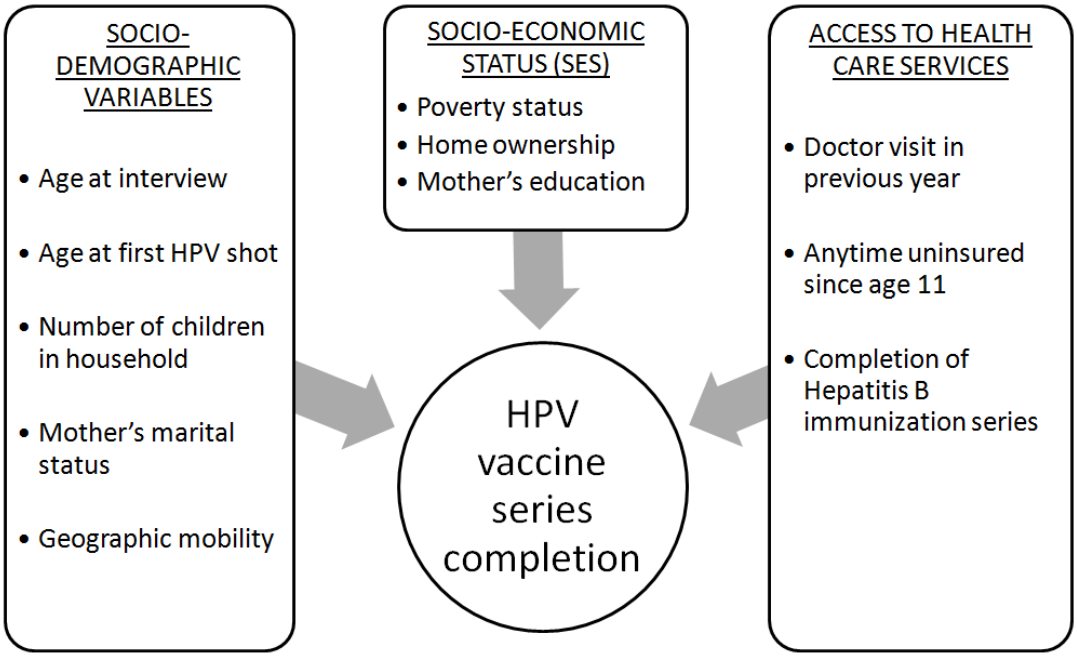
[1] Geographic mobility is defined as state of residence at birth different from current state of residence
[2] Taking into account the number of people in the household
† Reference group
■ Statistically significant before adjustment
▲ Confounder
● Statistically significant after adjustment

Table 9: Predictors of completion of the 3-dose HPV vaccine series **among non-Hispanic White girls** ages 13 to 17 who have initiated the series at least a year prior to interview and who have adequate provider data, weighted, with sample design

	Unadjusted OR for series completion	Unadjusted OR 95% Confidence Interval	Adjusted OR for series completion	Adjusted OR 95% Confidence Interval
Doctor visits in the last 12 months				
No	1.133	0.652-1.969		
Yes †				
Hepatitis B vaccine series				
Incomplete	0.976	0.665-1.430		
Complete †				
Any time uninsured since 11 ■▲●				
Yes	0.223	0.062-0.801	0.362	0.160-0.820
No †				
Age in years				
13	0.676	0.450-1.017		
14	1.207	0.829-1.758		
15	1.052	0.651-1.700		
16	0.823	0.436-1.565		
17 †				
Age in years at time of first HPV shot				
16	0.934	0.535-1.630		
15	0.785	0.386-1.599		
14	0.847	0.540-1.326		
≤13 †				
Mother's marital status ■▲●				
Single	0.469	0.254-0.865	0.564	0.349-0.911
Married †				
Number of children in the household ■▲●				
≥4	0.308	0.116-0.817	0.416	0.235-0.736
2-3	1.098	0.677-1.780		
1 †				
Poverty status[2]				
Below poverty level	0.644	0.379-1.094		
Above poverty level ≤$75K	0.679	0.420-1.097		
Above poverty level >$75K †				
Home ownership ■▲				
Rented	0.534	0.343-0.830	0.682	0.403-1.154
Owned/being bought †				
Mother's education				
<12 years	0.710	0.416-1.212		
12 years	0.611	0.332-1.124		
>12 years	0.799	0.535-1.217		
College graduate †				
Geographic mobility[1]				
Yes	0.722	0.484-1.078		
No †				

[1] Geographic mobility is defined as state of residence at birth different from current state of residence
[2] Taking into account the number of people in the household
† Reference group
■ Statistically significant before adjustment
▲ Confounder
● Statistically significant after adjustment

Figure 1. Factors potentially associated with completion of the Human Papillomavirus vaccine series for this study examined by race/ethnicity



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EDUCATION

Master in Public Health with Concentration in Epidemiology - August 2011
University of Maryland, College Park, MD

- Thesis: *"Factors associated with completion of the Human Papillomavirus vaccine series among Hispanic and non-Hispanic White adolescent girls in the United States"*

- Coursework: Epidemiologic and Biostatistical Methods (30 credits), Global Health Program Planning and Evaluation, Social Determinants of Health, Health Systems, Behavioral and Community Health, and Research Ethics

Bachelor of Arts in Modern Languages and Linguistics - December 2008
Minor in Biological Sciences
University of Maryland, Baltimore County, Baltimore, MD

EXPERIENCE

Research Intern January 2011- May 2011
Inter-American Drug Abuse Control Commission
Organization of American States, Washington, DC

- Analyzed data for CICAD Report on Drug Use in the Americas and three scientific articles.
- Conducted literature searches in regional databases to access data on drug consumption in the Americas.
- Managed databases with SAS and synthesize data into graphs and tables for analysis of patterns of drug use.
- Wrote analyses of the state of drug consumption and patterns of use in Latin America for cross-national reports.

Research Intern May 2010- December 2010
Cancer Prevention and Control, Non-Communicable Disease Unit
Pan American Health Organization / World Health Organization, Washington, DC

- Conducted epidemiological analysis for PAHO Cancer Strategy for the Americas.
- Performed literature searches in medical databases to access data on cancer in the Americas.
- Synthesized data into graphs, tables, charts and maps and wrote descriptive summaries.
- Assisted and supported the consultation process with PAHO/ WHO Country offices and Ministries of Health.

Research Volunteer September 2009- Feb 2010
Epidemiology Department
University of Maryland, College Park, MD

- Contributed to Dr Maria Kahn's presentation for the 2010 International Harm Reduction Association's International Conference.
- Conducted literature searches on sexually transmitted infections in high risk populations.
- Synthesized information collected and drafted literature reviews for scientific publications.

Special Volunteer/Guest Researcher May 2007- August 2009
Pediatric Tumor Biology and Ultrastructural Pathology Section
National Cancer Institute, National Institutes of Health, Bethesda, MD

- Produced a presentation for the 2008 American Association of Cancer Research meeting.
- Conducted literature searches on the expression of apoptotic proteins in pediatric cancer cells.
- Designed experiments to reduce the expression of apoptotic proteins in Neuroblastomas and Ewing sarcoma cells.

PUBLICATIONS

- Salazar-Silva F., Oliva Robles N.F., Hynes-Dowell M., **Demarco M.**, Villatoro-Velazquez J.A. **Relationship between Human Development and drug use**. Journal of International Drug, Alcohol, and Tobacco Research. In press, 2011.
- Bejarano J., Ahumada G., Sanchez G., Cadenas N., **Demarco M.**, Hynes M., Cumsille F. **Perception of Risk and Drug Use: An exploratory analysis of explanatory factors**. Journal of International Drug, Alcohol, and Tobacco Research. In press, 2011.
- Perez-Gomez A., Diaz-Granados O.S., Hynes-Dowell M., **Demarco M.**, Florez-Alarcon L. **Age at onset of alcohol consumption and risk of problematic alcohol and psychoactive substance use in adulthood in the general population in Colombia**. Journal of International Drug, Alcohol, and Tobacco Research. In press, 2011.

PRESENTATIONS

- Friedman S.R., Ompad D., **Demarco M.**, Khan M. **Harms and risks encountered by women drug users who have sex with women**. International Harm Reduction Association's International Conference, Liverpool, England. April 2010.
- **Demarco M.T.**, Jiang F., Zhang D. **The Molecular Mechanisms of Targeting COP9 Signalosome as Potential Antitumor Therapy**. Mid-Atlantic Pharmacology Society Meeting, King of Prussia, PA. November 2008. The Pharmacologist, Vol.50, No.4, pp.209. December 2008.

- **Demarco M.T.**, Galli S., Li G., Tsokos M. **XIAP silencing with RNA interference does not enhance sensitivity of Ewing sarcoma cell lines to TNF-Related Apoptotic Inducing Ligand (TRAIL)**. American Association of Cancer Research Meeting, San Diego, CA. April 2008. AACR Meeting Abstracts, **2008**: 829. April 2008.

COMPUTER SKILLS

Proficient in SAS (including procedures for complex sample survey data analysis), Stata, Microsoft Excel, Word, and PowerPoint.

ADDITIONAL TRAINING

- **Statistical Software Training: Introduction to SAS 9**, Maryland Population Research Center. 2011.
- **Statistical Software Training: Introduction to Stata 11**, Maryland Population Research Center. 2011.
- **Biomedical Research Basic Course**, Collaborative Institutional Training Initiative. 2010.
- **Social and Behavioral Research Basic Course**, Collaborative Institutional Training Initiative. 2010.
- **Protecting Human Research Participants**, National Institutes of Health. 2009.
- **NIH Research Ethics Orientation**, National Institutes of Health. 2007.

LANGUAGES

Spanish: Native.
English: Excellent.
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PROFESSIONAL AFFILIATIONS

Global Health Council 2011- Present
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American Association for Cancer Research 2008- Present
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