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Human Papillomavirus (HPV) Vaccine: Understanding Individuals Not Vaccinating in the South Using 2016 National Immunization Survey-Teen Data (NIS-Teen)

Saron Ephraim

5-1-2018

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ABSTRACT

Human Papillomavirus (HPV) Vaccine: Understanding Individuals Not Vaccinating in the South Using 2016 National Immunization Survey-Teen Data (NIS-Teen)

By

Saron Ephraim

May 1, 2018

INTRODUCTION: Human Papilloma Virus (HPV) is a highly contagious virus known to cause many cancers in men and women. Vaccination for HPV has been available since 2006 but coverage levels remain low with initiation rates at 60% and only 43% completion. The lowest vaccination rates are found in the South.

AIM: This study aims to use data from the 2016 National Immunization Survey –Teen to evaluate parental reasons for not vaccinating their teen for HPV among respondents in the South. The study evaluated the demographic correlations of the top four reasons reported for not vaccinating against HPV.

METHODS: Mantel-Haenszel χ^2 test was done to assess possible differences for individuals initiating HPV vaccination and those who had not by sociodemographic factors. Logistic regression done evaluated several sociodemographic factors for top reasons for not vaccinating. Analysis of the data was done using Statistical Analysis Systems 9.4.

RESULTS: The top four reasons given for not vaccinating for HPV were: 1) vaccine is not needed/not necessary; 2) vaccine was not recommended; 3) concerns about vaccine safety/side effects and 4) lack of knowledge about vaccine. Mother's education, mother's age, race of teen, and gender were significantly associated with the top four reasons.

DISCUSSION: The results of this study imply specific sociodemographic factors are associated with the top four reasons for declining HPV vaccine. Highly educated mothers were significantly associated with the top four reasons for declining vaccine.

Keywords: Human Papilloma Virus (HPV), vaccination rates, southern states, not vaccinating for HPV, HPV vaccine safety concerns/side effects

Human Papillomavirus (HPV) Vaccine: Understanding Individuals Not Vaccinating in the South Using 2016 National Immunization Survey-Teen Data (NIS-Teen)

by

Saron Ephraim

B.A., University of California, Irvine

A Thesis Submitted to the Graduate Faculty
of Georgia State University in Partial Fulfillment
of the
Requirements for the Degree

MASTER OF PUBLIC HEALTH

Under the Direction of

Richard Rothenberg, MD MPH FACP

ATLANTA, GEORGIA
30303

APPROVAL PAGE

Human Papillomavirus (HPV) Vaccine: Understanding Individuals Not Vaccinating in the South Using 2016 National Immunization Survey-Teen Data (NIS-Teen)

by

Saron Ephraim

Approved:

Dr. Richard Rothenberg
Committee Chair

Dr. Eric Wright
Committee Member

May 1, 2018
Date

Acknowledgments

First and foremost, I want to thank God for giving me this opportunity and for covering me with grace, supplying all that I needed and propelling me through to the finish line. To my grandpa who left us in January of this year, Teklu Abere, this accomplishment is for you. Thank you for planting the seed of curiosity in me, for leaving an indelible mark on my life, and for always instilling in me the value of education. I want to extend my deepest gratitude to my committee members who have helped direct and guide me on this journey. They have helped me navigate the many dips and turns of the thesis writing process. Thank you, Dr. Rothenberg, for making yourself available to explain concepts to me and for being patient with me. Thank you, Dr. Wright, for reminding me that although the thesis process has its ups and downs there was an end goal in mind. I want to thank my family who have helped cheer me along and encourage me through the many challenging times! I want to thank my aunt, Mekdes Teklu, for her unyielding support. Thank you for listening to me on the phone, accepting my many calls at all hours of the day, and for always reminding me that I could do this. To my parents, thank you for your love, support, and prayers. Although we are thousands of miles apart, I felt you both have been right alongside me on the whole time. To my family I have acquired over life's journey, my beloved friends, thank you for all the encouragement and for being examples of what excellence looks like. They say you are the company you keep and because of the brilliance you exude in all you do, you have pushed me to finish my thesis. Thank you to all those who helped edit and gave feedback (Shana Gulley, Akilah Wise, Brittany Peoples, Mindy Garland, Jeremiah Williams, and Oswald Dadson). I want to say a special thank you to my friend and confidant, my boyfriend Jeremiah Williams; thank you for being in the trenches with me and for encouraging me to step up my game by how you were so tenacious in your pursuit of excellence! I am so grateful we could finish our thesis journey at GSU together. I look forward to many more accomplishments with you. Thank you to the School of Public Health and to the many phenomenal faculty who have helped shape my educational experience at GSU. Thank you to the staff at the School of Public Health who have helped me understand the many pieces to the program at GSU. I am forever grateful for this opportunity.

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Saron Ephraim
613 Jenmarie Drive
Mableton, GA 30126

The Chair of the committee for this thesis is:

Richard Rothenberg, MD MPH FACP
School of Public Health
Georgia State University
P.O Box 3995
Atlanta, Georgia 30302-3995

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Saron Ephraim
613 Jenmarie Drive
Mableton, GA 30216
408.603.0987
Saronephraim21@gmail.com

EDUCATION

Georgia State University Atlanta, GA
Master's in Public Health, Concentration: Health Management & Policy **(Expected)** May 2018

University of California, Irvine Irvine, CA June 2011
Bachelor of Arts in Public Health Policy and African American Studies

University of Ghana, Legon Accra, Ghana Fall 2009
Coursework: Dance, Spanish (oral), History and Independent Research on Traditional Herbal Medicine
University of California, Irvine, Education Abroad Program

EMPLOYMENT

Department of Public Health, Atlanta, GA March 2018 – Present
Adult & Adolescent Immunization Coordinator

- Provide oversight and leadership of the Georgia Adult Vaccine Program (AVP).
- Provide technical assistance and advice to AVP enrolled providers to develop, implement, and improve services related to AVP.
- Collaborate with Immunization Program leadership and CDC partners to create, update, and implement AVP specific policies.
- Review pending AVP provider enrollment applications, ensure completeness of applications and grant approval for vaccine shipment activation.
- Serve as coordinator for adult and adolescent immunization campaigns and projects throughout the state of Georgia.
- Coordinate the successful purchase of flu vaccines for the State and Vaccines for Children(VFC) supply and ensure successful distribution to all AVP and VFC providers in the state of Georgia.
- Coordinate programs with other health care providers/organizations to promote optimal implementation of adult and adolescent immunization services.
- Provide technical assistance and advice to internal and external partners related to the development, implementation, and improvement of program objectives.
- Research, prepare and submit grant applications and grant reports.
- Collaborate with internal and external stakeholders to promote, enhance and integrate program goals in populations and services.
- Represent the Georgia Immunization Program at meetings and conferences locally and nationally.
- Sit on local and national coalitions and work groups aimed at improving vaccine coverage for adults and adolescents.

Department of Public Health, Atlanta, GA January 2017 – March 2018
Immunization Regional Consultant

- Supervised the successful implementation of the Vaccines for Children (VFC) and Adult Vaccine Program (AVP) in over 113 Public Health and private health clinic facilities in Fulton and Clayton County.

- Provided technical assistance and advice to all VFC or AVP enrolled providers to develop, implement, and improve services related to VFC or AVP.
- Coordinated and completed VFC compliance visits on all VFC-enrolled providers annually.
- Evaluated all 7 Public Health facilities annually in addition to the private facilities visited.
- Provided educational information on VFC policy changes, new requirements, updated protocol for vaccine management, and updated storage and handling procedures of all vaccines distributed through VFC program.
- Conducted a minimum of 10 unannounced storage and handling visits at active VFC-enrolled providers annually.
- Completed enrollment visits for all new providers joining VFC or AVP program. Entered new providers into the PEARS database system once enrollment was successfully completed.
- Collaborated with public health and private clinic centers to present HPV coverage level data at each site and discussed ways to improve vaccine coverage.
- Educated private health centers, Public Health facilities, schools and daycares on the proper use of the Georgia Registry of Immunization Transactions and Services (GRITS). Provided additional retraining for new staff in facilities.
- Provided technical assistance to all VFC and AVP providers on vaccine inventory management within the GRITS system. Conducted trainings related to inventory management and troubleshooting issues that arose at various facilities due to mismanagement of the inventory system.
- Represented the state Immunizations Program at various local and state-wide conferences to distribute resources and education material to attendees.
- Collaborated with the county Immunization Coordinator to provide support to staff in Public Health clinics by presenting at the area meetings to update clinic nursing and clerical staff on any changes to immunization practices.
- Facilitated the transfer of vaccines from different facilities for use prior to the expiration of vaccines.
- Conducted annual school assessments to collect data on student compliance rates for vaccination requirements for school attendance
- Collected data for the Georgia Adolescent Immunization Study (January – March 2017)

Department of Public Health, Atlanta, GA July 2013 – December 2016

Immunization Program Consultant

- Supervised the successful implementation of the Vaccines for Children (VFC) program in over 88 Public Health and private health clinic facilities in Fulton County.
- Completed VFC compliance visits on at least 45 active VFC-enrolled providers annually. Evaluated all 6 Public Health facilities annually in addition to the private facilities visited. Provided educational information on VFC policy changes, new requirements, updated protocol for vaccine management, and updated storage and handling procedures of all vaccines distributed through VFC program.
- Conducted a minimum of 10 drop in storage and handling assessment visits at active VFC-enrolled providers annually.
- Educated private health centers, Public Health facilities, schools and daycares on proper use of the Georgia Registry of Immunization Transactions and Services (GRITS). Provided additional retraining for new staff to facilities.
- Planed, coordinated and implemented immunization related education training to providers that request training.
- Collaborated with the County Immunization Coordinator to provide support to staff in Public Health clinics, presented at the area meetings to update clinic staff and brainstorm on education programs for the county.

- Assisted all VFC providers on vaccine inventory management within the GRITS system. Conducted training related to inventory management and troubleshoot issues that arouse at various facilities due to mismanagement of the inventory system.
- Facilitated the transfer of vaccines from different facilities for use prior to expiration of vaccines.
- Conducted annual school assessments to collect data on student compliance rates for vaccination requirements for school attendance.
- Collected data for the Georgia Adolescent Immunization Study (January – March 2015, January – March 2016).

Center for Disease Control and Prevention, Buffalo, NY July 2011 – June 2013

Public Health Associate

Data Coordinator with HIV/AIDS Epidemiology Program

- Accurately and systematically collected and maintained data on reported suspect HIV/AIDS cases and confirmed HIV and/or AIDS diagnosis through medical record review and when necessary, interviews with appropriate medical personnel using standard data collection tools and databases.
- Collaborated with physicians and nurses in locating relevant patient history within Electronic Medical Records or paper charts. Was responsible for 316 cases with 263 closed cases as of 5/21/2013 which significantly reduced the case load in Western New York Regional Office.
- Entered patient medical history and relevant HIV/AIDS lab records into the Partner Notification Assistance Program (PNAP) Tracking System for HIV/AIDS cases and updated electronic data system weekly.
- Processed suspected cases, completed accurate Case Reporting Forms (CRF) for all closed cases and submit to Central Office.
- Identified potential HIV reporting sources, established and maintained effective working partnerships, provided in-service training on case definition and reporting requirements, including instructing diagnostic clinicians on the responsibility to report newly diagnosed cases and requests for partner services on the Medical Provider HIV/AIDS and Partner/Contact Report Form.
- Assisted with a Syphilis outbreak in Buffalo which included 18 original patients and over 46 secondary contacts. Responsible for mapping out information collected by DIS officers and plotting the different connections between patients. Presented the finalized cluster maps to HIV/STD program director for internal use.

Public Health Tanning Salon Inspector

- Conducted inspections of tanning salons in three counties in Western New York (Erie, Livingston, and Cattaraugus counties) ensuring compliance with regulations, identifying public health hazards, and explaining any regulation violation to operators and providing advice on means of rectifying violations.
- Coordinated with operators prior to inspection by providing prior notification of what would be inspected and communicated relevant tanning salon information during assessment of tanning facilities.
- Resolved concerns and deescalated frustrations of disgruntled tanning salon owners who were frustrated with new regulations and policy for their salons.
- Provided ongoing technical assistance to each facility on strategies to address and correct violations and conducted follow-up visits to reassess compliance.
- Collected and analyzed tanning inspection visit data and developed a comprehensive report detailing the amount of time required to complete inspections by inspectors in the Western Region Office. The finalized report was sent to upper management for program evaluation purposes.
- Interpretation and Data entry of water sample results into the Safe Drinking Water Information System (SDWIS). Entered water sample data collected by the Hornell District Office.

Public Health Representative

- Conducted 49 Vaccine for Children (VFC) provider site visits to assess the quality of the program and ensure proper storage and handling of publicly purchased vaccine.
- Provided technical assistance for new VFC enrolled providers and presented information and resources to develop, implement and manage a successful VFC program.
- Resolved technical issues with the electronic shared drive where all the documents for all the various programs within the Bureau of Immunizations for the Buffalo and Rochester office are housed. Troubleshooting includes but not limited to providing education and ongoing training to staff on how to manage and maintain the database, how to locate "missing" data in files, and how to update working lists for various projects.
- Coordinated and conducted school audits with school health officials to ensure compliance with the New York State Public Health Law 2164; this included reviewing student immunization records for 2011/2012 school year.
- Completed 11 college audits out of 33 colleges assigned to be audited in the 2011/2012 school year by reviewing student health records to assess compliance with New York State Public Health laws 2165 and 2167.
- Ensured that the appropriate people received the results of the audits and notice of their passing or failing the audit. Entered school and college audit data into the Health Commerce System upon completion of audits.
- Conducted training for a new staff member on how to manage the shared drive, create new working lists and manage existing ones, and how to use and export data to Central Office from the CoCASA program.
- Collaborated with IT staff to establish the shared drive for the immunization program in the Western Regional Office to help house all the documents for the various program in Immunizations and reduce the number of paper copies used by the program.
- Created a folder within the shared drive to enable all staff in the program to view past VFC visits and enter new VFC data directly into the CoCASA program.
- Served as the acting secretary for the Western New York Pediatric Immunization Action Coalition and the Western New York Adult Immunization Coalition from August 2011 to September 2012.

TECHNICAL SKILLS

- Proficient in Microsoft Office platforms and possess extensive troubleshooting experience
- Proficient in CoCASA program, SAMS Database, VTracks
- Expert in Georgia Registry of Immunization Transactions and Services (GRITS)
- Proficient in the use of Macintosh systems
- Extensive knowledge with various social media platforms
- Lotus Notes and Outlook proficient
- Language: Proficient in Amharic, functional knowledge of Spanish

COMMUNITY INVOLVEMENT AND ORGANIZATIONAL AFFILIATION AND AWARDS

CDC Public Health Associate Program Certificate of Completion Atlanta, GA
May 2013

New York State Department of Health Commissioner's Award
December 2012

Watsonian Society Atlanta, GA
Member since July 2012

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Introduction

1.1 Background

Human Papilloma Virus (HPV) vaccination rates remain well below the 2020 Healthy People goal of 80% in the United States. National coverage data from 2016 found that 60.4% (65.1% of females; 56% of males) of teens had initiated the HPV series and only 43.4% (49.5% of females; 37.5% of males) had completed all recommended doses (Walker et al., 2017). Although the HPV vaccine has been around for over a decade, vaccine uptake remains low. The South, as a region, had some of the lowest HPV vaccination rates in 2011 with 48.4% initiation and 30.6% completion (Rahman, McGrath, & Berenson, 2014). National data shows that the lowest HPV vaccine initiation and completion rates are in southern states with 47.8% initiation in Mississippi and 30.8% completion in South Carolina (Walker et al., 2017). It has been well established that HPV is a virus that causes many types of genital and oral cancers. There are an estimated 19,400 women and 12,100 men who are affected by cancers cause by HPV annually in the United States (Centers for Disease Control and Prevention [CDC], 2017). HPV infection is responsible for 99.8% of cervical cancer and 90% of genital warts and cancer of the anogenital, head and neck regions (Rahman et al., 2014). HPV is a very common virus and approximately 79 million Americans are currently infected with HPV and about 14 million new cases of HPV infections occur each year (CDC, 2017).

The Food and Drug Administration (FDA) first licensed a vaccine in 2006 for use in females age 9 through 26 ("FDA Licensure of Bivalent Human Papillomavirus Vaccine", 2010) and the Advisory Committee on Immunization Practices (ACIP) made a routine recommendation for HPV vaccination for girls 11 to 12 years of age (up to age 26). In 2011 that

recommendation was extended to include boys up to age 21 (Seyferth, Bratic, & Bocchini, 2016). Low vaccine coverage is a public health concern because HPV is very common. Every adult will eventually acquire HPV, even if it is a latent infection, at least once in their lifetime. Previous research has found some trends in the possible explanation for the low uptake in HPV vaccine. Many studies have shown that having a strong provider recommendation helps improve vaccine initiation for HPV vaccine and that low uptake of HPV vaccine is due to a lack of physician recommendation (Mohammed, Vivian, Loux, & Arnold, 2017). In addition, concerns about safety and insufficient knowledge of HPV have been cited as sources for low uptake (Mohammed et al., 2017). Other studies have suggested that completion is a challenge for this vaccine despite having provider recommendation (Luque, Tarasenko, Dixon, Vogel, & Tedders, 2014). The rise in vaccine hesitant parents and parents who are electing to delay vaccinating their children have also been offered up as an explanation for low uptake. Existing studies looking at the low vaccine uptake have tried to understand why parents are choosing not to vaccinate their children for HPV. Once the factors for refusing HPV vaccines are properly understood, appropriate public health interventions can be implemented to improve health outcomes. In the same effort, this study also aims to better understand the reasons provided by parents for not vaccinating their teens for HPV in the South.

1.2 Purpose & Research Questions

The purpose of this study is to evaluate the main reasons for not vaccinating for HPV within the 17 southern states using the 2016 National Immunization Survey –Teen data. Because the South has the lowest initiation and completion rates for HPV vaccine, it is

beneficial to understand the nuances for the reasons given for not vaccinating among individuals who are not vaccinating for HPV. The main research questions for this paper are:

1) What are the most common reasons provided for not vaccinating for HPV in the 17 southern states?
2) What are some of the sociodemographic factors that correlate with the top reasons for not vaccinating?
3) Is there a relationship between gender, race, mother's age, number of children under 18 in the household, mother's education and the reasons provided for not vaccinating for HPV?

Based on existing research, the expected outcome is that the top reasons for not vaccinating for HPV in the South will resemble the reasons provided at the national level. Older mothers and those with higher education levels will be associated with the top reasons identified for declining HPV vaccination. There may be additional variations in how demographic characteristics correlate with the responses given for not vaccinating for HPV. Once the reasons for declining HPV vaccination are better understood, more focused interventions can be implemented to address concerns about HPV vaccine in the South.

Literature Review

2.1 Vaccine Coverage

In 2016, only 43.4% of adolescents (49.5% of females and 37.5% of males) between the ages of 13 to 17 were up to date with their HPV vaccination series. These numbers were higher for adolescents who had one or more doses of HPV, 61.1% for females and 56% for males (Walker et al., 2017). Improvements in HPV coverage levels have been occurring but they have

been very gradual. In 2014, the initiation rate for HPV vaccine was 60% for females and 41.7% for males (Reagan-Steiner et al., 2015). Between 2011 and 2012 there was no progress for national HPV vaccination coverage rates for females ages 13 to 17 and a 3.3 percentage point increase in 2014 (Reagan-Steiner et al., 2015). From 2015 to 2016 HPV vaccination initiation rates and completion rates went up 4.3 percentage points and 2.2 percentage points respectively (Walker et al., 2017). Other vaccines routinely administered for the same age range as the HPV vaccine, Tdap and Meningococcal (MenACWY), both have higher vaccination rates than HPV with 88% and 82.2% respectively (Walker et al., 2017). In general, other vaccines routinely administered in the United States have had higher acceptance and completion rates; most of these vaccine rates have reached or exceeded the 2020 Healthy People goals. Vaccine initiation for HPV continues to slowly increase but remains 22 to 28 % points lower than those for Tdap and ≥1 -dose MenACWY (Walker et al., 2017).

There are differences in coverage levels observed in different subgroups and geographic regions for HPV vaccine. 2012 data showed that initiation rates for those that are older (19 to 26 years of age) were only 34.5% for females and 2.3% for males (Rahman, Islam, & Berenson, 2015). A study conducted by Rahman, Islam, and Berenson in 2015 found that HPV vaccination rates did not differ by region for men but they did for women and the lowest rates of initiation for women 19 to 26 were found in the South. Another study conducted by Rahman, McGarth, and Berenson (2014) found similar trends for girls 13 to 17 years old with the lowest HPV initiation and completion rates found in the South, 48.4% and 30.6% respectively. These low coverage levels for HPV vaccination in the South signal a need to further understand the reasons for the low uptake in this region of the country.

Race and income were found to be influential in initiation and completion rates among boys. The odds were higher for initiating and completing HPV vaccines for boys who were on Medicaid/SCHIP, boys who received a provider recommendation, boys from households with incomes below the poverty threshold, boys who were Hispanic and boys who were Non-Hispanic Black (Henry, Swiecki-Sikora, Stroup, Warner, & Kepka, 2017). A study conducted by Henry et al. (2017) found that the lowest initiation rates for HPV vaccination among boys were in more affluent areas regardless of race/ethnicity. These disparities in HPV vaccination initiation rates highlight potential targets for interventions aimed at improving vaccination rates.

2.2 HPV Vaccination is Cancer Prevention

In the US, all cervical cancer and anal cancers in the population are attributable to HPV infections (Seyferth et al., 2016). HPV infection causes most anogenital cancers as well as oropharyngeal cancers which contributes to an estimated 600,000 cancer occurrences worldwide and 250,000 premature deaths (Saraiya et al., 2015). There are currently three different HPV vaccines licensed and available for use in the United States: the 4-valent HPV vaccine which was first licensed in 2006 for use in women and in 2009 for use in men; the 2-valent HPV vaccine licensed for use in only women in 2009; the 9-valent HPV vaccine which was licensed in 2014 for use in both women and men (Seyferth et al., 2016). The ACIP has recommended that adolescents between 11 to 12 years of age routinely receive HPV vaccine and females 13 to 26 years and males 13 to 21 years who had not been previously vaccinated receive vaccination for HPV (Petrosky et al., 2015). In 2016 the recommendation changed from

a three-dose series to a two-dose series depending on when the vaccine was first initiated (Walker et al., 2017).

HPV vaccine has been shown to be effective and has contributed to reductions in the prevalence of HPV. A study comparing pre- and post-vaccine era prevalence of HPV strains found in the vaccine noted that there was a 56% decrease in prevalence among 14 to 19-year-old females (Markowitz et al., 2013). Not only has the vaccine been shown to help reduce the prevalence of HPV included in the vaccine, it has also produced the appropriate immune response among those vaccinated. A study conducted by Joura et al. (2015) demonstrated that nearly 100% of women 16 to 26 years of age vaccinated with 9-valent HPV vaccine developed antibodies of all the included strains in the vaccine within the first month after completing the 3-dose series. There are an estimated 31,500 newly diagnosed cancers in men and women attributable to HPV and approximately 90% of these could be prevented with the receipt of the 9-valent HPV vaccine (Walker et al., 2017, p.881). In addition, the beneficial effects at the population level for HPV vaccination can be observed as early as 3 years after the introduction of an HPV vaccination program (Joura et al., 2015). The benefits of implementing an HPV vaccination program and improving coverage levels help prevent cancer at the individual as well as improve population health in a short timeframe.

2.3 Provider Recommendation

Many studies demonstrate the fundamental role provider recommendations have with HPV vaccine initiation rates. In a study conducted by Mohammed et al. (2016) parents cited that the main reason for not vaccinating their boys for HPV was the lack of a strong recommendation from the provider. There have been many efforts to improve provider

recommendation of the HPV vaccination to patients but rates remain low. Mohammed et al. (2017) used National Immunization Teen Survey data from 2014 and found that overall 72.6% of girls and 51.8% of boys received a provider recommendation of HPV vaccination. Provider recommendation is one of the most important predictors of HPV vaccine uptake among adolescents and if patients are not receiving recommendations the likely outcome will be low vaccine utilization.

There is also evidence showing that among parents of teen girls surveyed only 29% were given HPV recommendations that aligned with current national guidelines (Lindley et al., 2016). This implies that despite providers' making recommendations, few may be making the recommendation in line with the ACIP guidelines. The deviation from the national guidelines for HPV vaccination leads to variation in who is receiving a recommendation. Girls have a 2.57 higher odds of receiving provider recommendations for HPV vaccines than boys, which points to the bias associated with lower recommendation for boys (Mohammed et al., 2016).

Variations in the way providers make recommendations have also been observed for different racial and ethnic groups. A study conducted by Burdette, Webb, Hill, & Jokinen-Gordon (2017) found that provider recommendations among males and females varied by race and ethnicity. Approximately 52% of African American females received a recommendation compared to 61% among non-Hispanic White females (Burdette, Webb, Hill, & Jokinen-Gordon, 2017). This study also found that race and ethnic disparities in HPV vaccination rates among males are heavily influenced by differences in provider recommendations. For females, minority girls have seen a higher increase in provider recommendations and HPV vaccination uptake compared to non-Hispanic Whites (Burdette et al., 2017). Luque, Tarasenko, Dixon,

Vogel, & Tedders (2014) showed that only "46% of Georgia Vaccines for Children (VFC) providers who saw 11 to 12-year-old female patients, always made a recommendation for HPV vaccination. Similarly, Texas had 48% of the physicians reporting that they had always recommended HPV vaccination for female patients between 11 to 12 years old (Tarasenko, Dixon, Vogel, & Tedders, 2014).

Other researchers have found similar variations in the rate of vaccine recommendations made by providers based on the teen's demographic factors. Among boys, the lowest vaccine recommendation rates were found for those living in the South (43.7%), those living below the poverty line (49.4%), and for those with mothers having less than a high school education (44.8%) (Mohammed et al., 2016). The lowest recommendation rates for females were observed among Hispanics (69.2%), living in the South (69.1%), those living below the poverty line (64.9%), and those with mothers whose education level was less than high school education (61.9%) (Mohammed et al., 2016). Since provider recommendation is an important factor in the uptake of HPV vaccines these variations in recommendation can contribute to the variation in uptake among different subgroups. Adolescent boys and girl living in the South had lower odds of vaccine recommendation compared to those living in the Northeast, Midwest, and West (Mohammed et al., 2016). Vaccination coverage for females with ≥1-dose of HPV was lowest in Mississippi with 47.9% and up-to-date estimates for females was lowest in South Carolina with 30.8% (Walker et al., 2017). The literature suggests that those residing in the South are receiving recommendations for HPV at lower rates which may be influencing the trend in low HPV vaccination initiation and completion in this region.

In addition to the importance of the provider's recommendation, the providers' vaccine-related attitudes are also strongly associated with the parents' attitudes about vaccinations (Mergler et al., 2013). A study conducted by Salmon et al. (2008) found that most Primary Health Care Providers (PHCPs) identified by children exempt from school immunization requirements and those children without school immunization exemptions had similar attitudes concerning vaccinations. There was a striking difference found between PHCP of children with vaccine exemptions regarding immunization safety beliefs. The study findings show that the knowledge, attitudes, and practices of PHCPs may be a contributing factor on the parent's decisions to decline or accept vaccinations (Salmon et al., 2008). Mergler et al. (2013) also found that guardians had 45 times higher odds of agreeing that there were community benefits to having children fully vaccinated when their provider agreed, compared to guardians whose providers did not agree. The acceptance of vaccines by parents is not simply based on provider recommendation but also related to the providers attitude about vaccinations.

2.4 Who's Refusing to Vaccinate & Why?

A study conducted by Cheruvu, Bhatta, and Drinkard (2017) looked at those who had no intentions to vaccinate for HPV over several study periods using NIS-Teen data and found very distinct characteristics for those not vaccinating. Parents in the survey years 2009 to 2012 were significantly more likely to report 'no intent' to vaccinate for HPV and cite safety and effectiveness concerns as their reason for not vaccinating for HPV compared to parents surveyed in 2008 (Cheruvu, Bhatta, & Drinkard, 2017). This study also found that, for unvaccinated females, three out of five parents reported that they had no intentions to vaccinate their daughters in the next 12 months. There were also some sociodemographic

factors associated with the parents' intention to not vaccinate for HPV. Factors associated with parents' decision to not vaccinate their daughters included: the number of people in the household, annual household income of $35,001 - $75,000, mothers with higher than high school education, and mother's over 45 years of age (Cheruvu et al., 2017). A similar study that looked at parents' intent to vaccinate for HPV found that for parents of US adolescents (13 to 17), maternal education was the strongest predictor of intent to obtain HPV vaccination for their teen (Mohammed et al., 2017). Among parents of adolescent boys, mother's marital status, and non-Hispanic black race/ethnicity were significant predicators of intention to obtain HPV vaccination (Mohammed et al., 2017).

Similar trends were found among those initiating the HPV vaccination series. For boys, racial/ethnic minorities and those in the VFC program had higher rates of initiation whereas boys with highly educated mothers were less likely to be fully immunized (Johnson, Lin, Cabral, Kazis, & Katz, 2016). Using data form NIS-Teen a study conducted by Johnson et al. (2016) revealed several reasons parents provided for refusing to vaccinate their teens for HPV: vaccine was not recommended, vaccine was not needed, lack of knowledge, safety concerns, and the teen was not sexually active. There were also differences in reasons for vaccine refusal based on the gender of the child. Parents/guardians of male children were significantly more likely to indicated that the vaccine was not recommended by the provider and that the vaccine was not necessary; whereas parents/guardians of girls were significantly more likely to report concerns for vaccine safety (Johnson et al., 2016). Challenging the results of previously cited studies, this study also found that provider recommendation was not associated with completion of the three-dose series indicating that although provider recommendation is important there may be

other factors associated with completion of the series (Johnson et al., 2016). There were also some characteristics that made individuals immune to provider recommendations. Even though providers were more likely to recommend the vaccine to girls who had mothers with higher education levels, these mothers were immune to the recommendations from the provider (Johnson et al., 2016). Provider recommendation may be important but there are other factors that influence the decision of caregivers to get the HPV vaccine for their teen.

Thompson, Rosen, Vamos, Kadono, & Daley (2017) conducted an analysis of NIS-Teen data from 2012 to 2015 to evaluate the reasons provided for not vaccinating for HPV and found that the most common reason for non-vaccination among males was lack of recommendation in years 2012 and 2013. However, in 2014 and 2015 the most common reason was that the vaccine was not needed. For females, the most common reason for not vaccinating was that the vaccine was not needed for all survey years. These studies demonstrate that there is still a gap in knowledge among parents about the importance and need for HPV vaccination.

2.5 Vaccine Hesitancy

Vaccine hesitancy has been around since vaccines were first developed and individual hesitancy to vaccinate has been an ongoing concern for the healthcare community (Patel & Berenson, 2013; Siddiqui, Salmon, & Omer, 2013). The success of vaccine programs have led to a shift in fear from vaccine-preventable diseases to the fear of the vaccines that prevent those diseases (Siddiqui et al., 2013). Many who are electing to not vaccinate tend to be older mothers (≥30 years old), college educated and tend to be living in higher income households (Siddiqui et al., 2013). Vaccine Hesitant Parents (VHP) believe that children receive too many vaccines, that their child may have serious side effects from vaccines, and that vaccines may

negatively impact their child's immune system (Williams, 2014). Most barriers to vaccinate for VHP are centered around concerns about vaccine safety (Williams, 2014). Results from studies evaluating the demographic information of parents who tend to refuse vaccines revealed that parents who refuse tend to be more educated whereas those who accept vaccination have a lower education level (Patel & Berenson, 2013).

The literature suggests that the low uptake of HPV vaccine is also connected to safety concerns, and inadequate knowledge about HPV (Mohammed et al., 2017). National Immunization Survey from 2003 found that 21.8% of parents intentionally delayed vaccine doses and that these parents reported vaccine safety concerns as reasons for the delay (Salmon, Dudley, Glanz, & Omer, 2015). A systematic literature review conducted by Holman et al. in 2014 found that parents were aware of the HPV vaccine but expressed the need for more information before they decided to vaccinate their children and cited lack of knowledge as a barrier (Holman et al., 2014). Holman et al. (2014) also found that parents reported having concerns about adverse effects and vaccine safety which were hinderance for vaccine uptake.

A focus group conducted by Sanders Thompson, Arnold, and Notaro (2012) of African American parents also uncovered similar findings of the need for more education on HPV vaccinations and the reasons that HPV vaccination is recommended at younger ages. The semi-structured interview of 30 participants was conducted after initial interviews involving two hundred African American men and women about their attitudes towards HPV vaccination. There were six major themes identified as influencing parental decisions about HPV vaccination and those included: the influence of physician recommendation, vaccine decision making, desire for information related to vaccine safety, youth sexuality, HPV vaccine costs, and

religious issues affecting HPV vaccination decisions (Sanders Thompson et al., 2012). The researchers found that although this group was religious, religion did not appear to be a barrier to HPV vaccination and these parents were not concerned that HPV vaccination would lead to early sexual activity (Sanders Thompson et al., 2012). The findings by Sanders Thompson et al. did show that there were concerns about vaccine safety, cost, and age of vaccination. Despite the concerns there was a desire to receive more information on these topics. Another important finding to note from this study was the suggestion that parents were not aware of the reasons for the targeted ages for HPV vaccination which aligned with previous studies. If parents are not clear on the need to vaccinate adolescents 11 to 12 years for HPV then they will decline the vaccine on the basis that it is not needed or necessary (Sanders Thompson et al., 2012). It is important to understand the perceptions parents have of HPV vaccination, their concerns, and gaps in knowledge; this will inform tailored interventions to improve vaccine uptake and sufficiently address parents' concerns.

In addition to concerns about safety, attitudes about HPV vaccination and actual choices about vaccinating for HPV can be conflicting. A United States national assessment of parental attitudes about male HPV vaccination found that 90% of parents agreed that male HPV vaccination was generally but only about half of parents of boys planned to have their own sons vaccinated against HPV as adolescents (Dempsey, Butchart, Singer, Clark, & Davis, 2011). Although parents perceived HPV vaccination as a good thing there was a disconnect when it came time to vaccinating their own child. This disconnect demonstrates the potential breakdown in public health messaging about HPV and the way parents receive these messages.

In 2009, the Association of State and Territorial Health Offices (ASTHO) commissioned a survey to collect information about effective messages and materials to address parental concerns about vaccinations. The results of the survey showed that a strong majority of parents supported vaccinations but had concerns about their safety and possible adverse effects (Association of State and Territorial Health Offices [ASTHO], 2010). The survey also evaluated vaccine acceptance and found that 16% of parents had refused vaccine for their children. Of those refusing vaccines 6% are considered "minor refusers" who decline Hep A, HPV, or flu vaccines; 10% are considered "significant refusers" who refuse one or more routinely recommended childhood vaccines (ASTHO, 2010). Another 5% of parents and guardians have major concerns about vaccinating their children yet they have not refused a vaccine (ASTHO, 2010). The survey found that the most frequently refused vaccine was HPV. The findings of the ASTHO commissioned survey demonstrate the persistent concerns from parents about vaccines, even among those who choose to vaccinate.

2.6 Policy Interventions

49.8% of adolescent males and 62.8% of females had one or more doses of HPV vaccine in 2015 but 81.3% had received Tdap and 87.1% had received meningococcal conjugate (MVC4) vaccine (Thompson, Rosen, Vamos, Kadono, & Daley, 2017, p. 289). These numbers suggest that HPV vaccination rates continue to linger behind those of Tdap and MCV4 indicating that there is something specifically unique about the perceptions of HPV vaccination that is leading to the slow uptake. Due to this finding, many states have attempted to pass legislative and policy level interventions with the attempt to increase uptake. A study conducted by Perkins, Lin, Wallington, and Hanchate (2016) used NIS-Teen data for survey years 2009 to 2013

evaluated vaccination rates among girls residing in states and jurisdictions with school-entry mandates for HPV and those in states with educational mandates. The study found that laws passed to improve HPV vaccination rates did not result in higher vaccine coverage in states and jurisdictions with mandates compared to those without (Perkins, Lin, Wallington, & Hanchate, 2016). It concluded that before considering legislation, policies should focus on getting providers to give strong, consistent recommendations to prevent skepticism and hesitancy among parents (Perkins, Lin, Wallington, & Hanchate, 2016).

Another study by Sadaf, Richards, Glanz, Salmon, and Omer (2013) conducted a systematic review of interventions to reduce vaccine refusal and hesitancy. The findings from this study did not reveal any evidence on effective interventions to address parental vaccine hesitancy and refusal. Sadaf et al. (2013) discussed the need to develop interventions that can influence parents' perceptions about vaccines and the need for research focused on changing behavior. As vaccine refusals grows, policy makers should seek interventions that can improve vaccination rate among parents who normally refuse vaccinations (Sadaf, Richards, Glanz, Salmon & Omar, 2013). The need to address the concerns of parents who are hesitant about vaccinating for HPV is imperative in order to improve vaccine coverage in the United States. Increasing HPV vaccination coverage will help reduce the burden of disease caused by HPV.

Vaccine recommendation, although important, is not being given consistently. HPV vaccination rates continue to fall behind other adolescent vaccination rates. The lowest initiation and completion rates for HPV vaccine are found in the South. And mothers that are older, white, with college education, and more affluent tend to be the ones not vaccinating. Concerns about vaccine safety, not understand why HPV vaccine is administered between 11 to

12 years, and a general lack of awareness of how the immune system works in conjunction with vaccines have led to the low uptake in HPV vaccination. Fully understanding similar possible trends in the South will help improve education efforts aimed at improving vaccination coverage levels for HPV.

Methods & Procedures

3.1 National Immunization Survey –Teen 2016 (NIS-Teen)

NIS-Teen is an annual survey conducted by the National Center for Immunization and Respiratory Diseases and the National Center for Health Statistics of the Centers for Disease Control and Prevention. NIS-Teen uses a two-phase method of collecting a large national probability sample of teens aged 13 to 17 years of age. The sample includes households in the 50 states, the District of Columbia, and the U.S. Virgin Islands. The first phase involved a random digit dialing (RDD) telephone (landline and cell phone numbers) survey to identify households with age-appropriate teens. Once a household was identified the adult with the most knowledge about the teen's immunization history was interviewed. In the second phase providers identified as having administered vaccinations to the teen were mailed surveys to collect information about the immunization history of the teen. The 2016 dataset had a total of 41,994 completed household interviews. Detailed methods for sampling for the NIS-Teen 2016 are available for review (National Center for Immunization and Respiratory Diseases, 2017). NIS-Teen 2016 was deidentified and made available for use as a public dataset.

3.2 Sample

This study used a subset sample (n=16,125) of all respondents residing in the 17 states that are part of the South region as defined by the United States Census Bureau. The 17 states

are Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia (U.S. Census Bureau, n.d.). From the 16,125 respondents in the south, another subset was taken from the data for those who had a "yes" or "no" response to the question asking if the teen had any doses of HPV vaccine (n=14460). Only the household survey portion of NIS-Teens was used for this study.

3.3 Reasons for not Vaccinating for HPV

Respondents of the household survey were asked several questions about HPV vaccination in relation to the selected teen. The parent or guardian was asked *"has the teen ever received HPV shots?"* and parents could respond yes, no, or don't know. Those who responded with a "no" were asked a follow up question about their intentions to have the teen vaccinated. The question asked, *"how likely is it that the teen will receive HPV shots in the next 12 months?"*. Parents who responded, "*very likely*" or "*somewhat likely*" were considered to have intentions to vaccinate their teen. Those who responded, *"not too likely", "not likely at all"*, or *"not sure/don't know"* were considered to be parents who had no intention to vaccinate their teen for HPV vaccine. These parents were asked follow-up questions about the main reasons for choosing not to vaccinate in the next 12 months. Respondents had an option to select the main reason from 14 possible options. If the parent provided more than one reason they were asked *"what would you say is the MAIN reason?".* For the analysis, the following reasons were selected to be evaluated for the subgroup that was defined as having no intention to vaccinate for HPV:

- vaccine was not recommended
- not needed/not necessary
- don't believe in immunizations
- lack of knowledge
- [teen] not sexually active
- not appropriate age
- safety concerns/side effects
- religion/orthodox
- more info/new vaccine
- not a school requirement
- increased sexual activity concerns
- child is male

3.4 Statistical Analysis

The sample size (n=14460) consisted of those who responded "yes" or "no" to the question that asked, *"has the teen received HPV shots?"*. A univariate analysis was conducted to test for differences between those who responded "yes" or "no" to the question by sociodemographic factors (age of teen, gender of teen, relationship of respondent to teen, mother's age, mother's education level, marital status of mother, housing, poverty status and the number of children under 18 in the household). The sociodemographic factors were selected based on what was available in the household survey and based on what was found in the literature for factors associated with declining HPV vaccination. A similar univariate analysis was done to test the relationship between respondents that answered "yes" or "no" and the states in which they resided. These tests were used to determine if there were difference among those who started vaccinating for HPV and those who did not by different sociodemographic factors. The p-values were calculated with 95% confidence intervals and statistical significance was defined as a p-value of < 0.05.

Frequencies were calculated for the 12 main reasons provided for not vaccinating for HPV among respondents who were defined as having no intention to vaccinate. Those who answered "yes" or "no" to the 12 reasons were included in calculations for the frequencies

(n=5824). The top four reasons provided were identified and further frequency distributions were evaluated for these top four reasons and sociodemographic factors including the gender of the teen, mother's age, relationship of respondent to teen, and the number of teens under 18 in the household.

A logistic regression analysis was performed for each of the top four reasons given for not vaccinating for HPV. The dependent variable was the response of "yes" to the reason for not vaccinating for HPV; meaning the respondent agreed that the reason selected was the main reason for electing not to vaccinate their teen for HPV in the next 12 months. The following independent factors were included in the model the gender of teen, mother's age, mother's education level, the number of children under 18 in household, race/ethnicity, and the relationship of respondent to the teen. These factors were included in the model because of existing evidence in the literature that showed connections with these factors and intention to vaccinate for HPV. The model was tested four different times for the top four different reasons for not vaccinating. All analysis was done using Statistical Analysis Systems 9.4.

Results

4.1 Sample Characteristics

Table 1 has the distribution of HPV vaccination status for teens 13 to 17 among the southern states included in this study. Statistical significance was found between those answering "yes" or "no" to having a dose of HPV and the state of residence of the teen. This indicates that there is a difference between those who had started their HPV vaccination and those who had not started by state of residence.

Table 1: HPV Vaccination Status by State of Residence

*True State of Residence of Teen	n=14460 # (%)	HPV Dose Yes (%)	HPV Dose No (%)
Alabama	608 (4.2)	283 (46.6)	325 (53.5)
Arkansas	638 (4.4)	290 (45.4)	348 (54.6)
Delaware	677 (4.7)	392 (57.9)	285 (42.1)
District of Columbia	725 (5.0)	505 (69.7)	220 (30.3)
Florida	764 (5.3)	381 (49.9)	383 (50.1)
Georgia	679 (4.7)	357 (52.6)	322 (47.4)
Kentucky	578 (4.0)	262 (45.3)	316 (54.7)
Louisiana	626 (4.3)	300 (47.9)	326 (52.1)
Maryland	843 (5.8)	535 (63.5)	308 (36.5)
Mississippi	618 (4.3)	250 (40.5)	368 (59.6)
North Carolina	695 (4.8)	357 (51.4)	338 (48.6)
Oklahoma	581 (4.0)	268 (46.1)	313 (53.9)
South Carolina	629 (4.4)	283 (45.0)	346 (55.0)
Tennessee	550 (3.8)	261 (47.5)	289 (52.6)
Texas	3822 (26.4)	1853 (48.5)	1969 (51.5)
Virginia	826 (5.7)	456 (55.2)	370 (44.8)
West Virginia	601 (4.2)	318 (52.9)	283 (47.1)

* State FIPS Code used.
Mantel-Haenszel Chi-square test was used to calculate p-values using 95 % confidence interval (CI) for the difference between those answering yes or no to having HPV doses among teen's true state of residence n= 14460(those with responses of Don't Know and unknown were removed from the calculation of this value).All values in table are statistically significant with p-value = 0.0003.

Table 2 provides demographic characteristics of adolescents 13 to 17 years of age who either had received a dose of HPV vaccine or who had not started the series. There was statistically significant difference found between those having received a dose of the HPV vaccine and those who had not for seven of the sociodemographic factors selected. Age of teen, gender of teen, relationship of respondent to teen, mother's age, mother's education level, and marital status of mother all had statistically significant p-values indicating a difference between those who had started HPV vaccination and those who had not. There is correlation between the selected sociodemographic factors and initiation of HPV vaccination.

Table 2: Characteristics of NIS-Teen 2016 Respondents Residing in the South by Vaccination Status

Participant Characteristics	n=14460 Number(%)	HPV Dose? Yes (%)	HPV Dose? No (%)	p-value ǂ
*Age of Teen				<.0001
13	2927 (20.2)	1327 (45.3)	1600 (54.7)	
14	2872 (19.9)	1415 (49.3)	1457 (50.7)	
15	2932 (20.3)	1516 (51.7)	1416 (48.3)	
16	3060 (21.2)	1637 (53.5)	1423 (46.5)	
17	2669 (18.5)	1456 (54.6)	1213 (45.5)	
Gender of Teen				<.0001
Male	7429 (51.4)	3390 (45.6)	4039 (54.4)	
Female	7031 (48.6)	3961 (56.3)	3070 (43.7)	
Race/Ethnicity of Teen				0.9211
Hispanic	2579 (17.8)	1411 (54.7)	1168 (45.3)	
Non-Hispanic White Only	8063 (55.8)	3899 (48.4)	4164 (51.6)	
Non-Hispanic Black Only	2425 (16.8)	1328 (54.8)	1097 (45.2)	
Non-Hispanic Other + Multiple Race	1393 (9.6)	713 (51.2)	680 (48.8)	
Relationship of Respondent to Teen				0.0002
Mother (step, foster, adoptive)/Female Guardian	9653 (66.8)	5169 (53.55)	4484 (46.5)	
Father (step, foster, adoptive)/Male Guardian	3662 (25.3)	1655 (45.19)	2007 (54.8)	
Grandparent	600 (4.2)	315 (52.50)	285 (47.5)	
Other Family Member/Friend	540 (3.7)	210 (38.89)	330 (61.1)	
Don't Know	1 (0.0)	--	1 (100)	
Refused	4 (0.0)	2 (50.0)	2 (50.0)	
Mother's Age Category				0.0205
≤ 34 Years	1387 (9.6)	721 (52.0)	666 (48.0)	
34 to 44 Years	6249 (43.2)	3054 (48.9)	3195 (51.1)	
≥ 45 Years	6824 (47.2)	3576 (52.4)	3248 (47.6)	
Mother's Education Level				0.0353
Less than 12 Years	1529 (10.6)	791 (51.7)	738 (48.3)	
12 Years	2473 (17.1)	1203 (48.7)	1270 (51.4)	
More than 12 Years, Non-College Graduate	3758 (26.0)	1848 (49.2)	1910 (50.8)	
College Graduate	6700 (46.3)	3509 (52.4)	3191 (47.6)	
Mother's Marital Status				<.0001
Married	9914 (68.6)	4861(49.0)	5053 (51.0)	
Never Married/Widowed/Divorced/ Separated/Deceased/Living with Partner	4546 (31.4)	2490 (54.8)	2056 (45.2)	
Housing				0.2441
Owned or Being Bought	10345 (71.5)	5237 (50.6)	5108 (49.4)	
Rented	3602 (24.9)	1867 (51.8)	1735 (48.2)	
Other Arrangement	357 (2.5)	175 (49.0)	182 (51.0)	
Don't Know	20 (0.1)	10 (50.0)	10 (50.0)	
Refused	136 (0.9)	62 (45.6)	74 (54.4)	
**Poverty Status				0.3758
Above Poverty > $75,000	6431 (44.5)	3282 (51.0)	3149 (49.0)	
Above Poverty ≤ $75,000	4653 (32.2)	2256 (48.5)	2397 (51.5)	
Below Poverty	2432 (16.8)	1368 (56.3)	1064 (43.8)	
Unknown	944 (6.5)	445 (47.1)	499 (52.9)	
Number of Children under 18 in House Hold				0.3550
One	5701 (39.4)	2815 (49.4)	2886 (50.6)	
Two or Three	7419 (51.3)	3903 (52.6)	3516 (47.4)	
Four or More	1340 (9.3)	633 (47.2)	707 (52.8)	

*Age of teen at time of interview

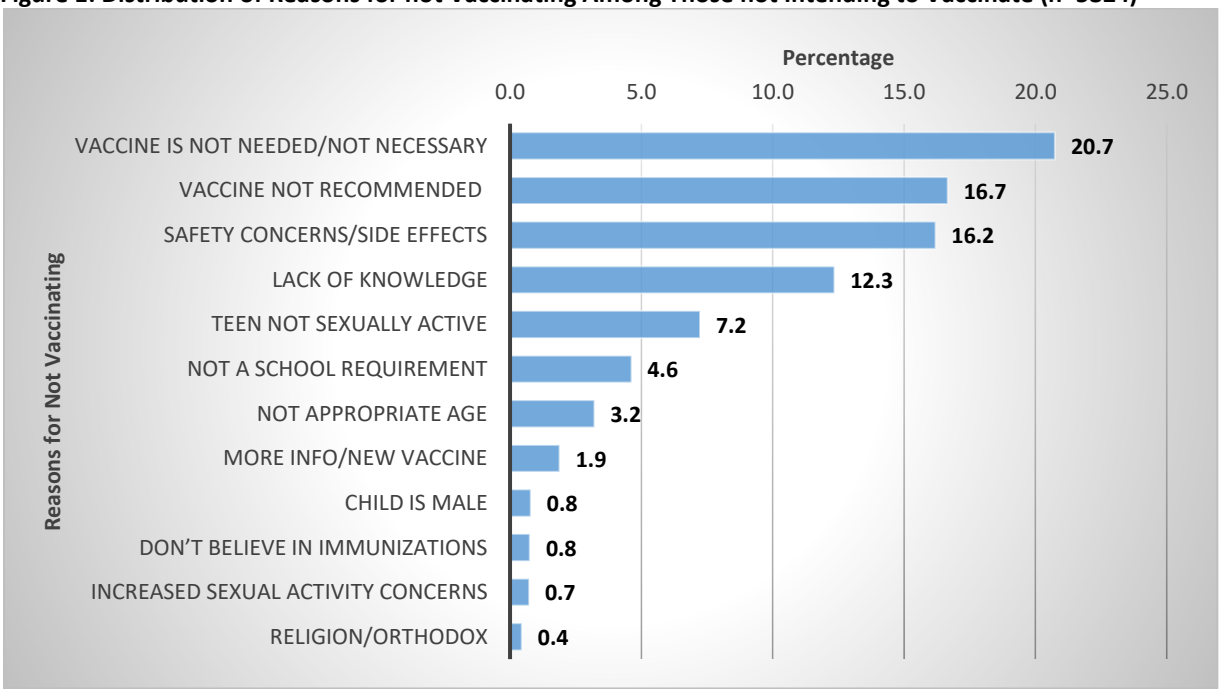
** Based on the 2015 census poverty threshold; based on exact income if given or any established income bound

ǂ Mantel-Haenszel Chi-square test was used to calculate p-values using 95 % confidence interval (CI) for the association between teen's sociodemographic factors and the difference of answering yes or no to having any doses of HPV. n= 14460(those with responses of Don't Know and unknown were removed from the calculation of this value).

4.2 Distribution of Reasons for Not Vaccinating for HPV

Frequency distributions for the 12 reasons for not vaccinating for HPV can be found in Figure 1. The distribution of reasons for not vaccinating ranged from 0.4% citing "religion/orthodox" to 20.7% citing "vaccine as not needed/not necessary" among those with no intention to vaccinate for HPV. The top four reasons for not vaccinating for HPV were: vaccine not needed/not necessary (20.7%), not recommended (16.7%), safety concerns/side effects (16.2%) and lack of knowledge (12.3%).

Figure 1: Distribution of Reasons for not Vaccinating Among Those not Intending to Vaccinate (n=5824)



4.3 Top Four Reasons for Not Vaccinating for HPV

The distribution of sociodemographic information for the top four reasons for not vaccinating for HPV vaccine highlight interesting trends. Figures 2 through 5 show the distribution of the top four reasons by different sociodemographic factors. Those who answered "yes" for the top four reasons were divided out by gender of teen and age of mother.

Approximately over 80% of those electing not to vaccinate because of the top four reasons had mothers over the age of 34. Less than 15% of the respondents electing not to vaccination due to the top four reasons had mothers who were 34 years old or younger. This was the case for both male and female teens. Those declining to vaccinate for HPV due to the top four reasons tend to be teens with older mothers.

Figure 2: Reasons for not Vaccinating by age of Mother for Male Teens

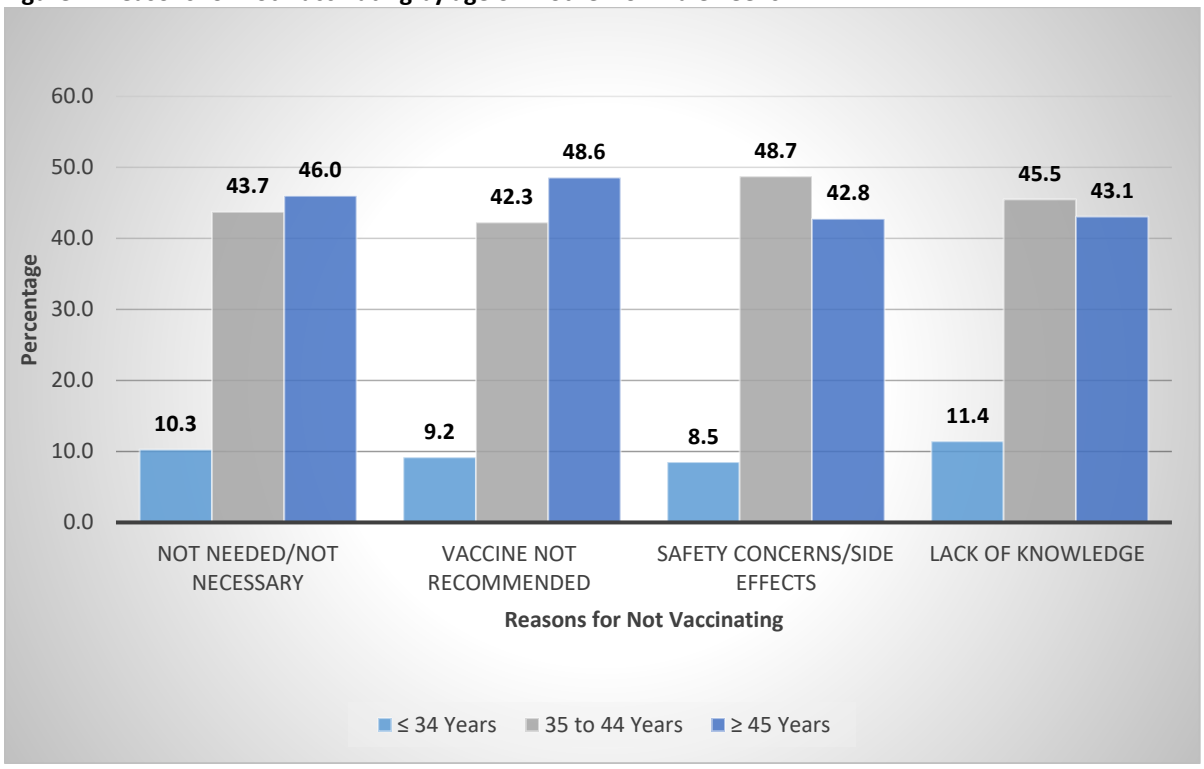
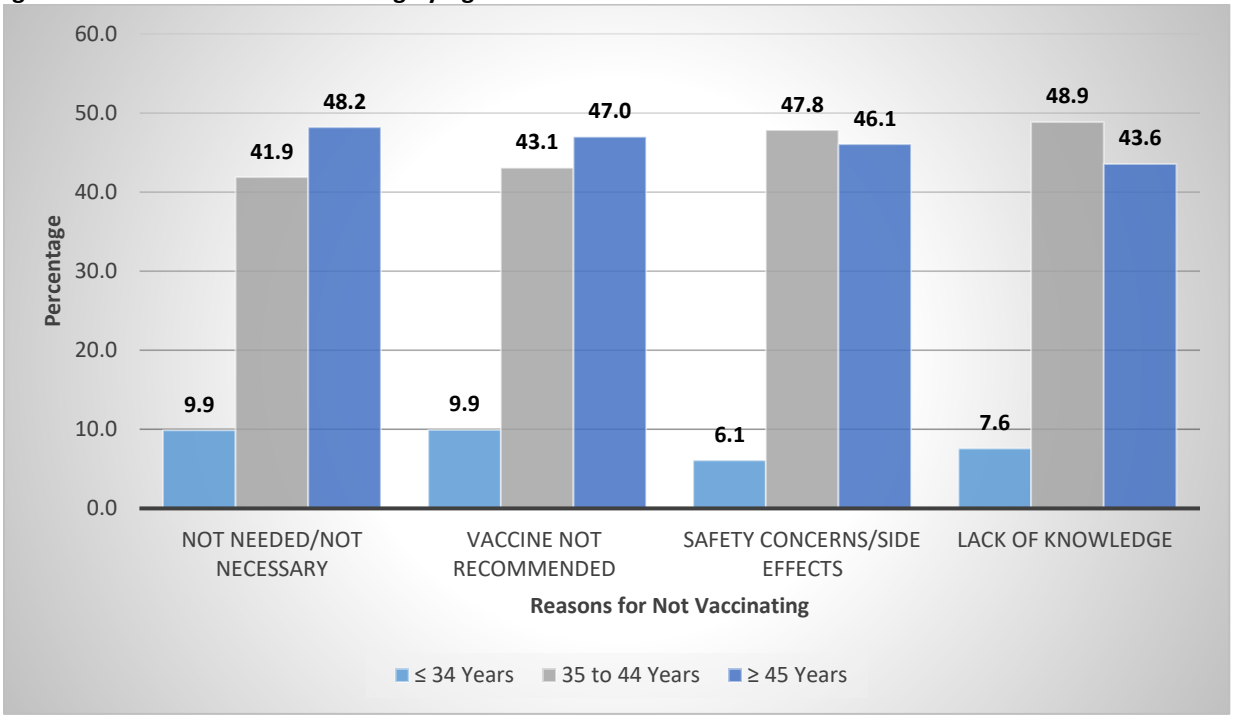


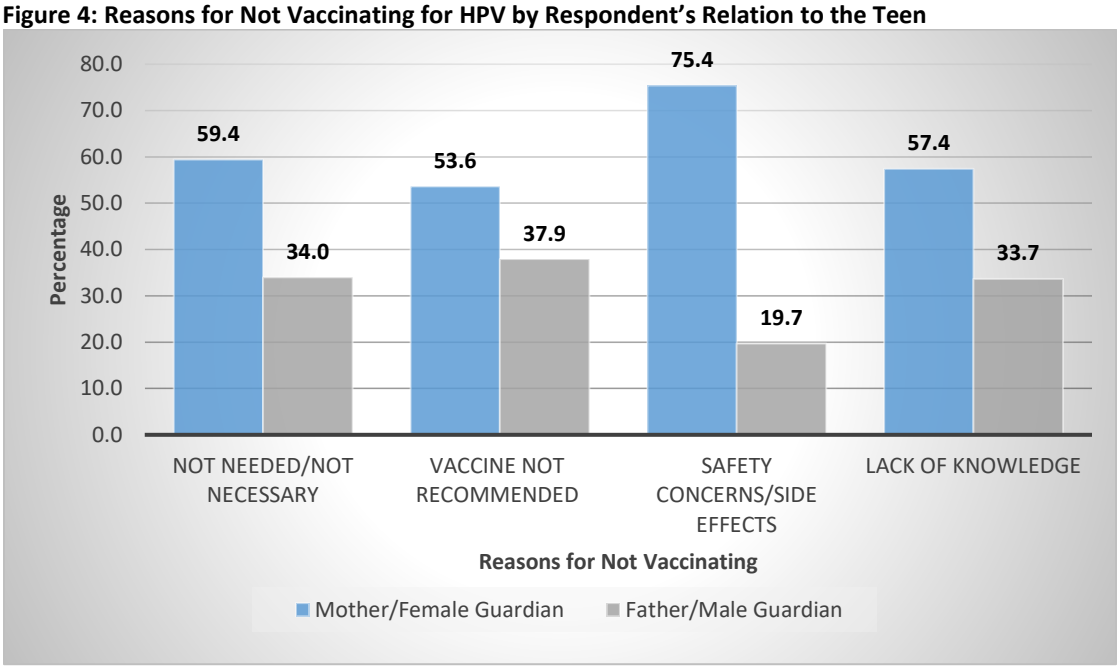
Figure 3: Reasons for Not Vaccinating by Age of Mother for Female Teens



Mothers tended to be 45 years or older for those choosing not to vaccinate for HPV because "vaccine was not needed/not necessary" or because "vaccine was not recommended". A slightly larger percentage of those not vaccinating because of "safety concerns/side effects" or "lack of knowledge" had mothers between the ages of 35 to 44. Those who declined HPV vaccination were likely to be teenagers with older mothers. This finding aligns with what was found in the literature; mothers of teens not vaccinated for HPV tend to be older.

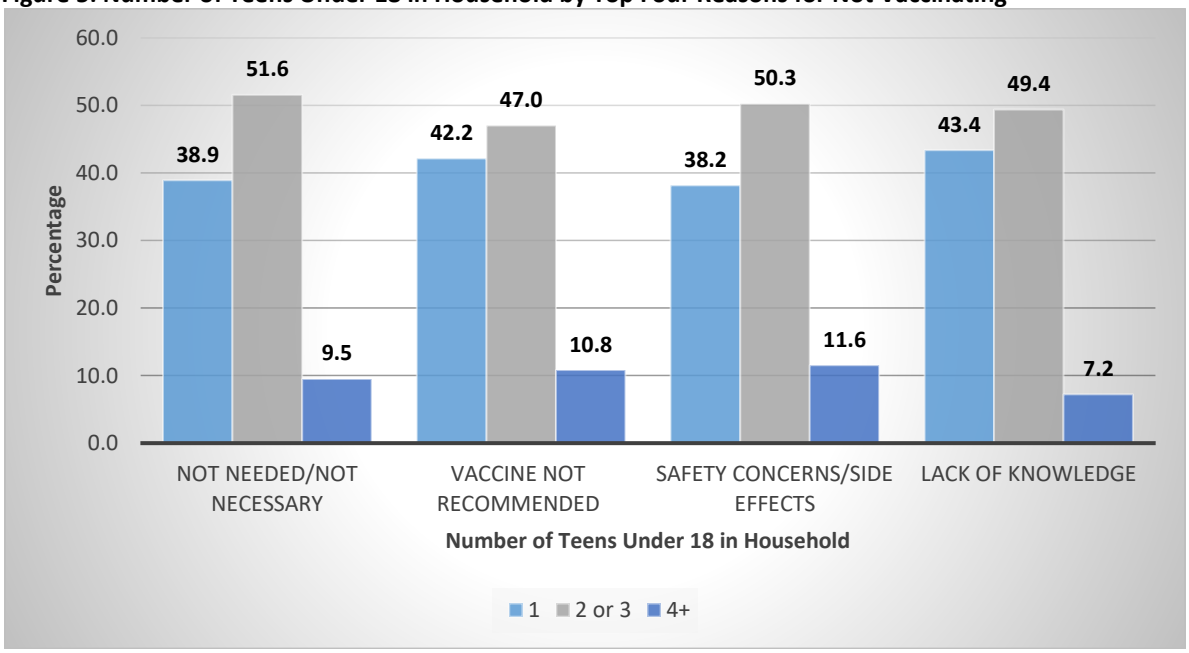
Figure 4 shows the top four reasons given for not vaccinating by the relationship of the respondent to the teen. More mothers/female guardians responded with the top four reasons for not vaccinating their teen for HPV. 75.4% of those who responded that "safety concerns/side effects" were the main reason for not vaccinating for HPV were mothers/female guardians of teen.

Figure 4: Reasons for Not Vaccinating for HPV by Respondent's Relation to the Teen



Among those who selected "vaccine not recommended" as the reason for not vaccinating for HPV, 37.9% were fathers/male guardians. Figure 5 shows the breakdown of those who answered with the top four reasons by the number of teens under 18 in the household.

Figure 5: Number of Teens Under 18 in Household by Top Four Reasons for Not Vaccinating



The smallest proportion of those not vaccinating due to the top four reasons had households with 4 or more teens under 18. The bulk of those responding with the top four reasons for not vaccinating for HPV had households with 2 or 3 teens under the age of 18. Among those who said they would not vaccinate for HPV because it was “not needed/not necessary”, 51.6% had households with 2 or 3 children under the age of 18. 47% of those who elected to not vaccinate for HPV because the vaccine was not recommended had households with 2 or 3 children under the age of 18. For those who did not vaccinate because of “safety concerns/side effects” or because of “lack of knowledge”, 50.3% and 49.4% respectively, were families with 2 or 3 children under the age of 18 in the household. This may indicate that the number of children under 18 in the household may impact the decision to vaccinate for HPV. It’s conceivable that that parents with more children may have had more exposure to recommendations for HPV vaccination due to more encounters with healthcare professionals.

4.4 Sociodemographic Factors & Top Four Reasons for Not Vaccinating for HPV

All odds ratio estimates for sociodemographic factors tested for association with top four reasons for not vaccinating in the model can be found in the appendix. Table 3 has all the statistically significant sociodemographic factors associated with the top four reasons for not vaccinating in the South.

Table 3: Characteristics Associated with Top Reasons for not Vaccinating

Reasons for Not Vaccinating for HPV	Point Estimate	95% Wald Confidence Limits
Characteristics for "Not needed/Not necessary"		
Mom's age between 35 - 44	0.74	0.57 - 0.96
Relation of Respondent to teen being mother/female guardian	0.83	0.72 - 0.97
Characteristics for "Vaccine not recommended"		
Gender of Teen Being Male	1.21	1.03 - 1.42
Mother having more than 12 yrs non-college education	0.80	0.65 - 0.98
Mother being a college graduate	0.63	0.52 - 0.76
Relation of respondent to teen being mother/female guardian	0.65	0.55 - 0.76
Characteristics for "Safety Concerns/Side Effect"		
Gender of Teen Being Male	0.64	0.55 - 0.74
Mother having more than 12 yrs non-college education	1.39	1.11 - 1.74
Mother being a college graduate	1.45	1.17 - 1.79
Relation of respondent to teen being mother/female guardian	2.05	1.70 - 2.46
Race Being White	1.49	1.19 - 1.86
Characteristics for "Lack of Knowledge"		
Gender of Teen Being Male	1.39	1.16 - 1.67
Mother having more than 12 yrs non-college education	0.79	0.56 - 0.89
Mother being a college graduate	0.57	0.46 - 0.71
Only one child <18 yrs in household	1.87	1.29 - 2.72
Two or three children <18 yrs in household	1.70	1.19 - 2.43
Relation of respondent to teen being mother/female guardian	0.83	0.69 - 0.99

*All odds ratios on this table were statistically significant.

Several sociodemographic factors were found to be statistically significant in influencing the decision to not vaccinate because of the reason "vaccine is not needed or not necessary". Mothers between the ages of 35 to 44 were 26% less likely to answer that the main reason for not vaccinating was because HPV vaccine was "not needed/not necessary" when compared to mothers who were 34 years old or younger. Mothers or female guardians were 17% less likely to decline HPV vaccination because it was "not needed/not necessary" when compared with fathers or male guardians.

Factors in the model that were found to be statistically significant with answering that "vaccine not recommended" was the main reason for declining HPV vaccination were: the gender of the teen being male, the relation the respondent to teen being mother/female guardian, the mother having higher than 12 years non-college education, and the mother having college education. Those who were male teens were 21% more likely to not vaccinate

for HPV because vaccine was not recommended when compared to female teens. Teens whose mothers had 12 years or more non-college education were 20% less likely to indicate that the reason for not vaccinating for HPV was “vaccine not recommended” when compared with teens whose mothers had high school or lower level education. Teens with mothers who were college graduates were 37% less likely to say they did not vaccinate for HPV because it was “not recommended” when compared with teens whose mothers had a high school or lower level education. Teens whose mothers had higher education levels were less likely to have provided the reason, “vaccine not recommended”, as the main reason for not vaccinating for HPV. Mohammed et al. (2016) also found that teens with mothers who had lower education levels received the lowest recommendation rates for HPV. The literature supports what was found in this model. Mothers or female guardians were 35% less likely to say the main reason for not vaccinating was “vaccine not recommended” when compared to fathers or male guardians. This indicates that fathers or male guardians are not vaccinating their teens because vaccines are not being recommended to them.

For individuals who answered that the main reason for not vaccinating for HPV was because of “safety concerns/side effects”, the following factors were found to be statistically significant with this response: gender of the teen being male, mother having 12 years or more non-college education, mother being a college graduate, respondent being the mother or female guardian of the teen, and race of teen being white. Male teens were 37% less likely than female teens to indicate that “safety concerns/side effects” were the main reasons for not vaccinating. Teens with mothers who had more than 12 years non-college education were 39% more likely to indicate that safety concerns or side effects were the main reason for not

vaccinating for HPV when compared with teens whose mothers had high school or lower level education. Teens with mothers who were college graduates were 45% more likely to indicate that HPV vaccine was declined because of “safety concerns/side effects”. Mothers or female guardians were 2.05 times more likely to indicate “safety concerns/side effects” were the main reason for not vaccinating when compared to fathers or male guardians. White teens were 49% more likely to say, “safety concerns/side effects” were the main reason for not vaccinating when compared with black teens. The education level of the mother shows up again with this reason and teens whose mothers have higher education were more likely to indicate “safety concerns/side effects” as the main reason for not vaccinating their teen for HPV.

For respondents who answered that the main reason for not vaccinating for HPV was due to “lack of knowledge”, the following factors were found to be statistically significant: gender of teen being male, mother having more than 12 years non-college education, mother being a college graduate, only having one child under 18 in the household, having 2 or 3 children under 18 in the household, and the respondent being the mother or female guardian to the teen. Male teens were 39% more likely to have “lack of knowledge” be the reason that was given for not vaccinating when compared to female teens. Teens whose mother had more than 12 years non-college education were 21% less likely to indicate that lack of knowledge was the reason for not vaccinating for HPV. Meanwhile teens with mothers with college education were 43% less likely to indicate lack of knowledge as a reason for not vaccinating for HPV when compared to mothers with high school or lower level of education. Teens in households with only one child under 18 were 87% more likely to indicate lack of knowledge as the reason for not vaccinating when compared with households with 4 or more children under the age of 18.

Families with 2 or 3 children under 18 were 70% more likely to indicate lack of knowledge was the main reason for not vaccinating when compared with families with 4 or more children under 18. Mothers or female guardians were 18% less likely to say lack of knowledge was the main reason for not vaccinating when compared to fathers or male guardians. These findings indicate that mother's higher education level was a protective factor against selecting lack of knowledge as the reason for not vaccinating. Smaller household size seems to indicate a higher chance of not vaccinating for HPV because of lack of knowledge.

All four reasons for choosing not to vaccinate for HPV had some statistically significant finding for the respondent being the mother/female guardian of the teen. This indicates that the relationship of the respondent to teen has some influence on choosing not to vaccinate for HPV due to the top four reasons. In three of the top four reasons, there was consistent statistical significance among these factors: mother's education level being higher than high school and gender of the teen. Household size was only found to be statistically significant for the response of "lack of knowledge" as the reason for not vaccinating. Households with one, two or three children under the age of 18 were more likely to cite lack of knowledge as the main reason for not vaccinating for HPV.

Discussion

5.1 Discussion & Limitations

The findings in this study echo previous published literature. Teens in the south are not vaccinating for many of the same reasons found by researchers looking at national data. The respondent being the mother or female guardian was found to be statistically significant for the top four reasons for not vaccinating. This is worth noting because mothers/female guardians

serve as the influential decisionmakers regarding their teens receiving HPV vaccination. Because mothers/female guardians are sort of gatekeepers for their teens it is important to address the concerns that they are most worried about. Mothers were also 2.05 times more likely to indicate, “safety concerns/side effects” as the main reason for not vaccinating. If mothers are making the decisions about vaccinations for HPV then their major concerns need to be successfully addressed by public health officials. Gender of the teen is also an important factor to keep in mind when evaluating the reasons for not vaccinating. Male teens were 20% more likely to not vaccinate because vaccine was not recommended and 39% more likely to not vaccinate because of lack of knowledge. Having a mother with higher education means that “safety concerns/side effects” are main reasons for not vaccinating for HPV. In contrast having a mother with a high school level or lower education means the reason for not vaccinating is due to lack of vaccine recommendation and lack of knowledge. This finding is in alignment with what was found in previous research and shows that those electing not to vaccinate for HPV tend to be mothers with higher education. Another important finding is that those with higher education did not cite lack of knowledge as a reason, instead they were less likely to indicate not vaccinating because of lack of knowledge. Mothers with higher education had safety concerns but still did not indicated they have lack of knowledge about HPV vaccines. Future research efforts should consider exploring the rational for the concern about safety/side effects for HPV vaccination among mothers with higher education. Further investigation is warranted for understanding what “lack of knowledge” means to parents. Does it mean they have no idea what HPV vaccines are meant to protect their child from? Or is it that they have heard of the vaccine but would like more information? These and similar questions should be explored for

those who indicated “lack of knowledge” was the main reason for not vaccinating for HPV. Additional research should focus on those who are not vaccinating and attempt to identify best methods to address concerns for these populations.

Limitations of this study include the inability to generalize any of these findings beyond the region that was studied. Because the NIS-Teen data is a cross-sectional survey it is not generalizable over different periods of time. Household surveys may include recall bias because respondents were asked questions about events in the past (has the teen ever received HPV vaccination). Those who refused to respond to the questions were not included in the analysis and there could be something unique about those that refused that could have influenced their decisions about HPV vaccines. Future efforts should consider looking at those who refused the questions about vaccinating for HPV and compare them with the group that did respond to see if variances among the groups exist. Differences in attitudes towards HPV vaccination by states, by different health departments and by providers can influence decisions parents make to vaccinate for HPV. This, in turn, can be a confounding variable impacting findings in this study. The variables available in the NIS-Teen 2016 dataset do not account for these other potentially influential factors. The overall burden of disease for HPV in the population may be understated as most cases are latent.

5.2 Implications of Findings & Recommendations

Public health efforts around HPV vaccination and education should focus on mothers with higher education levels. In addition, the interventions should be centered around educating mothers about the safety of the HPV vaccine. Mothers with less than high school education should also be targeted with public health efforts to improve knowledge about HPV

vaccination. Providers should be educated about the importance of making consistent recommendations for all their clients and follow all ACIP guidelines. Providers need to recommend HPV vaccination for mothers with less than high school education and boys more consistently. The public has a limited understanding of how the human immune system works and the ways in which vaccines interact with the natural immune response to induce protection against vaccine preventable diseases. HPV vaccine education should focus on efforts to alleviate the concerns about safety and side effects. Education efforts need to be targeted to those who are not vaccinating. Providers need to be educated on how to: 1) address concerns from parents about safety/side effects, 2) handle resistance from parents who feel vaccinating for HPV is not need or not necessary, 3) make consistent recommendations across all patient populations, and provide resources for those who lack knowledge. Public health must also support the efforts of providers by disseminating accurate and timely information about the need to vaccinate every child with HPV vaccine.

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Appendix

Table 4: Odds Ratio Estimates for Reason "Not Needed/Not Necessary"

Sociodemograpic Factor	Point Estimate	95% Wald Confidence Limits
Gender of Teen		
Female	1.0	--
Male	1.12	0.97 - 1.29
Mother's Age		
≤34 Years	1.0	--
35 – 44 Years	**0.74**	**0.57 - 0.96**
≥45 Years	0.80	0.61- 1.05
Mother's Education Level		
≤ high school	1.0	--
>12 yrs non-college	1.21	0.99 - 1.47
College graduate	1.16	0.96 - 1.39
Number of Children <18 Years in Household		
4 or more	1.0	--
One only	1.0	0.77 - 1.30
Two or three	1.11	0.87 - 1.41
Relationship of Respondent to Teen		
Father/male guardian	1.0	--
Mother/female guardian	**0.83**	**0.72 - 0.97**
Race/Ethnicity of Teen		
Black	1.0	--
White	0.93	0.77 - 1.12
Hispanic	0.79	0.61 - 1.01

Table includes reference groups (1.0) for each sociodemogrpahic factor included in the model. Bolded values indlicate statistical significance.

Table 5: Odds Ratio Estimates for Reason "[Vaccine] Not Recommended"

Sociodemograpic Factor	Point Estimate	95% Wald Confidence Limits
Gender of Teen		
Female	1.0	--
Male	**1.21**	**1.03 - 1.42**
Mother's Age		
≤34 Years	1.0	--
35 – 44 Years	1.17	0.86 - 1.59
≥45 Years	1.33	0.96 - 1.82
Mother's Education Level		
≤ high school	1.0	--
>12 yrs non-college	**0.80**	**0.65 - 0.98**
College graduate	**0.63**	**0.52 - 0.76**
Number of children <18 Years in Household		
4 or more	1.0	--
One only	0.87	0.66 - 1.15
Two or three	0.87	0.67 - 1.13
Relationship of Respondent to Teen		
Father/male guardian	1.0	--
Mother/female guardian	**0.65**	**0.55 - 0.76**
Race/Ethnicity of Teen		
Black	1.0	--
White	0.85	0.68 - 1.05
Hispanic	1.00	0.77 - 1.31

Table includes reference groups (1.0) for each sociodemogrpahic factor included in the model. Bolded values indlicate statistical significance.

Table 6: Odds Ratio Estimates for Reason "Safety Concerns/Side Effects"

Sociodemograpic Factor	Point Estimate	95% Wald Confidence Limits
Gender of Teen		
Female	1.0	--
Male	**0.64**	**0.55 - 0.74**
Mother's Age		
≤34 Years	1.0	--
35 – 44 Years	1.31	0.95 - 1.81
≥45 Years	1.07	0.77 - 1.50
Mother's Education Level		
≤ high school	1.0	--
>12 yrs non-college	**1.39**	**1.11 - 1.74**
College graduate	**1.45**	**1.17 - 1.79**
Number of children <18 Years in houshold		
4 or more	1.0	--
One only	0.86	0.65 - 1.13
Two or three	0.87	0.68 - 1.13
Relationship of respondent to teen		
Father/male guardian	1.0	--
Mother/female guardian	**2.05**	**1.70 - 2.46**
Race/Ethnicity of teen		
Black	1.0	--
White	**1.49**	**1.19 - 1.86**
Hispanic	0.86	0.65 - 1.18

Table includes reference groups (1.0) for each sociodemogrpahic factor included in the model. Bolded values indlicate statistical significance.

Table 7: Odds Ratio Estimates for Reason "Lack of Knowledge"

Sociodemograpic Factor	Point Estimate	95% Wald Confidence Limits
Gender of Teen		
Female	1.0	--
Male	**1.39**	**1.16 - 1.67**
Mother's Age		
≤34 Years	1.0	---
35 – 44 Years	0.98	0.71 - 1.37
≥45 Years	0.84	0.60 - 1.20
Mother's Education Level		
≤ high school	1.0	--
>12 years non-college	**0.71**	**0.56 - 0.89**
College graduate	**0.57**	**0.46 - 0.71**
Number of children <18 Years in houshold		
4 or more	1.0	--
One only	**1.87**	**1.29 - 2.72**
Two or three	**1.70**	**1.19 - 2.43**
Relationship of respondent to teen		
Father/male guardian	1.0	--
Mother/female guardian	**0.828**	**0.69 - 0.99**
Race/Ethnicity of Teen		
Black	1.0	--
White	0.81	0.64 - 1.03
Hispanic	0.99	0.74 - 1.33

Table includes reference groups (1.0) for each sociodemogrpahic factor included in the model. Bolded values indlicate statistical significance.