

Improving Human Papilloma Vaccination Rates Through Provider Prompted Screening

Nichole Gaines

Lenoir-Rhyne University

April 19, 2024

Abstract

Background: Human papillomavirus (HPV) infection is a significant public health concern linked to cervical cancer. HPV is the causative agent for nearly 36,000 cases of cancer in women every year in the United States. Vaccination against HPV can prevent 33,000 of these cancers by preventing the variants that cause them (Kurosawa et al., 2022). The vaccination rate for the age group 18 to 26 in North Carolina is 18.3% compared to the national average of 52.2% (Boersma & Black, 2020). The purpose of this quality improvement project was to implement an EHR provider screening prompt for HPV vaccination status in young women ages 18 to 36 years and initiate vaccination as indicated. **Methods:** An EHR prompt was initiated to determine HPV vaccination status for patients during their routine and annual appointments. Based on screening, providers counseled patients on the need for vaccination and offered initial vaccination or completion of the series as indicated. **Results:** A total of 104 women met inclusion criteria. Screening was documented for 96 women (90.57%) and education related to HPV vaccination was given to 100 women (96.15%). Eleven women received the vaccine (10.58%) during their visit. Pre-implementation retrospective chart reviews revealed that only 2 of 106 women were screened and vaccinated (1.89%). **Conclusion:** Implementation of a screening prompt was significant as most women post-intervention were screened and received education. Additionally, there was an increase in the number of women who received the vaccine. The data supports that increased screening by the provider improved HPV vaccine acceptance.

Keywords: HPV awareness, HPV vaccination compliance rates in ages 18-36, HPV vaccine screening in primary care, electronic health record (EHR) screening tools for the HPV vaccine

Improving Human Papillomavirus Vaccination Rates Through Provider Prompted Screening

Cervical cancer is the second leading cause of cancer in women around the world. Globally, it is estimated that 633,000 new cases of cervical cancer were diagnosed, and 342,000 deaths occurred in 2020 (Boersma & Black, 2020). Cervical cancer remains a major health risk despite advancements in care. Although death rates are higher in underdeveloped countries, the United States death rate related to cervical cancer increased by 0.3% in the last two decades. Most women received their diagnosis in the later stages of the disease between the ages of 35 to 65 years (International Agency for Research on Cancer, n.d.).

Human papilloma virus (HPV) is the causative agent for 95% of cervical cancers diagnosed. The World Health Organization (WHO) estimated that approximately 80% of sexually active women will acquire the infection in their lifetime. Although other causes are linked to the development of cervical cancer, oncological studies have identified the specific HPV strains 16 and 18 as leading the transformation of cervical epithelial cells into invasive cancer cells (Mohamed et al., 2022). The identification of the specific strains has enabled the development of sensitive HPV screening tests for the secondary prevention of cancer, and three vaccines that can be utilized as primary prevention. Primary prevention through vaccination against HPV can begin as early as nine years of age. Secondary prevention screening methods are performed through gynecological examinations and PAP smear testing (American Cancer Society, 2023).

The treatment of cervical cancer accounts for 1% of all cancer treatments in the United States. More than 2.3 billion dollars in total annual medical costs were related to cervical cancer in 2020. The initial year post diagnosis and end-of-life phase are the costliest for an individual.

The financial impact of oral medications alone can total up to \$500 a month (Dowes et al., 2023). The cost of treatment versus vaccination screening and administration directly correlate to decreasing the overall medical cost. The Center for Disease Control and Prevention (CDC) is working to save lives and reduce health care costs through prevention of cervical cancer and early detection and treatment. (American Cancer Society, 2023).

The International Agency for Research on Cancer recognizes vaccination as a fundamental pillar in women's gynecological care since 90% of all cervical cancers can be prevented by completing the vaccination series alone (The Office on Women's Health, 2019). The National Breast and Cervical Cancer Early Detection Program (NBCCEDP) focus is on cervical cancer prevention to address health disparities in the United States. The Breast and Cervical Cancer Treatment Act of 1999 allows a patient with Medicare to have access to screenings, diagnostics, and vaccination coverage (Boersma & Black, 2020). In the state of North Carolina, the NBCCEDP has served more than 13,000 women through cervical screenings, treatment, and vaccination between the years of 2017 and 2021 (Centers for Disease Control and Prevention, n.d.).

Purpose

The purpose of this quality improvement project was to implement provider prompted HPV vaccination screening in a women's health clinic for patients from 18 to 36 years of age and administer the vaccine if indicated and with patients' consents. HPV vaccination screening at office visits and annual exams provides a prime opportunity to initiate the conversation around the importance of vaccination.

Literature Review

A review of literature was performed using databases including CINHALL, Medline, PubMed, and Google Scholar. Keywords used in the topic search were HPV awareness, HPV

vaccination compliance rates in ages 18 to 36 years, HPV vaccination screening in primary care, and electronic health record (EHR) screening tools for the HPV vaccinations. The results were filtered based on peer reviewed publications within the past five years that were written in the English language. A comprehensive online search was conducted to examine the literature and resources provided by national and public health institutes pertaining to HPV vaccinations and associated guidelines.

HPV Awareness

The awareness of HPV leading to cervical cancer is not as mainstream as risk factors for other cancers such as breast or colon. Although many women have heard of cervical cancer, many are unaware that HPV can be the cause and that it is transmitted sexually (Singh et al., 2019). In a study by Singh et al., a group of 242 women ranging from 16 to 65 years of age in a rural populated area, were surveyed on the awareness of cervical cancer screening and the HPV vaccine (2019). Although 85% of the women surveyed had heard of cervical cancer, only 34% recognized that it was transmitted sexually. Of the women surveyed, 22.3% were aware of prevention methods such as the HPV vaccine series but only 18.6% reported receiving one HPV vaccine in the past or completing the series (Singh et al., 2019).

HPV Vaccination Effectiveness

Vaccine effectiveness refers to the extent to which a vaccine effectively prevents disease in individuals (Ellingson et al., 2023). More than 13 years after the HPV vaccine received FDA approval, major health organizations continue to carry out systematic monitoring of vaccine safety. These studies have shown significant evidence supporting the positive effects of the HPV vaccine on the population, including a reduction in HPV infections, anogenital warts, and high-grade cervical lesions (Kudo et al., 2022). Lei et. al. examined the efficacy of the vaccination and

its direct impact on preventing HPV associated malignancy in real-world settings (2020). Among a group of women aged 18 to 26 who were administered their first round of vaccinations, the efficacy rate was shown to be 97% in preventing high-grade cervical lesions (CIN2+), anogenital warts, and more recently, pre-cancerous oral lesions (Lei et al., 2020).

Several clinical trials have demonstrated that the causative effect of HPV16/18 infections in the development of cervical precancerous lesions, has approached 100% (Kurosawa et al., 2022). The VIVIANE study conducted a seven-year study that included women over the age of 25. The participants were randomly assigned to receive either a bivalent vaccine or an aluminum hydroxide control. A total of 4407 women were assigned to a cohort with 2209 being vaccinated and 2198 serving as control. Additionally, 5747 women were assigned to the overall vaccination cohort, with 2877 being vaccinated and 2870 serving as controls. The vaccines were shown to be effective in preventing persistent HPV16/18 infections and cytological abnormalities (Kjaer et al, 2021).

HPV Screening in Primary Care

Effective cervical cancer screening methods start in the primary care setting. Many healthy women use their gynecologist as their primary care for annual examinations. Healthcare providers play an essential role in the education and prevention of cervical cancer (Dike et al., 2023). In a study performed by Chrysostomou et al. in 2020, a cost-effective strategy was the combination of education and vaccination in the age group 18 to 26 years. Primary care doctors and gynecologists in Ethiopia implemented a pilot program for HPV vaccination, which resulted in a notable rise in the vaccine completion rate among the age group studied. The program revealed that education provided by the provider in offices and outreach clinics was effective in reaching young women who face barriers in accessing vaccinations (Chrysostomou et al., 2020).

It is widely acknowledged that the United States should improve its efforts in educating healthcare providers and patients about the significance of vaccines in preventing cancer (Dowes et al., 2023). The effectiveness of utilizing electronic health record prompts to remind clinicians to assess a patients' vaccination status and administer vaccinations when necessary has been demonstrated (Hanley et al., 2023). Since women have the option of receiving cervical cancer screening through a Pap smear in various settings, some providers report that they do not include HPV vaccination screening. Unless patients are exhibiting a condition that warrants further investigation, assumptions are made that women have been questioned or screened at some point during a gynecology visit. (Hanley et al., 2023).

Barriers to Vaccination Screening

Multiple barriers exist that have delayed or prevented the completion of the HPV vaccination series. Inadequate information and negative attitudes have a detrimental effect not only on teenagers but also on others. As a result of insufficient knowledge and unfavorable attitudes, 87.3% of adolescents lacked the support of their parents or family members to receive the HPV immunization (Garbutt et al., 2022). Based on statistics provided by the CDC, many parents exhibit a reluctance to vaccinate their children due to a limited understanding of the vaccine (Harry et al., 2022). This has led to parents postponing the decision to administer the HPV vaccination due to the belief that their child had a low likelihood of contracting HPV. This attitude toward vaccination can follow an adolescent into adulthood. Providers can address these barriers and direct appropriate evidence-based education to increase the vaccination rate (Harry et al., 2022).

HPV vaccination rates in rural settings in the U.S. have lower rates compared to those in urban areas. Young adults aged 18 to 26 years in rural areas are less inclined to start the HPV

vaccine compared to urban young adults. According to the Centers for Disease Control and Prevention, the HPV vaccine coverage for adolescents in rural areas in 2019 was lower than in urban areas, with 47% in rural areas and 57% in urban areas (Kudo et al., 2022). Challenges at the systems level include issues with vaccination distribution and availability, shortages of healthcare providers, and clinical limits such extended appointment wait-times (McNeil et al., 2023).

Missed Opportunities for Vaccination

Missed opportunities for HPV vaccination emerge when eligible individuals fail to obtain a necessary dose in the vaccine series. In a study by Ruffin et al. (2015), the percentage of missed opportunities reported in community and continuity practices ranged from 62% to 73% on average. Missed opportunities were also linked to other factors such as race, language spoken, absence of preventive care visits, and type of visit. Non-preventive visits are more likely to contribute to a missed opportunity (Ruffin et al., 2015).

Krantz et al. examines the importance of missed opportunities during problem-focused visits. More than 90% of visits by young women were focused on addressing problems, such as gynecological concerns or medication adjustments and did not include HPV vaccine screening (2018). Of 1,467 unvaccinated females between the ages of 13-26, 96% of the participants had at least one missed opportunity for immunization during a problem focused visit (Krantz et al., 2018). Every interaction with a young adult patient should be seen as a chance to offer education and administer HPV vaccination to enhance immunization coverage. The frequency and intensity of the instruction and recommendations given by healthcare providers during visits could potentially boost vaccination coverage (Krantz et al., 2018).

Missed opportunities can occur when young women lack information regarding vaccine series recommendations, as well as the importance of scheduling extra appointments and follow-up (Markowitz et al., 2018). Missed chances are cited as the primary cause for the notably lower HPV vaccination rates in the United States. Providers may lack awareness of the current consequences of missed opportunities or lack the ability to mitigate them. Healthcare providers require further education and enhanced communication skills to decrease missed chances and enhance HPV vaccine coverage (Garbutt et al., 2022).

Poor communication between providers and parents can sometimes lead to missed opportunities. Provider attitudes regarding parental concerns and the perceived lack of time needed to discuss HPV vaccination in depth can lead to delays in discussing and administering the vaccine (Morgan et al., 2022). Myths around increased sexual activity and vaccination timing contribute to delays in parents and healthcare providers recommending the HPV vaccine. Conversational difficulties among clinicians, parents, and adolescents can lead to delays in communication and missed opportunities (Wirtz et al., 2022).

Provider Recommendation

The urgency to improve HPV vaccination coverage has prompted attention for initiatives aimed at improving the rate of HPV immunization. This support comes from global agencies that provide recommendations in adolescent health and cancer prevention, such as the CDC, the President's Cancer Panel, and the American Academy of Pediatrics (Zhu et al., 2023). An ongoing theme in the current work is the urgency to enhance the frequency at which healthcare providers promote the HPV vaccine. A provider's recommendation has a significant impact, as more than 70% of adolescents and young adults who received the recommendation elected to start the HPV vaccine series (Oh et al., 2021). A study conducted in the United States involving

more than 265,000 primary care patients has consistently shown a strong correlation between provider recommendation and the uptake of the HPV vaccine. This confirmed the connection between suggestion and initiation was consistently significant (Oh et al., 2021). Other studies with smaller sample sizes, consistently demonstrated significant associations between provider recommendations and starting the HPV vaccination. The outcomes validate the significance of provider recommendation in ensuring the initiation of the HPV vaccine series. (Laprise et al., 2020).

Emerging research indicates that healthcare providers' recommendations for HPV vaccination are not only rare but also tend to be inadequate. These recommendations generally downplay the significance of the HPV vaccine compared to other vaccines or propose delaying HPV vaccination to a later appointment. Moreover, individuals who consider healthcare professionals' advice as weak are less inclined to receive the HPV vaccine (Harry et. al, 2022). Healthcare providers are encouraged to make strong recommendations for HPV vaccination. It is recommended that healthcare professionals employ tactics such as explicitly stating the significance of the vaccine, highlighting its role in preventing cancer, and promoting the administration of the vaccine on the same day. Despite the significance of formative research, there is limited empirical knowledge about the definition of a strong recommendation and its impact on HPV vaccination behavior (Osaghae et. al, 2022).

Theoretical Framework

The framework selected to help guide this DNP project was the Health Belief Model (HBM). Developed in the 1950's by social psychologists, it helped them understand why so many people did not participate in screening programs to detect and prevent diseases (LaMorte, 2022). The HBM is composed of six constructs including perceived susceptibility, perceived

severity, perceived benefits, perceived barriers, cue to action, and self-efficacy (LaMorte, 2022). The model has been widely used to better understand the factors influencing preventive health behaviors such as screenings and vaccinations (Jones et al., 2015).

The HBM supports that individuals' health-related activities or behaviors are influenced by their individual perceptions and beliefs. Individuals are more inclined to engage in proactive choices when confronted with a personal threat or risk of illness or disease that is perceived as severe. The model assumptions further suggest that individuals' behaviors are influenced by their past experiences. Positive vaccination experiences generally lead to more favorable behavioral outcomes (Thompson, 2023). The HBM model supported this project aimed at addressing vaccination status, increasing patients' understanding regarding HPV and cervical cancer, and opting to be vaccinated. Patients' perceived susceptibility to developing cervical cancer and perceived benefits of reducing that risk were important factors related to their decision to be vaccinated.

Methodology

The primary aim of this quality improvement project was to increase provider prompted HPV vaccination screening in women aged 18 to 36 years and seek patient consent to administer the vaccine if indicated.

Population

The population for this quality improvement project included women between the ages of 18 to 36 years whose appointments were for gynecological purposes. Exclusion criteria were women who were pregnant or had medical contraindications to the vaccination. Contraindications to HPV vaccination include those who have experienced a severe allergic reaction to a previous administration of the vaccine, individuals with a hypersensitivity to yeast.

As a precautionary measure, women with an ongoing acute illness of moderate to severe intensity were excluded from receiving the vaccine (The Office on Women's Health, 2019).

Setting

This project was implemented in a women's health office in rural North Carolina that provides gynecological care for more than 8,000 patient visits annually. Providers in the office include four providers, two physicians, one nurse practitioner, and one certified nurse midwife. The primary patient demographic includes Caucasian, African American, and Hispanic women.

Interventions

The objective of this project was to activate an existing prompt in the electronic medical record to trigger clinical staff to screen presenting patients for current HPV vaccination status. A process was developed for all presenting patients to be screened on arrival prior to seeing the provider. The HPV vaccination status was reviewed by the provider who counseled patients on the importance of vaccination as a preventive measure for cervical cancer. The vaccination was offered to patients who met inclusion criteria and patients were encouraged by the provider to be vaccinated. An EHR smart phrase was used by the provider to document administration or refusal of the vaccine. HPV education embedded in the EHR was included in the visit summary issued to every patient upon the conclusion of their visit. For patients who agreed to initiate or finish the vaccine series, the immunization was recorded in the EHR. The EHR platform enables users to view vaccination education provided at previous visits and future scheduled vaccinations.

Study of Interventions

Project interventions were studied by collecting data related to the number of patients screened, whether education was provided, and if the patient received the HPV vaccination at the

visit. To compare pre- and post-implementation outcomes, retrospective chart reviews were performed for patients seen prior to implementation who also met inclusion criteria. At the end of the project implementation period, a chart review was conducted for the patients who met inclusion criteria and had a vaccine status prompt entered. At the conclusion of the post-implementation period, the number of screenings and HPV vaccine administrations were compared to pre-implementation data.

Measures

Retrospective chart reviews were completed to examine the number of screenings completed, HPV education provided, and HPV vaccines given before and after implementation of the project. The chart reviews were facilitated by utilizing the HPV vaccine screening tracker already built into the EHR. Demographic data including age and race/ethnicity were also collected. Post-implementation measures included the provider's use of the vaccine screening prompt in their documentation, administration of the vaccine, and education provided.

Analysis

A Fisher's exact test was performed to analyze whether screenings for the HPV vaccine documented pre-implementation and the number of screenings documented post-implementation were independent.

Descriptive statistical analysis was performed for demographic data including patient age and race. Nominal levels of data were collected and analyzed including a record of HPV vaccination history inquiries, vaccine education, and acceptance or declination of the vaccine.

Ethical Considerations

This quality improvement project did not introduce any new, experimental, or unapproved interventions that extended beyond the established best practice. Additionally,

patient confidentiality was maintained as no personal identifying patient information was collected during the project term. Vaccination assessment and administration are standards of care and therefore posed no risk or harm to patients. This project did not require any formal recruitment process or informed consent. Women who presented for all gynecological appointments and who met inclusion criteria were screened as part of the routine intake process. Pre- and post-intervention chart reviews only used age and race as identifiers with only charts meeting inclusion criteria reviewed. All information was obtained using a retrospective chart review. At completion of project and data analysis, all data will be deleted. There was no cost or compensation associated with this project.

Results

Demographic Summary Statistics

During the pre- and post-implementation period, a total of 210 women met inclusion criteria for the HPV vaccine. The pre-intervention retrospective chart reviews included 106 women, while 104 were from the post-implementation phase. The average age of the patient in the pre-implementation sample population (n=104) was 26.07. The average age of post implementation population (n=104) was 27.06. Among the 106 women pre-implementation that met inclusion criteria, the most frequent category for race was Caucasian (92.45%), followed by African American (3.77 %), Hispanic (1.89%), and Mixed Race (1.89%). For the post-implementation sample (n=104), Caucasian (85.58) was again the most frequent category followed by African American (4.8 %), Hispanic (4.8%), and Mixed Race (4.8%). The results are presented in Table 1 and Table 2 (*Intellectus Statistics*, 2019).

Table 1

Summary Statistics Table for Variable Age

Variable	<i>M</i>	<i>SD</i>	<i>n</i>	<i>SE_M</i>	Min	Max	Skewness	Kurtosis
----------	----------	-----------	----------	-----------------------	-----	-----	----------	----------

Age_PRE	26.07	5.52	106	0.54	18.00	36.00	0.19	-1.20
Age_POST	27.06	5.44	104	0.53	18.00	36.00	-0.02	-1.16

Note. '-' indicates the statistic is undefined due to constant data or an insufficient sample size.

Table 2

Frequency Table for Nominal Variable Race

Variable	N	%	Variable	N	%
Race PRE			Race POST		
Caucasian	98	92.45	Caucasian	89	85.58
AA	4	3.77	AA	5	4.8
Hispanic	2	1.89	Hispanic	5	4.8
Mixed	2	1.89	Mixed	5	4.8

Note. Due to rounding errors, percentages may not equal 100%.

HPV Vaccination Screening

The pre-intervention retrospective chart reviews included medical records for women who met inclusion criteria (n=106). Pre-intervention data showed that only two patients were screened for the HPV vaccination (1.89%) and 104 were not screened (98.11%). Post-intervention chart reviews (n=104) revealed that 96 women (92.31%) were screened using the modified HPV vaccination screening prompt in the EHR, and eight were not screened (7.69%). The frequency for pre- and post-implementation HPV screening can be seen in Table 3 (*Intellectus Statistics*, 2019).

Table 3

Frequency Table for Nominal Variable Pre- and Post-Screening

Variable	Pre-Intervention		Post-Intervention	
	<i>n</i>	%	<i>n</i>	%
HPV Vaccination Screening				
Yes	2	1.89	96	92.31
No	104	98.11	8	7.69

Note. Due to rounding errors, percentages may not equal 100%.

HPV Vaccination Education

Pre-implementation chart reviews (n=106) indicated that only 2 patients (1.89%) received education on the HPV vaccination and 104 did not (98.11%). Post-implementation chart reviews revealed that 100 women received provider education (96.15%) and four did not (3.85%). The frequencies for pre- and post-implementation provider vaccination education can be seen in Table 4 (*Intellectus Statistics*, 2019).

Table 4

Variable	Pre-Intervention		Post-Intervention	
	<i>n</i>	%	<i>n</i>	%
HPV Vaccination Education				
Yes	2	1.89	100	96.15
No	104	98.11	4	3.85

Note. Due to rounding errors, percentages may not equal 100%.

HPV Vaccination Given

Pre-intervention chart reviews (n=106) showed that only two patients received the HPV vaccination (1.89%) and 104 did not (98.11%). Post-intervention chart reviews (n=104) showed that 11 patients (10.58%) received the vaccine during the visit and seven patients were scheduled to receive the vaccine on a future visit (6.73%). There were 86 patients who declined (82.69%) the vaccination. The frequency for pre- and post-implementation vaccine administration can be seen in Table 5 (*Intellectus Statistics*, 2019).

Table 5

Variable	Pre-Intervention		Post-Intervention	
	<i>n</i>	%	<i>n</i>	%
HPV Vaccine Administration				
Yes	2	1.89	11	10.58
No	104	98.11	86	82.69
Future Visit Scheduled	0	0	7	6.73

Note. Due to rounding errors, percentages may not equal 100%.

A Fisher's exact test was performed to analyze whether screenings for the HPV vaccine documented pre-implementation and the number of provider screenings documented post-implementation were independent. The results showed no statistical significance based on an alpha value of 0.05, $p = 1.000$. Although this was not statistically significant, the data supports an increase in screening by the provider.

A Fisher's exact test was also performed to examine whether provider education in the EHR pre and provider education post outcomes were independent. The results showed no statistical significance based on an alpha value of .05, $p = 1.000$. This implies that the observed frequencies were not significantly different than the expected frequencies. Although this was found to not be statistically significant, the data supports an increased in education related to the HPV vaccine.

Discussion

Summary

The implementation of provider prompted screening for HPV vaccination brought awareness of the need to address patients' vaccination status. Patients identified as eligible for HPV vaccination received education related to the importance of HPV vaccination to reduce the risk of developing cervical cancer. The primary outcome and purpose of this project was accomplished by demonstrating that screening followed by patient education by the provider resulted in an increased rate of vaccination.

Interpretation

Provider prompted HPV vaccination screening was an effective strategy that led to an increase in the number of screenings performed, education provided, and vaccinations given. Even though the outcome data for pre- and post-implementation was not statistically significant,

the data did demonstrate that with these interventions, more women were willing to start the vaccine series on the same day. The results are consistent with studies that examined the provider role using EHR prompts to facilitate screening, education, and HPV vaccination.

Limitations

A limitation of this study was that only one provider participated in the project implementation that took place in a small rural clinic in North Carolina. Because the study population was mostly Caucasian, there could be limited generalizability to other primary care practices serving a more diverse patient population. There were some missed screening opportunities related to an issue with the EMR that may have limited the outcomes of the project.

Conclusion

Increasing HPV vaccination to reduce the incidence of cervical cancer is an important issue for public health research. This quality improvement project contributes to the existing knowledge by demonstrating that for this population, electronic prompts increased HPV vaccination screening and administration. Additional research is warranted to validate the usefulness of electronic screening prompts for other populations and geographic areas.

The implementation of evidence-based provider recommendations related to the HPV vaccination in primary care settings has been shown to enhance immunization rates among eligible individuals. Providing education to women during office visits is crucial to reduce barriers to immunization. By using electronic tools, healthcare organizations and primary care practices can improve HPV vaccination screening and provide evidence-based education to increase awareness and knowledge of HPV risks and the importance of vaccination.

References

- American Cancer Society. (2023, August 17). *American Cancer Society roundtable on cervical cancer*. www.cervicalroundtable.org
- Boersma, P., & Black, L. I. (2020). *Human Papillomavirus Vaccination Among Adults Aged 18-26, 2013-2018* (NCHS Data Brief).
- Chrysostomou, A. C., Stylianou, D. C., Constantinidou, A., & Kostrikis, L. G. (2020). Cervical cancer screening programs in Europe: The transition toward HPV vaccination and population based HPV testing. *Viruses*, *10*, 19–35.
- Dike, S. K., Cesario, S. K., Malecha, A., & Nurse, R. (2023). An education intervention to increase Human Papillomavirus vaccination confidence and acceptability: A randomized control trial. *Oncology Nursing Forum*, *50*(4), 423–436.
<https://doi.org/10.1188/23.ONF.423-436>
- Dowes, L. J., Nayar, R., Gerndt, J., & Saslow, D. (2023). Implementation in action: Collaboration on the transition to primary HPV screening for cervical cancer in the United States. *A Cancer Journal for Clinicians*, 1–3. <https://doi.org/10.3322/caac.21786>
- Ellingson, M. K., Sheikha, H., Nyhan, K., Oliveira, C. R., & Niccolai, L. M. (2023). Human papillomavirus vaccine effectiveness by age at vaccination: A systematic review. *Human Vaccines & Immunotherapeutics*, *19*(2), 2239085.
- Garbutt, J., Wang, R., Graham, S., McKay, V., Haire-Joshu, D., Barker, A., & Liu, L. (2022). Provider and practice factors associated with on-time vaccination in primary care. *Academic Pediatrics*, *23*(4), 800–807.
- Hanley, K., Chung, T. H., Nguyen, L. K., Amadi, T., Stansberry, S., Yetman, R., Foxhall, L., Bello, R., Diallo, T., & Lee, Y. L. (2023). Using electronic reminders to improve human

papillomavirus among primary care patients. *Vaccines*, *11*(872), 1–12.

<https://doi.org/10.3390/vaccines11040872>

Harry, M., Chrenka, E., Freitag, L., Saman, D., Allen, C., Asche, S., Truitt, A., Ekstrom, H., O'Connor, P., Sperill-Hillen, J., Ziegenfuss, J., & Elliott, T. (2022). Primary care clinicians' opinion before and after implementation of cancer screening and prevention clinical decision support in a clinic cluster-randomized control trial: A survey research study. *BMC Health Services Research*, *22*(38), 1–14. <https://doi.org/10.1186/s12913-021-07421-0>

Intellectus Statistics. (2019). *Intellectus Statistics* [Online computer software]. Retrieved from <http://analyze.intellectusstatistics.com/>

International Agency for Research on Cancer. (n.d.). IARC cancer database statistics.

<https://gco.iarc.fr/today/online-analysis-table?v=2020>

Jones, C. L., Jensen, J. D., Scherr, C. L., Brown, N. R., Christy, K., & Weaver, J. (2015). The health belief model as an explanatory framework in communication research: Exploring parallel, serial, and moderate mediation. *HHS Public Access*, *30*(6), 566–576.

Krantz, L., Ollberding, N., Beck, A., & Burkhardt, M. (2018). Increasing HPV vaccination coverage through provider-based interventions. *Clinical Pediatrics*, *57*(3), 319-326.

Kjaer, S., Dehlendorff, C., Belmonte, F., & Baandrup, L. (2021). Real-world effectiveness of human papillomavirus vaccination against cervical cancer. *Journal of the National Cancer Institute*, (113), 1329–1335.

Kurosawa, M., Yamaguchi, M., Hanley, S., Hara, M., Adachi, S., Miyagi, E., & Ikeda, S. (2022). Long term effects of human papillomavirus vaccination in clinical trials and real-world data: A systematic review. *Vaccines*, *10*(256), 1-14.

- Kudo, R., Hanley, S., Ueda, Y., Sekine, M., & Kurosawa, M. (2022). Problems with catch-up HPV vaccination after resumption of proactive recommendations. *The Lancet Oncology*, 23(8), [https://doi.org/10.1016/S1470-2045\(22\)00259-5](https://doi.org/10.1016/S1470-2045(22)00259-5).
- LaMorte, W. (2022). *The health belief model*. Boston University School of Public Health. <https://sphweb.bumc.bu.edu/otlt/MPH-Modules/SB/BehavioralChangeTheories/BehavioralChangeTheories2.html>
- Laprise, J., Chesson, H., Markowitz, L., Drolet, M., Martin, D., Benard, E., Brisson, M., & Brisson, M. (2020). Effective and cost-effectiveness of human papillomavirus vaccination through age 45 year in the United States. *Annals of Internal Medicine*, 172(1), 22–29. <https://doi.org/10.7326/M19-1182>.
- Lei, J., Ploner, A., Elfstrom, K., Wang, J., Roth, A., Fang, F., & Dillner, S. (2020). HPV vaccination and the risk of invasive cervical cancer. *New England Journal of Medicine*, 383(14), 1340-1348.
- Markowitz, L., Gee, J., Chesson, H., & Stokley, S. (2018). Ten years of human papillomavirus vaccination in the United States. *Academic Pediatrics*, 18(2), 1–10.
- McNeil, C., Barr, B., Munawar, I., DeWitt, M., Myers, J., & Shetty, A. (2023). Assessing barriers to human papillomavirus vaccination in at-risk rural communities of western North Carolina, United States. *Vaccines*, 11, 1785.
- Mohamed, M., Tawfik, A., Mohammed, G., & Elotla, S. (2022). Knowledge, attitude, and practice of cervical cancer screening and HPV vaccination: A cross-sectional study among obstetricians and gynecologists in Egypt. *Maternal and Child Health Journal*, 26, 565–574. <https://doi.org/10.1007/s10995-021-03352-8>.

Morgan, C., Giattas, M., Holroyd, T., Pfizer, A., Engel, D., Sidibe, A., Holloway, M., Bloem, P., Shimp, L., & Kumar, S. (2022). Integration of other services with human papillomavirus vaccination; Lessons from earlier in the life course highlight the need for new policy and implementation evidence. *Vaccine*, *40*, 94–99.

<https://doi.org/10.1016/j.vaccine.2021.12.066>

Oh, N., Biddell, C., Rhodes, B., & Brewer, T. (2021). Provider communication and HPV vaccine uptake: A meta-analysis and systematic review. *Preventive Medicine*, (148)

<https://doi.org/10.1016/j.ypmed.2021.106554>.

Osaghae, I., Dark, C., Chido-Amajuoyi, O., Chan, W., Wermuth, P., Pande, M., Cunningham, S., & Shete, S. (2022). Association of provider HPV vaccination training with provider assessment of HPV vaccination status and recommendation of HPV vaccination. *Human Vaccines and Immunotherapies*, *18*(6), 1–8.

<https://doi.org/10.1080/21645515.2022.2132755>.

0/21645515.2022.2132755.

Ruffin, M. T., Plegue, M. A., Rockwell, P. G., Young, A. P., Patel, D., & Yeazel, M. (2015).

Impact of an electronic health record reminder on human papillomavirus initiation and timely completion. *Journal of American Board of Family Medicine*, *28*(3), 324–333.

<https://doi.org/10.3122/jabfm.2015.03.140082>.

Singh, J., Roy, B., Yadav, A., Siddiqui, S., Setia, A., Ramesh, R., & Singh, K. (2019). Cervical cancer awareness and HPV vaccination acceptability among females in Dehli: A cross-sectional study. *Indian Journal of Cancer*, *55*(3), 233–237.

The Office On Women's Health. (2019). *HPV Vax Now* [Policy Brief].

<https://www.womenshealth.gov/about-us/what-we-do/programs-and-activities/hpv-vaxnow-campaign>

Thompson, S. R. (2023). *The essential guide to public health and health promotion* (2nd ed.).
Routledge.

Wirtz, C., Mohammed, Y., Engel, D., Sidibe, A., Holloway, M., Bloem, P., Kumar, S.,
Botherton, J., & Morgan, C. (2022). Integrating HPV vaccination programs with
enhanced cervical cancer screening and treatment: A systematic review. *Vaccine*, *40*(1),
116-123. <https://doi.org/10.1016/j.vaccine.2021.11.013>.

Zhu, X., Jacobson, R. M., MacLaughlin, K. L., St. Sauver, J., Griffin, J. M., & Finney Rutten, L.
J. (2023). Parent-reported barriers and parental beliefs associated with intentions to
obtain HPV vaccination for children in a primary care patient population in Minnesota,
USA. *Journal of Community Health*, 1–9. <https://doi.org/10.1007/s10900-023-01205-9>