

The Impact of a Human Papillomavirus Vaccine Best Practice Alert

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Abstract

The human papillomavirus (HPV) is the most commonly spread sexually transmitted infection in the United States. Although the HPV vaccine protects against transmission of the most common strains of HPV that cause genital warts and numerous urogenital cancers, uptake in the United States remains suboptimal. Failure to vaccinate leaves individuals vulnerable to the virus and subsequent complications of transmission. The evidence demonstrates that provider recommendation alone increases rates of vaccine uptake. The literature does not suggest a specific method for provider recommendation delivery; however, best practice alerts (BPAs) were correlated with increased vaccination rates. These findings have directed a proposed project that includes an electronic health record (EHR) change prompting internal medicine, family practice and women's health providers to educate and recommend the HPV vaccine at a Federally Qualified Health Center (FQHC) in the Southwest United States. The project demonstrates that after the implementation of a practice change of a HPV BPA in the EHR, HPV vaccination rates increased. Practice settings pre and post were similar, making the increase clinically significant. The strengths of this project include an increase in HPV vaccination rates, a sustainable intervention, and an intervention that can easily be replicated into other health maintenance tasks. There were some limitations including the BPA alert only catching the HPV 9 vaccine series and the BPA did not always capturing historical data. Despite these technical barriers the HPV BPA delivered an increase in the HPV vaccine to protect more individuals from the HPV virus, increased provider adherence to national guidelines, and provides a platform for BPAs to be utilized for other vaccines.

Keywords: human papillomavirus, vaccine, provider recommendation, uptake, electronic health record

The Impact of a Human Papillomavirus Vaccine Best Practice Alert

The human papillomavirus (HPV) is the most common sexually transmitted infection (STI) among women in the United States (CDC, 2016d). Some strains of the virus can develop into genital warts, and others can lead to the development of cervical and other urogenital cancers (CDC, 2015). Fortunately, a vaccination exists to prevent the transmission of HPV and protect sexually active individuals from developing complications from the infection. Although strongly recommended by many national organizations including the Center for Disease Control and Preventions (CDC), the Advisory Committee for Immunization Practices (ACIP), and the American Congress of Obstetricians and Gynecologists (ACOG), HPV vaccination rates continue to be sub-optimal (ACOG, 2015; CDC 2016c; CDC, 2015; Hofstetter & Rosenthal, 2016).

Problem Statement

HPV infections cause greater than 17,000 cancers in women every year in the United States (CDC, 2015c). In Arizona, 6.3 out of every 100,000 women will develop cervical cancer, and 2.4 out of every 100,000 will die from it (CDC, 2016a). HPV strains 16 and 18 are responsible for about 80% of cervical cancer incidences, where strains 6 and 11 account for 90% of all cases of genital warts (CDC, 2016d). The HPV vaccine protects individuals from these four strains, along with five other cancer-causing strains (CDC, 2016d). The Healthy People 2020 national initiative notes that only 28.1% of females ages 13-15 have been vaccinated with recommended doses, and presents a future goal of 80% or greater compliance rate by 2020 (Office of Disease Prevention and Health Promotion, 2017). The implementation of regular Papanicolaou (Pap) screenings has dropped cervical cancer from the most common cancer in females to significantly lower (fourth in the world) (ODPHP, 2017). In spite of advancements in

screening and the development of the HPV vaccine, in 2013, almost 12,000 women were diagnosed with cervical cancer and over 4,000 died from it in the United States (CDC, 2016b).

Considering the implications of contracting HPV and the dangers of the cancers it can lead to, along with the effectiveness of the HPV vaccination, increasing uptake of the vaccine would have a widespread impact on healthcare costs and reduction of disease. Thus, the purpose of this project is to explore the impact of a provider best practice alert (BPA) on HPV vaccination rates in eligible females ages 18-26.

Background and Significance

The HPV vaccine was approved in 2006 for females ages 9-26 and was later approved for males in 2009. In 2016, the CDC released a recommendation that children ages 11-12 only require two of the three doses in the series, while those 13 and older still require the three-part series (Meites, Kempe, & Markowitz, 2016). In addition, the vaccine originally protected against four strains of the virus but in 2015, the ACIP announced their support of the newer 9-valent HPV vaccine that protects against five additional strains of HPV (Petrosky et al., 2015). The new vaccine provides more coverage and has been extensively studied for its safety, immunogenicity, and efficacy. In regards to safety, few side effects or adverse events have been confirmed related to the vaccine, the most common being edema and redness at injection site. (Petrosky et al., 2016).

In women, HPV can lead to vulvar, cervical, vaginal, oropharyngeal, or anal cancers and cervical precancers (Petrosky et al., 2016). The HPV vaccine prevents the transmission of HPV thus preventing the development of said cancers. Despite the implications of contracting the HPV virus, vaccination rates in women are low across race and ethnic demographics (Bartlett & Peterson, 2011). While initiation of the three-part series is low, rates of completion of the series

are even less. In 2013, less than 40% of females had completed the series (National Vaccine Advisory Committee, 2016). It is hypothesized that provider influence is a factor in the decreased vaccination uptake rates.

Lack of provider recommendation is one of the largest barriers to vaccination and the likelihood of vaccination increases with provider endorsement (Bartlett & Peterson, 2011). The 2015 National Vaccine Advisory Committee reported that a third of patients surveyed were not offered the HPV vaccine by their provider. In the same survey, a majority of those who declined the vaccine reported they did so because they felt they did not have enough information regarding the vaccine (National Vaccine Advisory Committee, 2016). Provider recommendation and education have been shown to influence vaccination rates as well as patient behaviors (Berenson, Rahman, Hirth, Rupp, & Sarpong, 2015). It has also been shown that as few as 14% of providers recommend the HPV vaccine to eligible patients (Berkowitz, Malone, Rodriguez, & Saraiya, 2015). The lack of education and endorsement of the HPV vaccine has likely led to missed opportunities for eligible patients to receive the HPV vaccination.

A gap of care exists between vaccination awareness and vaccination rates. Provider oversight is a large barrier that contributes to this gap of care. Clinical reminders for providers to endorse vaccinations have been shown to improve vaccination rates (Bartlett & Paterson, 2011). BPAs integrated into electronic health records (EHRs) provide a reminder to providers to address vaccine status. BPAs have been shown to increase numerous vaccination rates including the flu, pneumococcal, and the HPV vaccine (Klatt & Hopp, 2012; Ledwich et al., 2009; Ruffin et al., 2015). Furthermore, provider recommendation in conjunction with practice alerts is an effective intervention at increasing uptake rates of the HPV vaccine (Fiks et al., 2013).

Evidence strongly supports that provider recommendation increases uptake regardless of the educational tools utilized (Bratic, Seyferth, & Bocchini, 2016). Although provider recommendation correlates directly with increased uptake, anecdotally patients rarely make appointments for vaccines alone. Often a chief complaint pulls focus away from HPV education if it is addressed at all. Utilizing each patient appointment as an opportunity to screen for vaccine discrepancies, and vaccinate same-day are two interventions that complement provider endorsement and increase uptake rates (Gilkey et al., 2016). A BPA integrated into an EHR can provide a resource for providers to decrease missed opportunities for HPV vaccination.

After a thorough literature review, the common theme to increase HPV vaccination rates is provider recommendation and BPAs. Providers must utilize every opportunity to educate and provide the HPV vaccine at every visit. No one intervention or educational tool was as impactful as provider support of and recommendation of the vaccine. As provider recommendation and BPA have been proven to increase uptake of many vaccines beyond HPV, it stands to reason that if providers were able to consistently recommend the HPV vaccine, that uptake rates would increase.

Internal Evidence

One Federally Qualified Health Center (FQHC) also reflects the vaccination uptake disparity. This FQHC located in the Southwest United States, like many across the United States have low HPV uptake rates. The most common factor contributing to the lack of immunization uptake is lack of provider recommendation. This was attributed to many factors including focus on a different chief complaint, short appointment times, and the lack of an EHR prompt for HPV vaccination status. Providers simply forget to ask and thus miss the opportunity to educate about the HPV vaccine. Furthermore, the demographic where HPV vaccinations are typically missed in

this FQHC are females, between 18-26 years of age. Fortunately, the knowledge and attitudes of these providers about the HPV vaccine were positive, and all providers interviewed agree that this is a gap in care.

Problem Statement and PICOT

Although rates of cervical cancer diagnoses and deaths are relatively low in the state of Arizona, the HPV vaccine uptake rates continue to be low. Not only does the HPV vaccine protect against the most commonly spread STI that can lead to many other diseases, it is a safe, quick, and cost-effective intervention that can have a significant impact on the health of women (and men). By reducing the spread of HPV, the aforementioned cancers, precancers and warts, will be reduced, thus lowering healthcare costs related to caring for these diagnoses.

This inquiry has led to the clinically relevant PICOT question, “In females ages 18-26 at a FQHC in the Southwest United States, does an HPV BPA impact rates of HPV vaccination?”

Search Sources and Process

In order to provide background to answer this question, the following databases were extensively searched: EBSCOhost, ProQuest, and PubMed (See Appendix A). 245 related articles were yielded from these database searches. The titles and abstracts were reviewed to determine the relevance to this PICOT question and deleted or retained accordingly (see Inclusion and Exclusion Criteria below). Ancestry searches were also performed on systematic reviews and literature reviews identified in articles from these database searches.

Inclusion and Exclusion Criteria

Inclusion criteria encompassed articles related to provider recommendation and BPAs. Articles needed to be within the last five years or older if relevant, however the final articles were all within that timeframe. Given that the vaccine has only been on the market for 12 years,

finding current literature was easily performed. Studies involving parents of eligible adolescents or adult women were both acceptable. Studies performed primarily on men were excluded, as well as any studies not peer reviewed, studies that did not discuss uptake or the gap in uptake, and any study that focused on interventions educating providers instead of on patient-provider interaction. All editorials were excluded.

Due to current nature of this topic, 245 relevant articles were produced with these initial searches. These titles and abstracts were reviewed and certain studies not relevant to the PICOT question were discarded. About 100 studies were evaluated for relevance, and even fewer were critically appraised. Among these studies, multiple ancestry searches were performed on the bibliographies of appropriate studies, which yielded some relevant studies. Finally, 12 studies were selected from both database searches and ancestry searches. These 12 adequately summarize both the current literature on HPV vaccination uptake, and examine provider recommendation and BPAs and their role in HPV vaccination uptake.

Evidence Synthesis

The evidence concludes that stagnant HPV rates are a problem and points to provider recommendation as a current barrier and solution. The data consistently correlates higher rates of vaccination uptake with a provider recommendation. Consistently noted barriers to uptake include lack of provider recommendation, lack of adequate education and knowledge on HPV, and potential financial concerns related to HPV vaccination. The literature also shows that BPAs are associated with an increase in provider awareness of vaccine eligibility. An increase in provider awareness increases the likelihood of vaccine recommendation. With consistent screening and discussion, providers can not only provide a platform for education, but also ultimately improve HPV vaccine uptake rates. Also, with the existence of government-assisted

vaccination programs, the provider can educate on available resources to eliminate the financial barrier. As provider recommendation and BPAs have been proven to increase uptake of many vaccines including HPV, it stands to reason that if providers were able to consistently recommend the HPV vaccine, uptake rates would increase.

Purpose Statement

The purpose of this project is to examine the impact of an HPV vaccine BPA within the EHR as a clinical reminder on HPV vaccine status for women ages 18-26. This practice change will benefit providers and patients at a FHQC in the Southwest United States.

Contribution of Theory to Utility of the Evidence

The Health Promotion Model, created by Nola Pender, is a demonstration of how individuals are complex in how they interact with their environment to achieve health (Nursing Theory, 2016). The model illustrates that prior behavior and personal factors influence how individuals perceive barriers to act, how they perceive their ability to act, influence interpersonal and situational perceptions, and how all of those components come together to influence a plan of action. The Health Promotion Model relates to the integration of a HPV BPA by ultimately influencing behavioral outcomes to increase provider recommendation of the HPV vaccine and HPV vaccine uptakes rates (See Appendix B).

Evidence Based Practice Model to Guide Project Development

The Ottawa Model of Research (OMR) lends itself to an implementation of a systematic change involving BPAs to prompt provider recommendation. The OMR is an ongoing continuum of assessment of barriers and supports to change (which consists of evidence based innovation, potential adopters, and practice environment), monitoring of the intervention and assessment of its use (which involves implementation strategies and adoption), and evaluation of

outcomes (Rycroft-Malone & Bucknall, 2010). It is a continuum in that once evaluation occurs; the implementer may go back to the assessment portion, the monitoring portion, or both. With the implementation of a project that changes provider behavior to include HPV endorsement and vaccination rates, evaluation of strategies, barriers, practice environment, and monitoring of outcomes are important to perform repeatedly and may occur in many different orders. This allows for assessment of what is effective and what is not, and provides an environment where innovation and improvement are occurring constantly, all for the betterment of patient outcomes and increased HPV vaccine uptake. This model provides a step-by-step road map for implementation of a provider recommendation change starting with assessment of patient's environment, including their social, cultural, and environmental perceptions about the HPV vaccine; assessing potential adopters for this change including key stakeholders; implementing/adopting the change, and then assessing how this has impacted uptake rates.

This model adequately incorporates not only those who will adopt the change; providers, medical assistants, allied health staff, but for the individuals for whom the practice change is implemented. By understanding personal barriers to vaccination uptake, providers can create interventions and recommendations that are personalized and impactful.

Project Methods

Ethics

Protection of human subjects was achieved through Arizona State University Institutional Research Board approval obtained on October 27th, 2017. No recruitment or funding was utilized during this project.

Setting and Population

The setting was a system of FQHCs in the Southwest United States encompassing women's health, family practice, and internal medicine practices. Participants include 68 providers working in these clinics and non-pregnant females ages 18-26.

Intervention

The intervention is an EHR change to the existing Clinical Decision Support System (CDSS) section of the EHR to alert providers of eligible females that need the HPV vaccine. The alert appears red if the patient is due for one of the HPV vaccinations within the series (See Appendix C) or appears green if the patient is up-to-date, the vaccine has been documented, or ordered by a provider (See Appendix D). This section of the EHR is already being utilized for other health promotion activities such as alcohol use screening, Chlamydia screening, smoking status, and depression screening.

Prior to the project, the EHR lacked a BPA for the HPV vaccine and there was no uniform method by which providers ascertained vaccine eligibility. After working with the information technology department and EHR champions, the BPA was created in the training environment of the EHR and went live at this facility in November of 2017. Providers were educated on this change at meetings. Any provider that was not in attendance at the meetings was education on a one-to-one session with an EHR champion.

Collaboration occurred with EHR personnel to implement the HPV BPA and the provider EHR champion acted as a liaison between EHR personnel and the investigator. Provider champions were called upon to relay information about the intervention to their respective departments.

Outcome Measures

Outcome measures include number of patients that received the HPV vaccine and total number of patient visits. De-identified reports containing this information were obtained from EHR personnel. No tools or instruments were used in this project. Data analysis includes descriptive statistics, paired samples T-tests to compare the frequency of vaccination rates by clinic, and standardized by total patients seen pre and post- intervention. Standardization occurred by dividing the number of patients vaccinated by the total number of eligible patients seen.

Outcomes

Data was collected from one internal medicine clinic, four family practice clinics, and five women's health clinics at this FQHC. This includes 68 providers overall. The data was provided to the investigator de-identified for non-pregnant females ages 18-26 from the above clinics. Post data collection ran from December 1st, 2017 to February 28th, 2018. Pre-intervention included the time period from December 1st, 2016 to February 28th, 2017.

Project Results

The overall results show an increase in HPV vaccination rates. Pre-intervention, 190 HPV vaccines were given, and post-intervention 350 HPV vaccines were given. This result is not statistically significant, ($M = -16.30, SD = 23.58$); $t(9) = -2.19$; $p = 0.057$ with a 95% CI. Total patients seen increased from 3137 to 3541 which is not statistically different ($M = -40.40, SD = 75.90$); $t(9) = -1.68$; $p = 0.127$. However, having two populations that are statistically similar with an increase in vaccination rates is a clinically significant finding. Standardizing the patients

yielded a percentage of individuals that received the vaccine before and after the intervention. Paired samples test reveal that there was an increase in percentage of those who received the HPV vaccine, but it is not statistically significant, ($M = -.070$, $SD = .1068$); $t(9) = -2.08$; $p = 0.068$.

Divided into specialty, all HPV vaccine rates increased and women's health increased by the largest margin (See Appendix E). In internal medicine, 8 HPV vaccines were given pre-intervention and 28 post-intervention. In family practice, 97 HPV vaccines were given pre-intervention and 137 post-intervention. In women's health, 85 HPV vaccines were given pre-intervention and 187 post-intervention. All specialties saw similar patient visits standardizing the patients that received the vaccine before and after the intervention.

Impact

This project impacts providers, patients, the health system, and health policy. Providers were able to comply with national guidelines, maximize efficiency during busy appointments types, and use the BPA as a reminder for the HPV vaccine. The BPA provides a resource for providers to quickly check HPV vaccine status on a patient during busy appointments. Patients have an increase of awareness of HPV and the HPV vaccine, potential protection from the HPV and related urogenital cancers and warts, and added value to their visit. Education empowers patients to participate in their healthcare and raises satisfaction. The system benefits, as this is a sustainable EHR system change, can be utilized for other vaccines, and facilitates timeliness of the HPV vaccine series. The HPV BPA is a low maintenance system change and will only need to be updated if the national guidelines change regarding the HPV vaccine dosing timeline. Finally, health policy is impacted in that the HPV vaccine decreases new cases of HPV each

year, with it the cost burden of evaluation and treatment of HPV. The increase in HPV vaccination rates also aligns with the national health policy of Healthy People 2020 goal.

Discussion

The HPV BPA alert was not present within the EHR prior to this system change at the project site. Following the completion of this project, the HPV BPA will remain in the EHR, making it a sustainable change. The low maintenance of the HPV BPA is ideal to be broadened to other health maintenance activities and other vaccines like the influenza vaccine. This project had similar findings to other literature. Clinical reminders for providers have been shown to increase in vaccination rates, which this project contributes to that database. The project also showed a positive correlation between a BPA and HPV vaccine uptake. Similar findings with other vaccinations and health maintenance tasks have been established (Fiks et al., 2013; Klatt & Hopp, 2012; Ledwich et al., 2009; Ruffin et al., 2015). Future research is needed to focus on the missed opportunities for HPV vaccination with a BPA in place. Rates of provider recommendation, refusal rates, BPA impact on completion of the HPV vaccine series, and the use of BPAs on other vaccines are also areas of future research. Future research could also look at the effectiveness of BPAs in the pediatric population.

The biggest strength to this project is after the implementation of a HPV BPA, the rates of HPV vaccination increased across multiple specialties that saw adult females ages 18-26. This shows that a HPV BPA replicated into another clinical site should show similar results no matter the specialty. This is a sustainable, low maintenance intervention that can be used for a number of other vaccines. Limitations of this project include the restrictions of the type of data that could be collected and challenges with the sensitivity of the alert to older versions of the vaccine and manually entered vaccines. The most significant gap in the data was the inability to

capture missed opportunities; meaning while an increase in vaccination rates was demonstrated, there is not a way of knowing how many of those females were eligible for the vaccine or declined the vaccine. There was also no data on number of times the alert was utilized thus it was difficult to tell if the increase was due to providers using the alert or another variable.

Conclusion

While this project had significant limitations in both data collection and the technology used to capture vaccine history, it did increase provider awareness of previously low vaccination rates and the increase in vaccination rates was clinically significant. An increase in the HPV vaccine leads to protection of more individuals from the HPV virus, an increase in provider adherence to national guidelines, and provides a platform for BPAs to be utilized for other vaccines.

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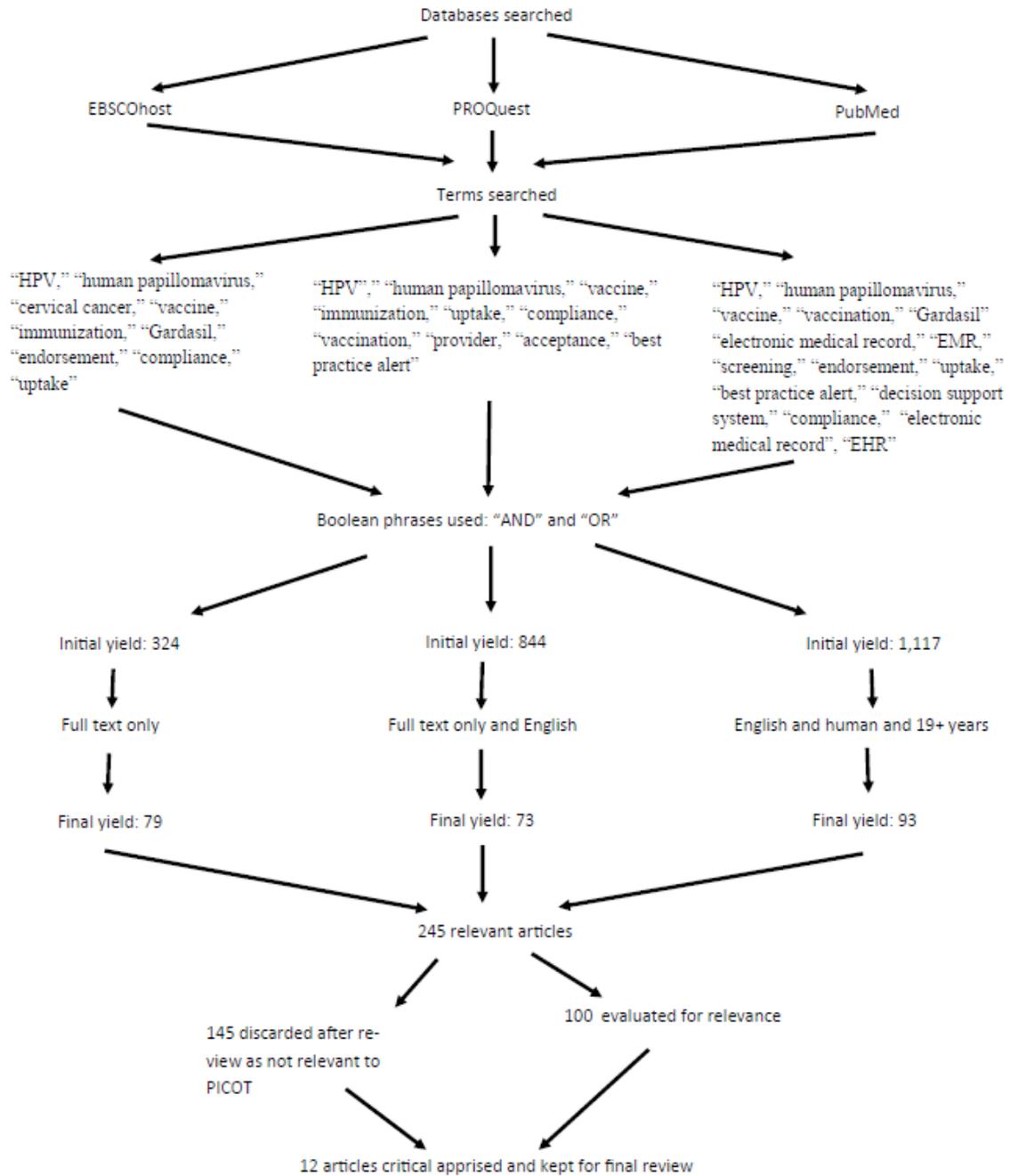
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Appendix A



Appendix B

Individual Characteristics and Experiences	Behavior-Specific Cognitions and Affect	Behavioral Outcomes
<p>Prior-Related Behavior:</p> <ul style="list-style-type: none"> • Low provider HPV recommendation rates <p>Personal Factors:</p> <ul style="list-style-type: none"> • Busy appointment times • Forgetfulness • Different chief complaints 	<p>Perceived benefits of action:</p> <ul style="list-style-type: none"> • HPV vaccination • Cancer prevention <p>Potential Barriers to Action:</p> <ul style="list-style-type: none"> • Patient resistance • Lack of education • BPA not utilized <p>Situational Influences</p> <ul style="list-style-type: none"> • BPA in the EHR 	<p>Health Promoting Behavior</p> <ul style="list-style-type: none"> • Provider recommends vaccine • Patient receives vaccine

Appendix C

Generic Practice Alerts					
HPV 9 valent (Gardasil 9) 9 through 26 years	2 M	09/29/2017			
PPSV23 (Pneumovax 23) (min 2 years)	0	09/29/2017			

Registry Alerts					
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Appendix D

Generic Practice Alerts					
HPV 9 valent (Gardasil 9) 9 through 26 years	09/25/2017	2 M	11/25/2017		
PPSV23 (Pneumovax 23) (min 2 years)		0	09/29/2017		

Registry Alerts					
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Appendix E

