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Intervention effects from a social marketing campaign to promote HPV vaccination in preteen boys

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Abstract

Objectives—Adoption of human papillomavirus (HPV) vaccination in the US has been slow. In 2011, HPV vaccination of boys was recommended by CDC for routine use at ages 11–12. We conducted and evaluated a social marketing intervention with parents and providers to stimulate HPV vaccination among preteen boys.

Methods—We targeted parents and providers of 9–13 year old boys in a 13 county NC region. The 3-month intervention included distribution of HPV vaccination posters and brochures to all county health departments plus 194 enrolled providers; two radio PSAs; and an online CME training. A Cox proportional hazards model was fit using NC immunization registry data to examine whether vaccination rates in 9–13 year old boys increased during the intervention period in targeted counties compared to control counties (n=15) with similar demographics. To compare with other adolescent vaccines, similar models were fit for HPV vaccination in girls and

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meningococcal and Tdap vaccination of boys in the same age range. Moderating effects of age, race, and Vaccines for Children (VFC) eligibility on the intervention were considered.

Results—The Cox model showed an intervention effect (β=0.29, HR=1.34, *p*=.0024), indicating that during the intervention the probability of vaccination increased by 34% in the intervention counties relative to the control counties. Comparisons with HPV vaccination in girls and Tdap and meningococcal vaccination in boys suggest a unique boost for HPV vaccination in boys during the intervention. Model covariates of age, race and VFC eligibility were all significantly associated with vaccination rates (p<.0001 for all). HPV vaccination rates were highest in the 11–12 year old boys. Overall, three of every four clinic visits for Tdap and meningococcal vaccines for preteen boys were missed opportunities to administer HPV vaccination simultaneously.

Conclusions—Social marketing techniques can encourage parents and health care providers to vaccinate preteen boys against HPV.

Keywords

HPV vaccine; social marketing; preteen boys; adolescent immunization

1. Introduction

Public health interventions often take years to be broadly adopted and sustained in practice settings,[1] and the human papillomavirus (HPV) vaccine is no exception.[2, 3] Two vaccines have been approved by the Food and Drug Administration (FDA) for use in the United States: HPV2, which protects against two types (16 and 18) of the virus, and HPV4, which protects against four types (6, 11, 16, 18). HPV types 6 and 11 cause genital warts and types 16 and 18 are associated with cervical, vaginal, vulvar, anal, penile, and throat cancers. [4, 5] Initial studies of vaccine effectiveness in reducing HPV infection and disease are promising.[4, 6]

Vaccination against HPV is most effective when given before sexual exposure to the virus. [7, 8] The Centers for Disease Control and Prevention (CDC)'s Advisory Committee on Immunization Practices (ACIP) first recommended HPV4 vaccination for routine clinical use in females, ages 11–12, in 2006[7] and in males, ages 11–12, in 2011.[8] HPV4 vaccine is the only one licensed for males. However, adoption of the vaccine has been slower than expected.[2] At the end of 2012, completion of the 3-dose HPV4 vaccine series among females and males ages 13–17 in the US was only 33% and 7% respectively.[2] By contrast, coverage estimates among teens aged 13–15 years for ≥1 Tdap vaccine dose and ≥1 meningococcal vaccine dose were 85% and 74%, respectively, indicating that the Healthy People 2020 goal of 80% vaccination coverage for adolescent vaccines is achievable.[2, 9] This lag in HPV vaccination coverage exists in spite of ACIP's recommendation that all age-appropriate vaccines be administered at a single visit.[2]

HPV vaccine has been primarily marketed to females to protect against cervical cancer.[10] Yet, HPV vaccination of boys would prevent most of an estimated 7,490 cases of HPV-associated cancer cases diagnosed annually in males.[6, 11, 12] A significant barrier to HPV-vaccination among preteens is reluctance by both healthcare providers and parents to

vaccinate at a young age.[2, 11, 13, 14] Health care providers play an influential role in parents' decisions to vaccinate their sons against HPV, yet evidence suggests providers are not yet fully promoting the vaccine at the recommended ages of 11–12.[2, 13–16] Lack of parental awareness coupled with underutilization of the vaccine lead to missed opportunities to reduce HPV disease and associated cancers.[2, 14, 17, 18]

The objective of our study was to conduct and evaluate a social marketing intervention with parents and providers to stimulate HPV vaccination among preteen boys at a critical time when the vaccine was new to both parents and clinical practice.

2. Methods

We evaluated a set of social marketing strategies intended to promote HPV vaccination in preteen boys, especially among racial and ethnic populations at greater risk of disease. We report here county-level vaccination data from the North Carolina Immunization Registry (NCIR) to assess outcome effects from the intervention. We also compared self-reported pre and post intervention vaccine knowledge, attitudes, beliefs, intentions and behaviors in parents and providers in intervention counties; and assessed campaign exposure and recall by parents and use of campaign materials by providers. Findings from these surveys are reported elsewhere.[19, 20]

2.1 Setting

We conducted an intervention to promote HPV vaccination with parents of preteen boys and healthcare providers who serve them in a 13 county region in NC in June-September, 2012. This region[21] includes relatively higher percentages of minority (non-Caucasian) groups than those for the state (Black/African American, 31.3% vs. 24.3%; American Indian, 8.0% vs. 1.2%; Hispanic/Latino, 10.4% vs 9.8%).[22] These racial and ethnic groups have higher reported rates of sexually transmitted infections and cancer-related consequences than do whites. [23]

2.2. Intervention description

Within the first year after the HPV4 vaccine was routinely recommended for males, ages 11–12, we tested a set of social marketing strategies to motivate parents of preteen boys to initiate HPV vaccinations and providers to start the vaccine series at the recommended ages of 11–12. Social marketing is the use of persuasive principles to influence human behavior in order to improve health or benefit society.[24] We based the intervention on four principles of social marketing:[24, 25] to promote (with radio public service announcements, posters, brochures, doctor's recommendation) the product (HPV vaccine), while considering the price (cost, perception of safety and efficacy, and access), and place (healthcare providers' office). Intervention counties were exposed to a campaign (*Protect Him*) with materials designed and pretested with racially and ethnically diverse parents of preteen boys, while control counties received no intervention.[26] The campaign ran for three months before the school year started and when parents were most likely to seek vaccinations for their children.

Key features of the intervention were based on our formative research[26] with parents and providers in the region and included:

- Two public service announcements designed to raise awareness about HPV vaccine for boys; ads ran for eight weeks with seven radio stations targeting parents of preteen boys in the 13 counties.
- Posters and brochures in English and Spanish (25,000 distributed to enrolled providers and 13 health departments) with the risk-related message, “One in two people will get HPV, which can lead to genital warts and cancer,” and multi-cultural images of parents and sons close together;
- One hour CME webinar with video vignettes modeling communication among providers, parents and preteen boys available to enrolled providers at no charge;
- One page tip sheet for providers to discuss HPV vaccination with parents and boys;
- Website (protecthim.org) with links to credible information sources, (e.g. CDC, pediatric and family medicine associations), useful for both parents and providers.

Additional description of the intervention and findings from the pre and post intervention surveys with parents and providers are reported in a second paper.

2.3. Study design

To measure the immunization impact of the intervention, we examined data from the NCIR, a population based Web application containing consolidated demographic and immunization history information on all of the recommended and required vaccines for NC citizens of all ages.[27] NCIR includes data reported regularly by NC healthcare practices by age, race/ethnicity and eligibility for Vaccines for Children (VFC), which provides vaccines recommended by ACIP and for children who might not be able to pay.[27] We compared HPV vaccine uptake (initial dose) in 13 intervention counties with a control group of 15 counties with socioeconomic characteristics similar to the intervention region.[21] To minimize possible contamination effects from intervention activities that may stimulate HPV vaccination among preteen males in a comparison group, we selected a control group of northeastern NC counties that was geographically distant and in a different radio market from the intervention region. We compared HPV vaccination in preteen males with HPV vaccination in preteen females and with two other adolescent age vaccines, Tdap and meningococcal. The Tdap vaccine is required for NC school entry in sixth grade while the meningococcal vaccine is voluntary.[27] To place these comparisons in context, we also examined vaccine uptake in all 100 counties in NC.

2.4. Data collection and measures

We received cohort data from NCIR for all children in the registry who: 1) were 9–13 years old at any time during the intervention (June 15-September 15, 2012), and 2) had any record of receiving HPV, Tdap, or meningococcal vaccine during the 15 month study period.[22]At baseline (6 months prior to the start of the intervention), we identified a risk set of males who had not received the HPV vaccine and examined their vaccination records for the 6 month pre-intervention, 3 month intervention, and 6 month post-intervention periods. This

cohort was analyzed to examine effectiveness of the intervention by comparing vaccination rates in the 13 intervention counties and the group of 15 control counties.

2.5. Data analyses

We used survival[28] (event history) analysis methods to estimate the vaccination rate before, during, and after the intervention. We expected a larger increase in HPV vaccination rates in members of the cohort in the intervention counties than the control counties. We computed the time-to-initiation of HPV series for members of the risk set. Boys who remained unvaccinated (HPV vaccine initiation) six months post-intervention were treated as having censored (incomplete) vaccination times. These data were examined descriptively as initiation rates for each time range and in the form of Kaplan-Meier survival curves.

First, the intervention effect was examined using a Cox proportional hazards model for time-to-initiation of HPV series for members of this risk set. The Cox model included a random effect (frailty parameter) for county, allowing for the estimation of a separate baseline vaccination rate in each county. The effect of the intervention was modeled using a time-varying covariate which took the value 0 for all counties up until the start of the intervention, then took the value 1 for intervention counties. An additional time-varying covariate took the value 0 everywhere except in the intervention counties during the post-intervention period. Tests of the parameters (model coefficients) corresponding to these time-varying covariates will indicate the presence of intervention effects during the three-month intervention and whether intervention effects were sustained in the six months following the intervention.

Second, to demonstrate whether the intervention was successfully targeted to HPV vaccination in boys, we fit similar models for HPV vaccination of girls and meningococcal and Tdap vaccination of boys in the same age range.

Third, we explored whether the intervention effect was modified by the three demographic variables (age, race/ethnicity, and VFC eligibility) in NCIR. Each potential effect modifier was examined separately, first through the construction of Kaplan-Meier curves, and then by adding interaction terms between the intervention status and the potential effect modifier to the previously-described Cox model. To avoid small sample sizes, analysis of the effect of race/ethnicity was limited to the three largest groups: Non-Hispanic White (NHW), Non-Hispanic Black/AA, and Hispanic (any race).

Fourth, we examined the extent to which providers were administering the HPV vaccine series in conjunction with one or more other vaccines. We defined “missed opportunity” for HPV vaccination as a clinic visit when a boy received either of the other two adolescent vaccines (Tdap or meningococcal) but not HPV. We computed the proportion of these opportunities in which a boy aged 11–13 received the HPV vaccine for the intervention counties, the control counties, and the state as a whole. The intervention and control counties were compared using a chi-square test.

3. Results

3.1. Characteristics of sample

In the NCIR data, there were 176,590 boys at risk for HPV vaccination during the study period, including 19,842 in the intervention and 6,027 in the control counties. Demographics for the entire state, and by intervention group, are in Table 1.

Compared to the intervention counties, boys not yet vaccinated for HPV at baseline in the control counties were slightly older (59.5% vs. 56.8% age 12–13, p<.0001). The control and intervention counties also had different racial breakdowns (P<.0001), with the control counties having fewer American Indian/Alaska Natives, fewer Hispanics, and more Non-Hispanic Black/African American boys in the risk set.

3.2. Intervention effects on HPV vaccination

Table 1 includes the HPV vaccination initiation outcome for all boys in the analysis. The data show the intervention group had a higher vaccination percentage during the intervention than the control group and a lower percentage remaining unvaccinated at the end of the study. Figure 1a–d shows the Kaplan-Meier curves corresponding to the data in Table 1.

In Figure 1a, which shows the HPV vaccination rates in 9–13 year old boys, the solid black line (intervention group) decreases more rapidly than the dashed black line (control group) starting around the time of the intervention, and supports greater uptake of vaccination in the intervention counties during that three months. The Cox proportional hazard model for HPV initiation in boys (first row of Table 2) quantifies the intervention effects, controlling for race, age, and VFC eligibility. During the intervention period, the effect of the intervention was statistically significant (p=.002). There was a significantly larger increase in vaccination rates in 9–13 year old boys in the intervention counties than the control counties. The hazard ratio (HR) of 1.34 indicates that an unvaccinated boy in the risk set was 34% more likely to get vaccinated during the three months in an intervention county than in a control county. There is no evidence that this effect was sustained past the intervention period, which is tested as the sum of the intervention effect and the post-intervention increment (HR=.99, p=.87).

3.3. Intervention effects on other adolescent vaccines

Figure 1b–d and the remaining rows in Table 2 provide the results of the Cox model assessing the intervention's effect on other adolescent vaccines. The intervention's effect on meningococcal vaccination in boys and HPV vaccination in girls was not significant. Boys in the NCIR data in the intervention counties were, however, 24% less likely to get a Tdap booster during the intervention and 16% less likely to get a Tdap booster in the period after the intervention (p<.001 and p=.02 respectively) than boys in the control counties.

3.4. Effect modification by age, race, and VFC eligibility

The demographic variables were each examined as potential modifiers of the intervention's effect on HPV vaccination through the examination of Kaplan –Meier curves (Figure 2) and

by adding interaction terms to the Cox model (Table 3). There was a significant modification of the intervention effect by age (p<.0001). The intervention effect was significant in the 11–12 year-old group (HR=1.54, p<.0001), which had a 54% higher probability of vaccination in the intervention vs. control counties, but not in the 9–10 year-old group (HR=1.05, p=.72) or 13 year-old group (HR=1.09, p=.48) of boys.

The interaction between race and the intervention effect was marginally significant (p=.08). Specifically, there was a significant intervention effect in NHWs (p=.004) and Non-Hispanic Black/AAs (p=.002), corresponding to about a 40% increase in likelihood of vaccination in the intervention relative to control counties for members of these groups. In contrast, the intervention effect was not significant in Hispanics (HR=1.09, p=.54).

The intervention effect was significant in both the VFC eligible and ineligible boys, and did not vary significantly according to VFC eligibility (HR=1.5 vs. 1.3, p=.11).

3.5. Missed opportunities

For missed opportunities, we compared the number of boys ages 11–13 receiving HPV vaccination as a percentage of the number of total vaccination visits for the intervention and control counties and for the entire state (Table 4a). Overall, three of every four clinic visits included Tdap or meningococcal vaccination but not for HPV.

Table 4a also shows that for Tdap and meningococcal vaccinations, prior to the intervention, there were slightly but non-significantly fewer missed opportunities in the intervention than control counties (p=.07), but during the intervention period boys in the intervention counties were significantly more likely to include the HPV vaccine with other vaccines than boys in the control counties (29.6% vs. 18.8%, p<.0001). Inclusion of the HPV vaccine remained higher in the intervention counties than the control counties in the six months post-intervention (p=.01).

To control for the potential bias of Tdap being a mandatory vaccine to enter sixth grade, we conducted an analysis of missed opportunities that excluded the required Tdap vaccine, thus only including the meningococcal vaccine in the denominator. For meningococcal only, the intervention and control counties are not significantly different pre-intervention, but the rate of inclusion of the HPV vaccine is significantly higher in the intervention than the control counties both during (p<.0001) and after (p=.02) the intervention (Table 4b).

4. Discussion

The “Protect Him” campaign was a social marketing intervention to increase HPV vaccine uptake among 11–12 year old boys in a 13-county region in North Carolina. Our analyses of the state's immunization registry data suggest a modest but significant intervention effect by boosting HPV vaccination of preteen boys in the targeted counties. We found that an unvaccinated boy in NCIR was 34% more likely to get vaccinated during the 12-week campaign period in an intervention county than in a control county. Additional comparisons between HPV vaccine uptake of preteen boys and HPV vaccine uptake of preteen girls showed significantly greater uptake for boys during the intervention. Finally, comparisons

between boys' vaccination with Tdap and meningococcal vaccines during the same time period suggest a unique boost for HPV vaccinations. We examined age, race, and Vaccine for Children eligibility status and found moderating effects by age and by race (intervention was most effective in 11–12 year olds and in non-Hispanic whites and non-Hispanic Blacks/ African Americans) but not by VFC status. As far as we know, the current study is the first to use a social marketing intervention to boost HPV vaccination among preteen males.[29] These strategies may be successfully used to increase HPV vaccination and ultimately reduce HPV infection in males,[30] but HPV vaccine uptake in boys, as in girls, still has a long way to go to achieve the 80% completion rate envisioned in Healthy People 2020.

Effective evaluation of social marketing campaigns using mass media is complex and usually involves multiple methods, including measures of both process and outcomes.[31, 32] Claims of intervention effect may be challenged by confounding influences, such as competing campaigns or other outreach efforts. One way to test for possible confounders of a quasi-experimental (population-based) intervention is to measure and compare similar, but non-equivalent immunization data such as meningococcal and Tdap vaccination. This method strengthens the evaluation of a campaign by incorporating measurement of multiple dependent variables at multiple time points. [31] In this study, we measured the main outcome variable of HPV vaccination of boys and three non-equivalent dependent variables (HPV vaccination of girls and Tdap and meningococcal vaccination of boys) at points not only during the intervention, but also prior to and following the intervention. We found that boys in the intervention group were less likely to get the Tdap vaccine than boys in the control group during the three months of the intervention. One possible reason for this, according to NC Immunization Branch personnel, is that the control counties may have been lagging behind in Tdap vaccinations, and the end of summer was a catch-up period for boys in those counties before they went back to school.[33]

An important contribution of the present study is the empirical evidence collected and analyzed to document missed opportunities to vaccinate preteens against HPV at clinic visits when they are receiving other adolescent vaccines. Underutilization of the vaccine leads to missed opportunities to reduce HPV disease and associated cancers in males.[2] Measuring adolescent immunizations through vaccine registries may then be an additional way to evaluate efforts to increase HPV vaccination uptake and completion.[34]

Our study has several limitations. To the best that we could ascertain, there were no other campaigns urging preteen vaccination of males during the 12 week intervention in our targeted counties.[33, 35] If so, this would affect our claim that this social marketing intervention boosted HPV vaccination among preteen boys. There is also the possibility that the control counties may have been exposed to messages from our campaign. Any contamination would have reduced intervention effects; therefore it is possible that the intervention effect may be greater than what we measured. However to minimize the possibility of contamination, we used locally targeted radio stations, recruited providers and distributed materials only to practices in the intervention region.

We measured county-level reports of vaccination status, an appropriate measurement strategy for a population-based social media campaign Because the design is not

randomized, we used other known techniques[36] to strengthen our claims to causality including three non-equivalent dependent variables (Tdap, meningococcal, HPV vaccine for girls) and before/after surveys with parents and providers to measure mediating/explanatory variables. We analyzed self-reported data for intervention impact on individual knowledge, attitudes, and HPV vaccine intentions and initiations by parents of boys ages 9–13 and their providers for a second paper.

Another limitation is the exclusion of children who had no adolescent vaccinations during the intervention period, which does not allow our estimates of vaccination rates to be extrapolated to the population as a whole, though this limitation does not affect our analysis of missed opportunities. In addition, cost analysis was beyond the scope of the study so we did not assess per dose cost of the intervention. We are planning future research to include cost analysis in evaluation of the intervention components.

5. Conclusion

The objective of our study was to conduct and measure a social marketing intervention with parents and providers to stimulate HPV vaccination among preteen boys at a critical time when the vaccine was new to both parents and clinical practice. We hypothesized that our outreach would increase HPV vaccine uptake among preteen boys in intervention counties compared to control counties. We recommend comparing adolescent immunization trends on a county and regional level as an important mechanism for evaluating intervention effects.

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Highlights

- We evaluated a social marketing intervention to stimulate HPV vaccination. (77)
- We modeled change in vaccination rates in 9–13 year old boys using NC registry data. (85)
- Probability of vaccination increased significantly in the intervention region. (81)
- HPV vaccination rates were highest in the 11–12 year old boys.(64)
- Social marketing can promote timely vaccination of preteen boys against HPV. (77)

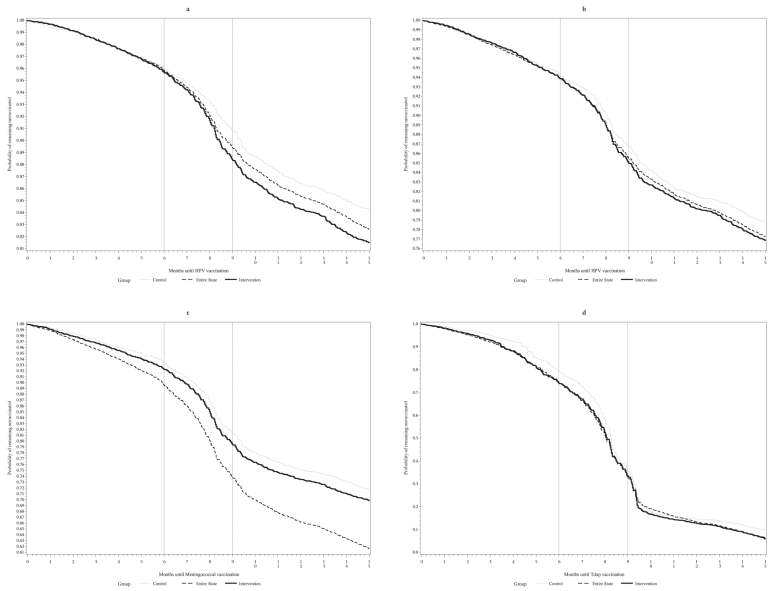

Figure 1a–1d.

Kaplan-Meier curves showing vaccination in intervention and control counties and the entire state. [all 4 graphs included in one Figure]

(a): HPV vaccination in 9–13 year old boys by intervention

(b): HPV vaccination in 9–13 year old girls by intervention

(c): Meningococcal vaccination in 9–13 year old boys by intervention

(d): Tdap vaccination in 9–13 year old boys by intervention

Note: The horizontal axis covers the period from six months pre- to six months post-intervention, with the vertical lines denoting the start and end of the intervention.

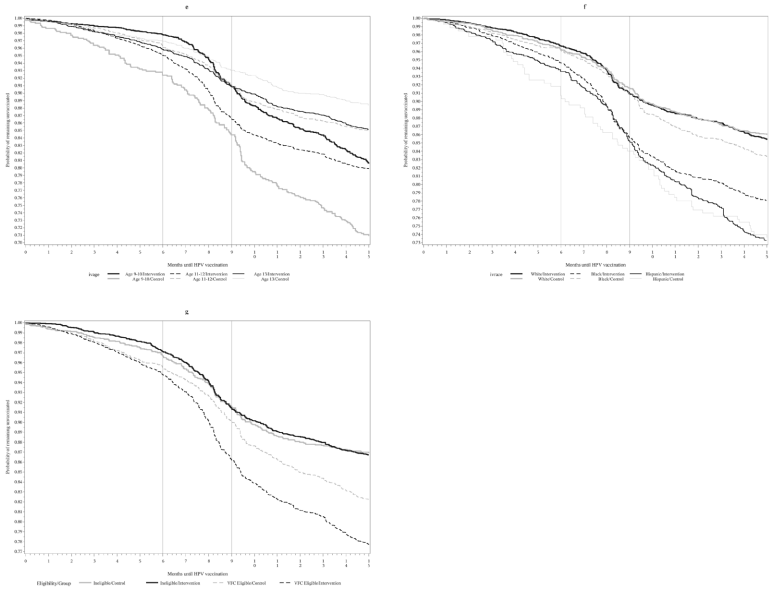

Figure 1e–1g.

Kaplan-Meier curves showing effect modification by age, race, and Vaccines For Children (VFC) eligibility on the intervention effect.

(e): HPV vaccination in 9–13 year old boys by age & intervention

(f): HPV vaccination in 9–13 year old boys by race & intervention

(g): HPV vaccination in 9–13 year old boys by VFC eligibility & intervention

Note: The horizontal axis covers the period from six months pre- to six months post-intervention, with the vertical lines denoting the start and end of the intervention.

Table 1

Demographic characteristics and vaccination outcomes by intervention group and for all of North Carolina for males ages 9–13

	Intervention Counties (N=19,842)		Control Counties (N=6,027)		Entire State (N=176,590)	
	N	%	N	%	N	%
Age (years)						
9–10	2,964	14.9	751	12.5	27,011	15.3
11–12	11,274	56.8	3,476	57.7	100,272	56.8
13	5,604	28.2	1,800	29.9	49,307	27.9
Race/Ethnicity						
Non-Hispanic White	7,886	39.7	2,407	39.9	77,602	43.9
Non-Hispanic Black/AA	6,202	31.3	2,824	46.9	42,838	24.3
Hispanic	2,069	10.4	269	4.5	17,293	9.8
American Indian/Alaska Native	1,579	8.0	41	0.7	2,120	1.2
Other/Unknown Race	2,106	10.6	486	8.1	36,677	20.8
VFC Eligibility						
Eligible for VFC dose	12,780	64.4	3,999	66.4	89,428	50.6
Ineligible	5,787	29.2	1,769	29.4	78,329	44.4
Eligibility unknown	1,275	6.4	259	4.3	8,833	5.0
Vaccination Status						
6 mo. Pre-intervention	857	4.3	242	4.0	7,388	4.2
During intervention	1,458	7.3	314	5.2	11,426	6.5
6 mo. Post-intervention	1,356	6.8	395	6.6	11,902	6.7
Remained unvaccinated (censored)	16,171	81.5	5,076	84.2	145,874	82.6

Note: Data include all children aged 9–13 during the intervention who received either Tdap, meningococcal, or HPV vaccine by March 15, 2013. Table 1 describes the males who had no record of receiving HPV vaccine prior to December 15, 2011, or 6 months before the start of the intervention. Most participants in the “Other/Unknown race” category (>85%) were of unknown race. The remaining participants in that category were described as American Indian/Alaska Native or Asian. A large number of 'unknown' race is due to this being a voluntary field for providers to complete in the NCIR.

Table 2

Cox proportional hazards models for time to vaccine initiation.

		Intervention vs. control difference during the intervention period relative to baseline		Intervention vs. control difference during the post-intervention period relative to baseline	
Population	**Outcome**	**Hazard ratio**	**p-value**	**Hazard ratio**	**p-value**
9–13 year old boys	HPV initiation in boys	1.34	.002	.99	.88
	Tdap booster	.76	<.0001	.85	.02
	Meningococcal vaccine	.96	.59	.88	.12
9–13 year old girls	HPV initiation	1.09	.32	.94	.48

Note: Models were adjusted for race, age, and VFC eligibility.

Table 3

Effect modification (EM) of HPV initiation in boys, ages 9–13

		Intervention effect during the intervention		
Effect modifier	**Subgroup**	**Hazard ratio**	**p-value**	**p-value for EM**
Age	9–10	1.05	.72	<.0001
	11–12	1.54	<.0001	
	13	1.09	.48	
Race	White	1.38	.0043	.08
	Black/AA	1.41	.0019	
	Hispanic	1.09	.55	
Eligibility for VFC dose	VFC Eligible	1.30	.0072	.11
	VFC Ineligible		.0006	
		1.49		

Note: Models were adjusted for race, age, and VFC eligibility.

Table 4a

HPV series initiated in conjunction with receipt of Tdap and/or menmgococcal vaccine, boys ages 11–13

	Number (%) receiving HPV vaccine/Number of opportunities† (%)			
	Entire State	Intervention counties	Control counties	p-value for chi-square of intervention vs. control
6 mo. Pre-intervention	3788/17002 (22.3%)	484/1842 (26.3%)	114/510 (22.4%)	0.07
During intervention	6743/29183 (23.1%)	981/3313 (29.6%)	204/1085 (18.8%)	<.0001
6 mo. Post-intervention	5779/20446 (28.3)	776/2392 (32.4%)	216/784 (27.6%)	0.01

† An “opportunity” is defined as any administration of Tdap and/or meningococcal vaccine on a boy ages 11–13 who had not yet started the HPV series.

Table 4b

HPV series initiated in conjunction with receipt of meningococcal vaccine (but not Tdap), boys ages 11–13

	Number (%) receiving HPV vaccine/Number of opportunities† (%)			
	Entire State	Intervention counties	Control counties	p-value for chi-square of intervention vs. control
6 mo. Pre-intervention	1801/5758 (31.3%)	235/549 (42.8%)	55/154 (35.7%)	p=.11
During intervention	2425/6706 (36.2%)	395/779 (50.7%)	75/216 (34.7%)	p<.0001
6 mo. Post-intervention	3250/7855 (41.4%)	449/836 (53.7%)	117/258 (45.4%)	p=.02

† An “opportunity” is defined as any administration of meningococcal (but not Tdap) vaccine on a boy who had not yet started the HPV series