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Increasing HPV Vaccination in a Network of Pediatric Clinics using a Multi-component Approach

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BACKGROUND AND INTRODUCTION

Despite continued public health efforts to increase human papillomavirus (HPV) vaccination among adolescents, initiation of the vaccine remains below the level needed to reach the Healthy People 2030 goal of 80% series completion by age 13.[1] Persistent infection with high-risk HPV types (predominantly 16 and 18) causes more than 90% of cervical and anal cancers, 70% of oropharyngeal cancers, about 70% of vaginal and vulvar cancers, and more than 60% of penile cancers.[2,3] In the U.S. from 2012-2015, 44,000 HPV-related cancers were reported (25,000 among women and 19,000 among men). The most common HPV-related cancers in the U.S. include oropharyngeal (19,000) and cervical (12,015).[4-6] Infection with HPV types 6 and 11 is associated with the development of genital warts that cause significant morbidity in both men and women.[7,8] In 2018, HPV vaccination rates among Texas youth fell below the U.S. rates as did rates of tetanus, diphtheria, and acellular pertussis (Tdap): 83.4% in Texas compared with 88.9% in the U.S. The effectiveness of HPV vaccine is acknowledged by its recognition as a Healthcare Effectiveness Data and Information Set (HEDIS) quality assessment measure.

A number of strategies are effective in mediating increased vaccination including HPV immunization champions,[9] provider assessment and feedback,[10,11] reminders to cue provider treatment and prevention behaviors,[11,12] provider skills training to improve HPV vaccination message delivery and overcome patient (parent) hesitancy,[13] reminders to initiate HPV vaccination and return to complete the vaccine series,[11,14] and patient education and skills training programs.[11,13,15] System-level strategies have been demonstrated effective because they triangulate approaches at various levels (organizational, provider, and patient).[11,16,17]

Vollrath et al. found that multicomponent interventions have a synergistic effect that increases provider vaccine support, improves parents' attitudes about the vaccine, and increases immunization acceptance.[16] The Community Guide recommends 2 multicomponent interventions: health care system-based interventions and community-based interventions implemented in combination.[11,18]

We present the results of a program to increase HPV vaccination. Funded by the Cancer Prevention and Research Institute of Texas (CPRIT), UTHealth School of Public Health and Baylor College of Medicine investigators developed, implemented, and evaluated a multicomponent

program that used evidence-based strategies to increase HPV vaccination in a network of pediatric clinics in the greater Houston, Texas area.[19]

METHODS

Setting and Population

The Adolescent Vaccination Program (AVP) was conducted from March 2016 through March 2019 within Texas Children's Pediatrics (TCP), a network of 51 clinics located in the greater Houston area. TCP clinics are located in 5 counties--Harris, Galveston, Fort Bend, Montgomery, and Brazoria--and serve more than 100,000 children and adolescents ages 11-17 years, approximately 30% of the pediatric population in the area. Six of the clinics are part of TCP's Community Cares Program, which provides care to children regardless of the family's financial situation or health insurance coverage.

At the time of the project, there were 249 physicians and 23 nurse practitioners, in addition to other clinical staff. Epic is the medical record system used in all TCP clinics. MyChart is the patient portal used to access a child's medical records online, request appointments, receive test results, or communicate with the child's physician. Our target populations were the clinic network, healthcare providers (ie, physicians, nurses, other clinic staff), and male and female patients ages 11-17 years and their parents who attended 1 of the 51 TCP clinics in the network.

Evaluation Question

Does a multicomponent program embedded in a healthcare system and delivered to healthcare providers and parents increase HPV vaccination initiation among adolescents ages 11 to 17 years over a 3-year period?

Program

For over a year preceding the funded project, we collaborated with the medical and professional staff at TCP to identify ways to improve initiation of HPV vaccination. The medical director made increasing HPV vaccination a goal for the network and worked with us to arrange 6 focus groups at clinics that represented the geographic and patient diversity of the TCP population. The purpose of the focus groups was to understand attitudes and practices regarding HPV vaccination from provider and staff

perspectives and to assess receptivity to the program. A total of 78 staff including physicians, physicians' assistants, nurse practitioners, medical assistants, and practice managers attended one of the focus groups. Meetings were recorded, and topics discussed were summarized by theme across the 6 clinics. We used information from the focus groups and our meetings with the medical director to select evidence-based strategies that were feasible to implement and sustainable within the TCP network. All 6 clinics agreed to serve as a Stakeholder Advisory Committee (SAC) throughout the project. Once funded, we met biweekly with the medical director and other TCP staff to discuss progress and identify ways to improve implementation of the program.

The program contained a suite of strategies to mediate increased vaccination comprising: 1) HPV immunization champions, 2) provider assessment and feedback (A&F), 3) continuing medical/nursing education (CME/CNE), 4) provider reminders, and 5) tailored patient (parent) reminders. Between August 2015 and March 2016 we pilot tested the program components in the 6 advisory clinics and made refinements based on stakeholder input before rolling them out to the other clinics in March 2016. The CME/CNE described HPV-associated disease burden, the rationale and scientific evidence behind HPV recommendations as well as describing proven effective strategies to increase HPV vaccination rates at individual, clinic and system levels. It also focused on how principles of medical ethics applied to HPV vaccination and employed real-life case vignettes to enhance provider communication skills and confidence around difficult HPV vaccine discussions. In addition, the medical director introduced the project at regional meetings, and he used his monthly electronic newsletter to announce the rollout of the project components and to encourage all staff to engage in the program. Figure 1 describes the components of the AVP. We used a systematic process, Intervention Mapping, to develop each of the strategies.[20] A detailed description of the development of the AVP is provided elsewhere.[19]

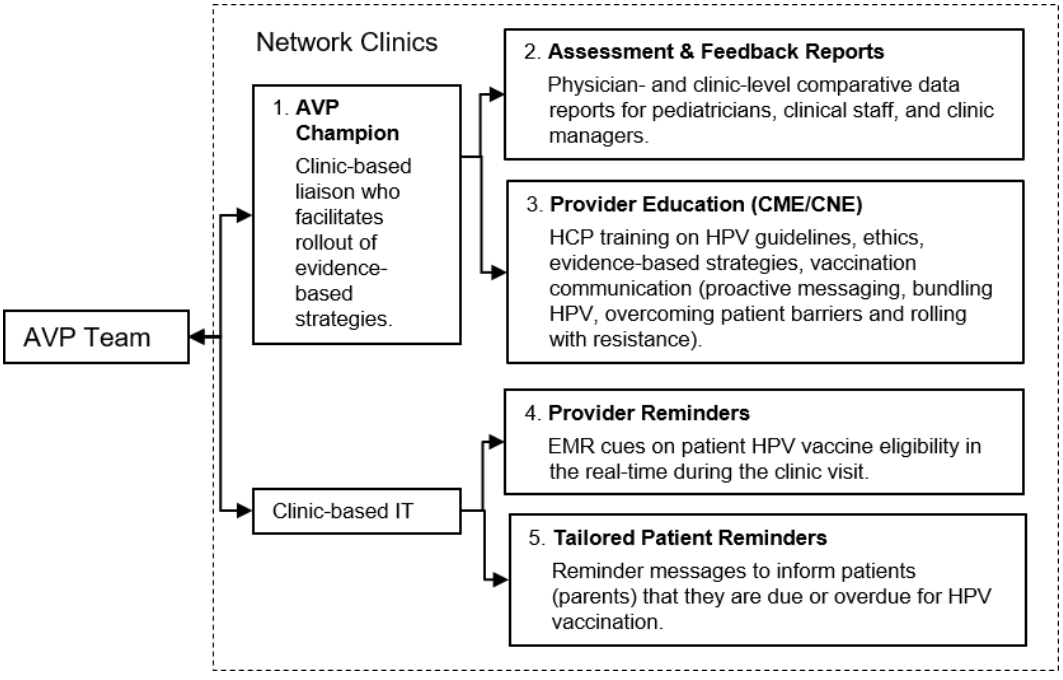
Evaluation

We used a single group pre/post design with an external comparison group. Our primary outcome was initiation of the HPV vaccine among 11- to17-year-olds based on the electronic health record (EHR) and measured as a binary variable (yes/no). We defined initiation as at least 1 dose of the HPV vaccine. We calculated monthly, quarterly, and annual rates of HPV vaccine initiation for each physician's patients and clinic in the network and for the

entire network. We examined initiation over time in relation to the introduction of each of our evidence-based strategies. Our comparison group was data for Texas from the National Immunization Survey (NIS)-Teen for the years 2014 through 2018. The age group reported by NIS-Teen was 13-17 years so we used that age group as our comparison with TCP in order to examine secular trends.

We used interrupted time series analysis (ITSA)[21,22] to measure the change in HPV vaccine initiation beginning with the introduction of assessment and feedback in March 2016. Other strategies were rolled out through September 2017. We continued to implement all strategies through the end of the project in March 2019. Beginning with January 2013, we had 38 months of data prior to introducing the first strategy in month 39, and 37 months of data on or after that date. An overall model of the network measured the change in HPV vaccine initiation before and after the introduction of the program. We also compared each clinic's experience with that of all other clinics in the network.

Figure 1. AVP system rollout of evidence-based strategies into network clinics



Results

Of the 108,734 patients who visited the clinic during the 3 years of our program, 49.4% were female, and 24.2% identified as Hispanic, 13.7% as African American, 45.2% as non-Hispanic white, 5.2% as other, and 11.8% had missing information. Approximately 80% of families had commercial insurance, 13.7% had Medicaid/Medicare, 3.7% had CHIP or Tricare, and 2.1% had no insurance or were missing information. Most patients preferred English (93.3%), 4.7% preferred Spanish, 3.6% spoke another language, and 2.1% had missing information.

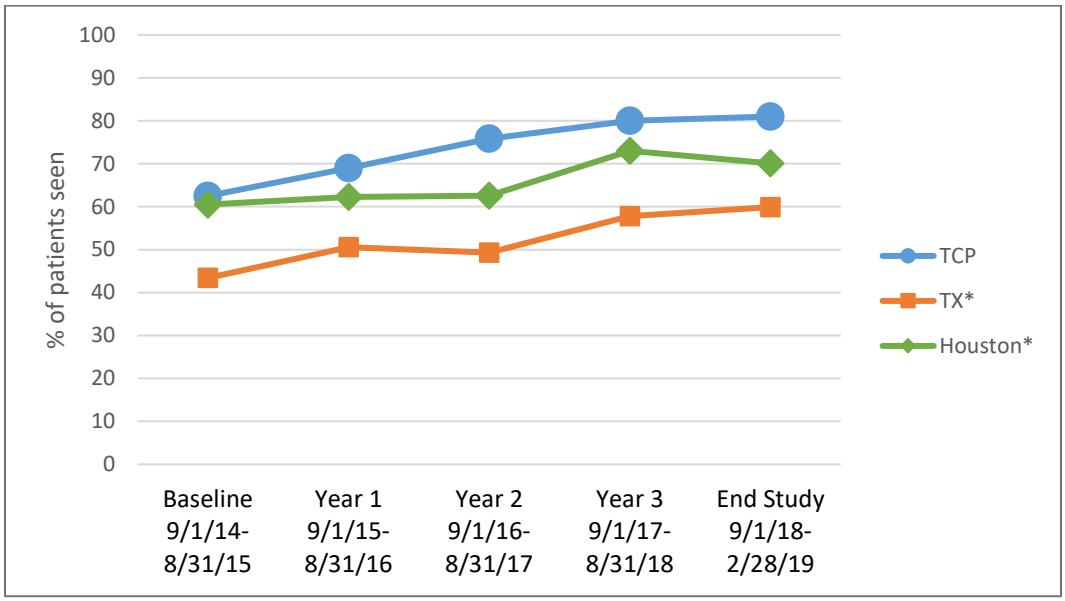
We examined patterns of initiation for the following factors measured from the EHR: patient age, sex, race/ethnicity, and type of insurance. There was no missing information for age or sex. For race/ethnicity 11.8% were missing information; for insurance, 2.4% were missing information.

We developed 2 online surveys, 1 for TCP physicians and another for clinical staff and managers, to assess system- and provider-level factors that may influence HPV vaccination practices. Physicians were surveyed in July-August 2015 and in January-February 2019. The survey measured organizational and patient barriers encountered when vaccinating adolescents. Variables on the surveys included previously tested items and scales shown to be associated with HPV vaccination practices as well as factors identified during our clinic focus groups. The medical director and physicians on our SAC reviewed the survey, and we incorporated their feedback. The evaluation team at UTHealth emailed physicians and other staff a link to the online survey, which took approximately 30 minutes to complete; those completing a survey received an electronic gift card from UTHealth. We administered the physician survey to all 227 TCP physicians, and 130 physicians completed it (57.3% response rate). For the clinic survey, we sent an electronic link to 50 practice managers and 423 advanced practice providers and other clinical staff, and we received completed surveys from 45 practice managers (90% response rate) and 375 advanced practice providers and clinical staff (88.7% response rate). Responses were well distributed across clinics with response rates ranging from 22% to 100%. Initial results of the physician survey are reported elsewhere.[23]

We compared TCP rates with data for Texas and Houston from the NIS-Teen for the years 2014 through 2018 (Figure 2). Because the age group reported for NIS-Teen was 13-17 years, we used that age group for

comparison with TCP. At baseline, initiation rates for TCP and Houston were approximately 60%; however, compared with Houston, TCP rates increased 28% vs 20.7% for Houston from baseline to year 3 (Figure 2).

Figure 2. HPV Vaccine Initiation Comparing TCP, Texas, and City of Houston, Ages 13-17*



*Data for Texas and City of Houston are from NIS-Teen survey years 2014-2018. NIS Teen data are only available for ages 13-17; therefore, TCP data are for the same ages.

September 2014 through August 2015 was the baseline year for the AVP program. Figure 3 shows the timeline for the introduction of our strategies in relation to HPV vaccine initiation rates for the overall clinic network for year 1 through the end of the program for ages 11-17. Initiation rates increased annually from September 2015 through the end of March 2019 (Table 1 and Figure 3)**.** ITSA analysis of the network data over 75 months showed an increase in HPV vaccination initiation of 0.396% per month from the introduction of the program at month 39 (Figure 4). Average individual clinic improvement was 0.37% per month ranging from -0.04% to 0.68% from the 39th month through March 2019. Data from 4 clinics were not included because they did not have data for all 75 months for the ITSA analysis. Initiation rates at baseline were slightly higher in the 6 advisory clinics compared with the non-advisory clinics (59% vs 56%).

Table 1. Patient Demographics and HPV Vaccine Initiation by Year, Ages 11-17

			HPV Vaccine Initiation									
			Baseline		Year 1		Year 2		Year 3		End of Project	
Characteristics	Mean # Patients Per Year	% of Population	N	%	N	%	N	%	N	%	N	%
Ages 11-17	111,126		100,472	56.4	107,505	64.4	115,225	72.6	121,301	76.8	123,861	77.4
Ages 11-12	40,453	36.4	37,109	45.9	39,252	56.4	41,749	67.0	43,701	71.0	44,611	70.8
Ages 13-17	70,673	63.6	63,363	62.5	68,253	69.0	73,476	75.8	77,600	80.0	79,250	81.0
Female	54,975	49.5	49,713	58.9	53,136	65.7	56,877	73.0	60,175	76.6	61,419	77.3
Male	56,151	50.5	50,759	53.9	54,369	63.1	58,348	72.2	61,126	77.0	62,442	77.4
Non-Hispanic White	49,387	44.4	46,807	52.0	48,568	59.7	50,765	67.8	51,408	72.3	51,947	72.7
Non-Hispanic AfAm	15,345	13.8	13,576	63.4	14,767	71.1	15,792	78.5	17,246	81.2	17,852	81.7
Hispanic	27,534	24.8	23,302	63.7	25,743	71.5	29,014	78.7	32,077	81.8	33,109	82.3
Other or Unknown Ethnicity	18,860	17.0	16,787	53.0	18,427	61.4	19,654	71.4	20,570	76.5	21,106	77.4
Commercial Insurance	89,220	80.3	81,094	54.3	86,331	62.7	92,676	71.2	96,779	75.6	91,984	75.7
Medicare/Medicaid	18,793	16.9	16,289	68.2	18,253	74.1	19,425	80.8	21,206	83.8	28,464	83.7
Other Insurance	872	0.8	695	54.2	805	63.7	923	70.2	1,066	73.2	1,113	73.1
None	2,240	2.0	2,394	47.8	2,116	51.3	2,201	59.2	2,250	63.1	2,300	65.7
English Language	103,442	93.1	94,152	55.7	100,407	63.7	107,052	71.9	112,156	76.1	114,200	76.7
Spanish Language	5,529	5.0	4,294	73.7	4,968	78.7	5,941	85.4	6,912	86.9	7,271	87.2
Other or Unknown Language	1,583	1.4	1,483	55.9	1,545	64.2	1,622	72.9	1,680	78.8	1,821	79.2

Baseline = 9/1/2014-8/31/2015
Year 1 = 9/1/2015-8/31/2016
Year 2 = 9/1/2016-8/31/2017
Year 3 = 9/1/2017-8/31/2018
End = 9/1/2018-2/28/2019

Figure 3. % HPV Vaccine Initiation for Patients Ages 11-17 by Year and Round of AVP Strategies

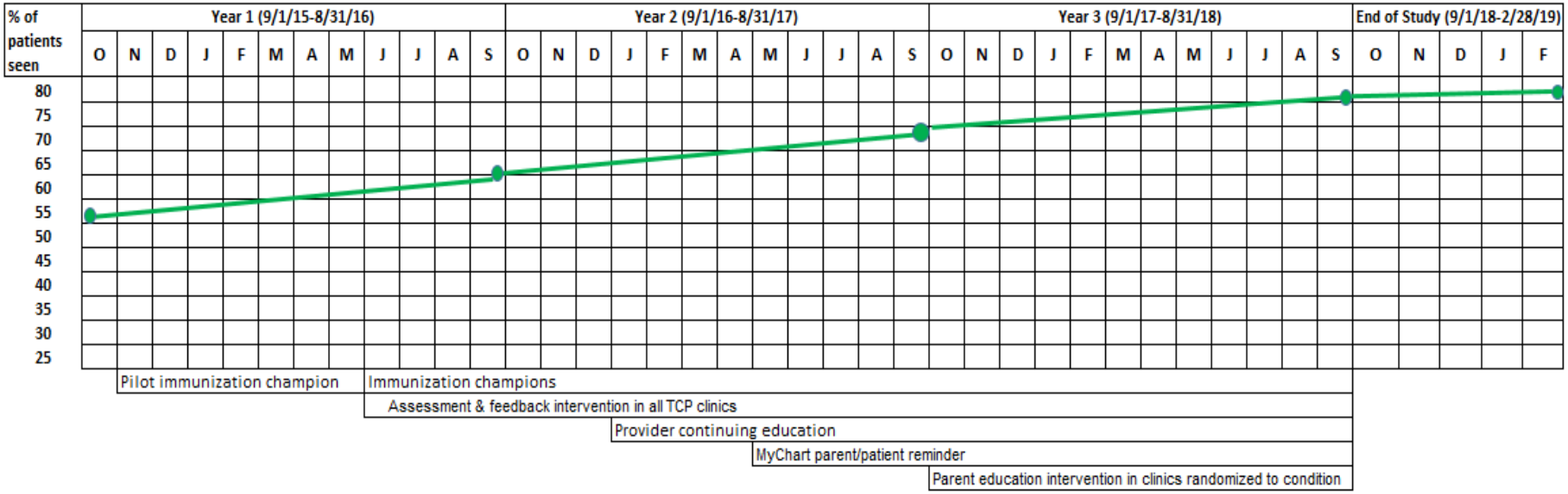
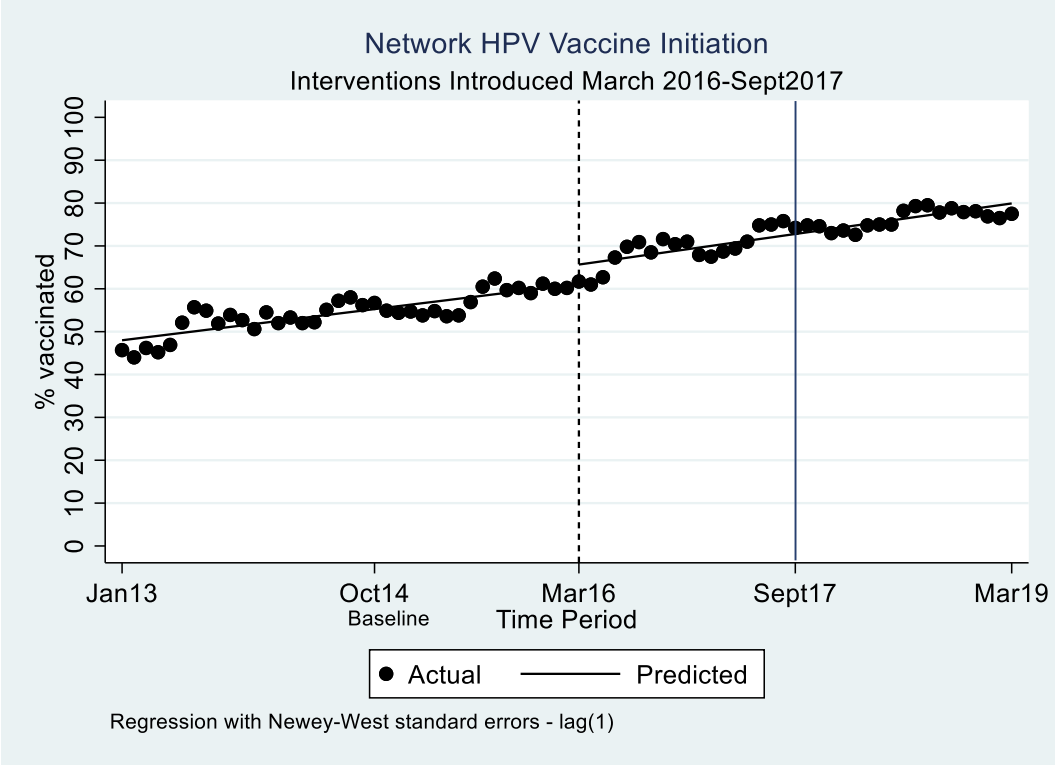


Figure 4. Interrupted Time Series for Clinic Network



Data for the 11-12 year age group, the target age group for initiating the vaccine, showed a greater percentage increase (54.2%) compared with the 13- to 17-year-olds (29.6%) (Table 1 and Figure 5). Rates of initiation were higher for females than males at baseline and year 1, but were similar in years 2-4 (Table 1 and Figure 6). Although patterns were generally similar for all racial/ethnic groups, Hispanics and African-Americans had the highest initiation rates in all years while non-Hispanic whites had the lowest rates (Table 1 and Figure 7). Families without insurance had the lowest rates while those with Medicaid/Medicare had the highest rates (Table 1 and Figure 8). Those with commercial or other types of insurance had rates that were intermediate between those with Medicaid/Medicare and those with no insurance.

Figure 5. HPV Vaccine Initiation over Time by Age Group

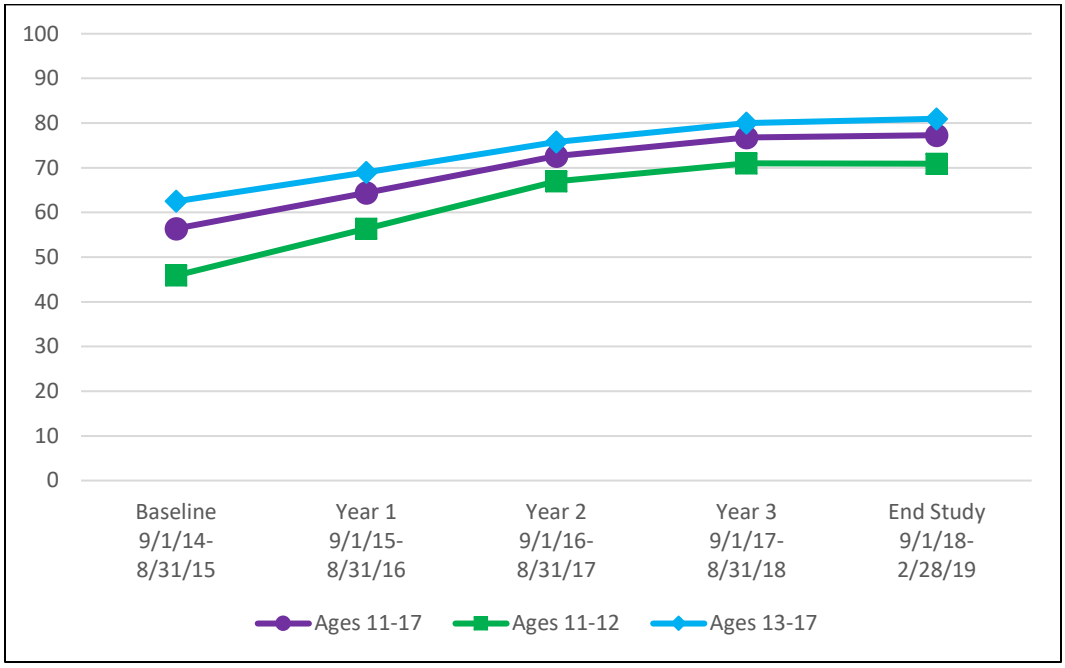


Figure 6. HPV Vaccine Initiation by Sex, Ages 11-17 for TCP Patients

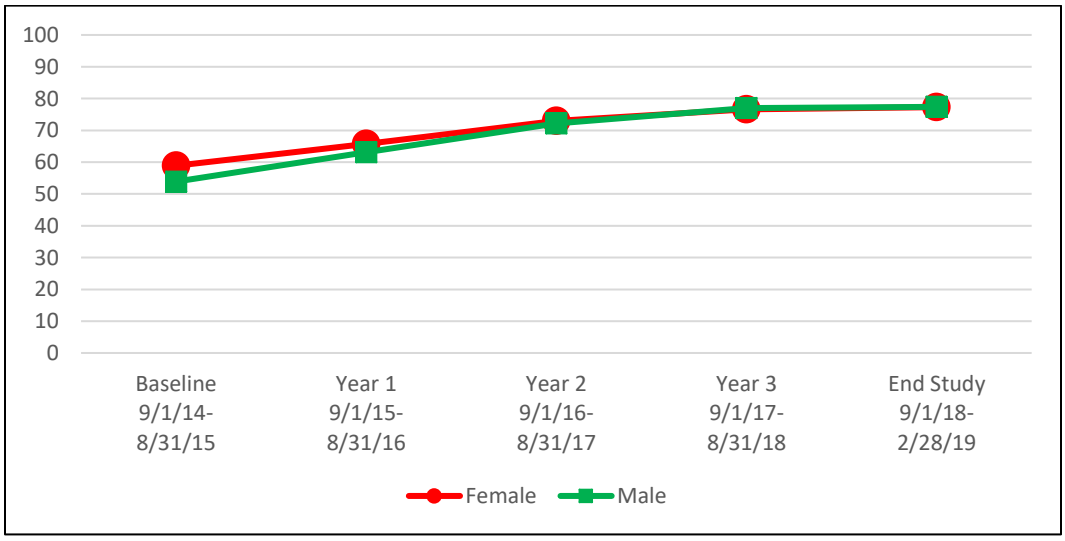


Figure 7. HPV Vaccine Initiation by Ethnicity, Ages 11-17 for TCP Patients

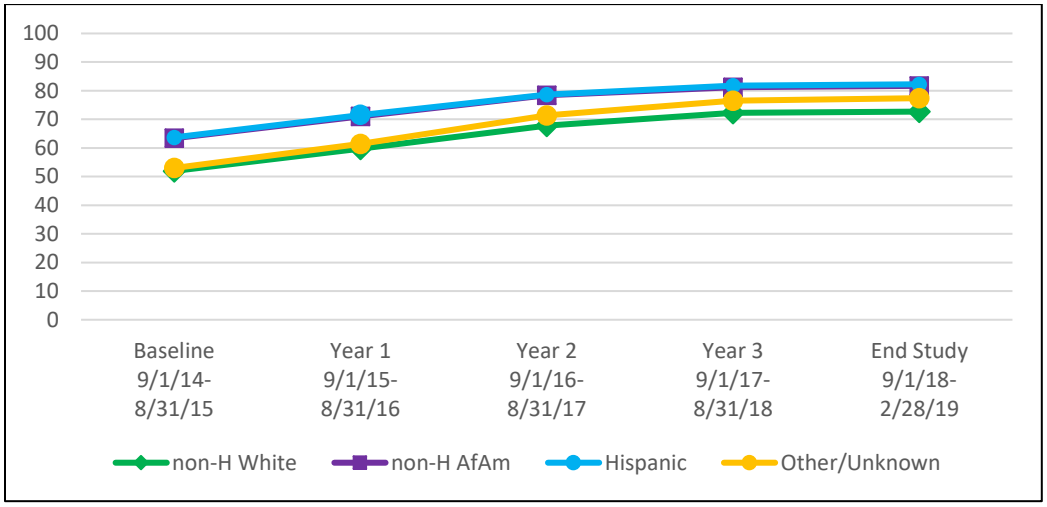
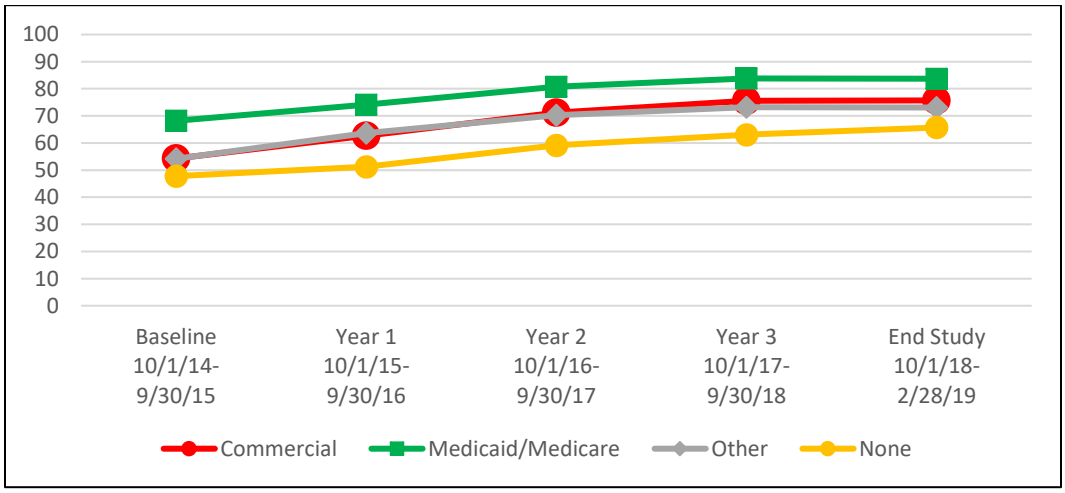


Figure 8. HPV Vaccine Initiation by Insurance Type, Ages 11-17 for TCP Patients



Discussion

HPV vaccination prevents most cervical, oropharynx, anus, penis, vulva, and vagina cancers. Although vaccination rates are slowly increasing, they do not yet meet the American Cancer Society's goal to have 80% of adolescents up to date before their 13th birthday by 2026. [24] The AVP was developed to enable providers to increase their rate of HPV vaccination. The program consists of the successive rollout of 5 evidence-based strategies. It was evaluated in a large clinic network in the Houston area that serves an estimated 30% of the pediatric population in a 5-county area.[19] During the 3-year period that the program was in place, initiation of the HPV vaccine increased from approximately 50% to 80% in the areas served by TCP.

Consistent with other studies,[25-27] the prevalence of HPV initiation was slightly higher in females than males in the early years of the project but rates coalesced by the end of the project. Hispanics and African Americans had higher initiation rates in all years of the project compared with non-Hispanic whites. Families without insurance had the lowest rates while those with Medicaid/Medicare had the highest.[25]

An important strength of our project was that we worked closely with the clinic leadership for over a year prior to receiving funding. This lead time was crucial for understanding the system and establishing trusting relationships. For example, the medical director facilitated communication with the 51 clinics by using his monthly newsletter to introduce the stage of the project. We also were permitted to use internal office mail to distribute materials related to our strategies, eg, assessment and feedback reports. Another strength of our project was clinic leadership support to develop a vaccine registry in conjunction with the network IT department to enable more accurate records of vaccination status. This was vital for effectively targeted patient reminders. Further, clinic leadership facilitated the inclusion of branched chain decision algorithms within the Epic EHR enabling tailored reminders to providers on patient vaccine eligibility and responsiveness to changes that occurred to the guidelines during the project, eg, change in the dose for adolescents 15 years or younger from 3 to 2.

A limitation of the project was the pre/post design. Without a comparison group from the same population, we could not directly rule out alternative hypotheses, particularly secular trends. We used rates for Houston from NIS-Teen as a proxy, and we observed a secular trend in both TCP and

NIS-Teen data; however, the NIS-Teen Houston data showed a more gradual increase compared with TCP data, suggesting that our program was effective at increasing HPV vaccination beyond secular trends. In addition to secular trends, there were other activities that promoted and encouraged HPV vaccination both in and outside the clinic network including the Texas HPV Coalition, a group of organizations with the goal of increasing HPV vaccination in Texas (https://texashpvcoalition.org). Because TCP patients constitute a sizable proportion of NIS-Teen estimates, it is possible that estimates of initiation for Houston from NIS-Teen are overestimated. Finally, the demographics of TCP and Houston differ. According to 2018 interim census estimates, Houston is 25% non-Hispanic white, 51.6% commercially insured, and 51.2% English language preference compared with TCP, which is 44% non-Hispanic white, 80% commercially insured, and over 90% English language preference.

The AVP is a promising program for sequenced rollout of evidence-based strategies to increase HPV vaccination initiation in a clinic setting. The AVP was effective at increasing initiation of the HPV vaccine series among male and female adolescent patients. The program was designed as sequential but overlapping rollout of individual components, limiting our ability to test the effectiveness of each component (eg, CME/CNE). It is possible that there was a synergistic relationship between components because improving knowledge and communication skills are likely a prerequisite to a provider's ability to improve suboptimal vaccination rates, as highlighted in audit and feedback reports.[16] Further, despite the time pressures on physicians, we demonstrated willingness to engage in physician-targeted interventions (CME and A&F). In a survey of physicians and clinic staff at the end of the program, over 80% agreed or strongly agreed with the statement "willing to use new programs". We continued to monitor vaccination rates for a year beyond implementation of the program, and rates did not decline, suggesting that some of the strategies were sustained.

While demonstrated effective in this project, the potential for the AVP to be adopted and implemented in other clinical networks remains to be determined. Because the demographic composition of TCP and Houston differ, generalization of our results should be done cautiously. We are in the process of replicating the AVP in a smaller network of clinics with a different population in San Antonio, Texas (PP180089). We also are developing a dissemination plan whereby clinics may access a web-based program that includes a stepped guide, tools, and resources to guide implementation of the AVP, tailored to their clinic system's needs (PP190041). Critical in such

a plan is that clinics have the capacity to readily onboard the AVP evidence-based strategies on their own, beyond the infrastructure support of a funded evaluation trial. Finally, in another CPRIT project, we developed and tested an app for parents (RP150014). The app provides information to dispel myths about HPV and the vaccine and to schedule an appointment for their child.

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