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# Human Papillomavirus Vaccination Rates Among Adolescents in South Carolina

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# HUMAN PAPILLOMAVIRUS VACCINATION RATES AMONG ADOLESCENTS IN SOUTH CAROLINA

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**Abstract**

**Problem Statement**: Among adolescents 11-17 years of age in South Carolina, low rates of human papillomavirus (HPV) vaccination can negatively impact health outcomes through increased risk of acquiring HPV-associated cancers.

**Purpose**: To determine if the 4 Pillars™ Immunization Toolkit increased HPV vaccination rates among adolescent patients.

**Methods**: The 4 Pillars™ Immunization Toolkit was the framework for this bundled intervention. Pillar 1, convenience and easy access, included after-school HPV express clinics. Pillar 2, communication, utilized staff motivational interviewing skills, campaign promotion materials, documentation of declination, and second-dose callback appointments. Pillar 3, enhanced vaccination systems, was designed to use the state immunization information system (IIS) to assess vaccination data and identify adolescents for second dose callback. Pillar 4, motivation, aimed to track the progress of vaccination rate improvement and promoted a clinic immunization champion.

**Inclusion Criteria**: Patients 11-17 years of age who received vaccination services at a health clinic in the southeastern United States. Nursing staff included nurses employed at the clinic.

**Analysis**: Due to the denial of a data-sharing agreement, data was not released for analysis and evaluation of this project. Chi-square testing was intended to compare aggregated HPV coverage rates at baseline to intervals throughout the project and post-intervention. The clinics were well-attended and successful through informal communication, even though specific data could not be shared.

**Implications for Practice**: Implementing a multi-strategy vaccination toolkit may significantly improve adolescent HPV vaccination coverage rates and positively affect health outcomes.

*Keywords*: 4 Pillars™ Immunization Toolkit, human papillomavirus, vaccine, adolescents

## Human Papillomavirus Vaccination Rates Among Adolescents in South Carolina

Worldwide, there are 630,000 cases of cancer annually that are associated with human papillomavirus (HPV) (Serrano et al., 2018). This includes cervical cancer, which is the fourth leading cause of death (Serrano et al., 2018). HPV vaccination can prevent HPV-related cancers (Hirth, 2019). The Advisory Committee on Immunization Practices (ACIP) recommends HPV vaccination as part of the adolescent vaccination platform (Wodi et al., 2023). Unfortunately, HPV vaccination rates for adolescents 11-17 years of age in South Carolina are below the Healthy People 2030 HPV vaccination target of 80% for adolescents (Office of Disease Prevention and Health Promotion, n.d.). To address this discrepancy, measures such as implementing a vaccine toolkit may increase adolescent HPV vaccination coverage rates in South Carolina.

## Background

HPV infection has implications for cancer morbidity and mortality and an associated economic burden. The most prevalent sexually transmitted disease worldwide, 85% of the population is infected with HPV during their lifetime (Centers for Disease Control and Prevention [CDC], n.d.-a). Most HPV infections are transient and resolve spontaneously; however, the persistent high-risk oncogenic HPV types can cause cancer (Serrano et al., 2018). HPV infection is attributed to almost all cervical cancers and is causally related to the following cancers: anal (90%), vulvar and oropharyngeal (70%), penile (60%), and vaginal (75%) (National Cancer Institute, 2023). In the United States, HPV is attributed to 36,500 new cancer cases (CDC, n.d.-a) and 4,000 cervical cancer deaths annually (CDC, n.d.-b). Annually, in South Carolina, there are 580 new cases of HPV-related cancers, including 170 women diagnosed with cervical cancer with 75 associated deaths (Hollings Cancer Center [HCC], n.d.). In addition, the economic costs of HPV-related cancers are substantial. In 2017, in the United States, the present value of future lost productivity related to HPV-attributable cancer deaths was $4.2 billion (Priyadarshini et al., 2021).

Over 90% of HPV-associated cancers can be prevented with HPV vaccination (CDC, n.d.-b).

Additionally, the HPV vaccine is safe and effective (Markowitz & Schiller, 2021). Despite this safe and effective preventive measure, in 2022, only 62.6% of adolescents in the United States were up to date with HPV vaccination (Pingali et al., 2023). In South Carolina in 2022, only 54.4% of adolescents 13-17 years of age were considered up-to-date with either two or three doses of the HPV vaccine (CDC, n.d.-c). Additionally, school requirements can serve as an impetus to increase vaccination rates (Calo et al., 2022). However, South Carolina does not include an HPV vaccine requirement for school entry (South Carolina Department of Health and Environmental Control [SC DHEC], n.d.-a).

A health clinic in central South Carolina is the location identified for the implementation of this project. Specifically, this clinic has a high client volume and serves an adolescent population. Additionally, this clinic can provide the HPV vaccine to all adolescents regardless of the ability to pay as the clinic is an enrolled provider in the federal Vaccine for Children (VFC) program. The VFC program ensures vulnerable populations have access to vaccines, including Medicaid, uninsured, and underinsured children (SC DHEC, n.d.-b). South Carolina's statewide immunization information system (IIS) database was to be the source of HPV vaccine-administered data for this project. All immunizations administered in South Carolina must be entered into the IIS (South Carolina Immunization Registry, 1976/2019).

Despite several strategies to promote HPV vaccination, the rates remain low for adolescents. The ACIP recommendation, including HPV vaccination as part of the adolescent vaccination platform (Wodi et al., 2023), and removing financial barriers through the VFC program, have not resulted in increased immunization rates. Given the continued low HPV vaccination rates and the importance to public health, the clinical question for this project is: Among adolescent patients 11-17 years of age (P), what is the impact of adding a vaccine program toolkit (I) to current health clinic practice (C) on human papillomavirus (HPV) vaccination rates (O) over three months (T)?

Evidenced-based support to address this practice problem was found through a literature search

using PubMed-Medline, CINAHL, Web of Science, and Cochrane Library. The databases were searched using the following terms and phrases: “immunization,” “vaccine,” “vaccination,” “toolkit,” “outpatient,” “clinical process,” “vaccination program,” “human papillomavirus,” “HPV,” “vaccination rates,” “nurs*,” and “strategies.” The search was narrowed by including the terms “public health,” “adolescent,” and “pediatrics.” The searches were limited to articles in the English language with free, full text from 2018 to 2023. The search years were expanded through 2014, including landmark articles related to a bundled intervention structure in contrast to individual interventions. Duplicate articles with similar conclusions and content irrelevant to the subject were excluded. Using the inclusion and exclusion criteria, 40 articles were chosen for review, and 19 were selected for an Evidence Table (Appendix A).

The use of combined immunization strategies is an effective means to increase vaccination rates (Gilkey et al., 2023; Hawk et al., 2017; Siddiqui et al., 2022; Zimmerman et al., 2014). For HPV vaccination specifically, the multi-pronged approach improves vaccine series initiation and completion in quality improvement projects (Abdullahi et al., 2020; Nissen et al., 2019; Perkins et al., 2020; Szilagyi et al., 2021). Using a menu of empirically supported strategies supports customized initiatives unique to the clinic sites. Additionally, interventions that allow for a tailored approach to choose strategies that integrate into the clinic processes are more sustainable after the intervention period (Cox et al., 2022; Perkins et al., 2020).

Toolkits are a practical intervention to implement bundled evidenced-based healthcare recommendations and improve the quality of care (Hempel, Miake-Lye, et al., 2019; Theole et al., 2020). Toolkits are designed to provide several resources to accomplish a designated task. Improved outcomes and high provider satisfaction are associated with implementing toolkits in clinical practice (Hempel, O’Hanlon, et al., 2019; Loskutova et al., 2021). Immunization toolkits that include several options are beneficial in developing coordinated campaigns to increase HPV vaccination coverage rates (Kessler & Auwaerter, 2021).

The 4 Pillars™ Transformation Program toolkit (formerly known as the 4 Pillars™ Immunization Toolkit) is an evidence-based intervention framework to increase vaccination coverage (Hawk et al., 2017; Wells et al., 2022; Zimmerman, Moehling, et al., 2017). Based on a Community Preventive Services Task Force recommendation (Community Preventative Services Task Force, 2014), Zimmerman et al. (2014) developed the 4 Pillars™ Program toolkit as a combination of system-based interventions to increase childhood immunization rates. The 4 Pillars™ Program toolkit has successfully increased vaccination rates in children and adults (Hawk et al., 2017; Zimmerman, Moehling, et al., 2017; Zimmerman et al., 2014). Specifically, the program has increased adolescent vaccinations for children aged 11 - 17, including HPV vaccination (Zimmerman, Raviotta, et al., 2017). The adaptability and versatility of the 4 Pillars™ Program toolkit to individual practice locations make the program a unique immunization intervention (Zimmerman et al., 2014). The 4 Pillars™ Program toolkit is founded on the RE-AIM model of reach, efficacy, adoption, implementation, and maintenance, underscoring the intervention's utility in various practice settings (Hawk et al., 2017). The RE-AIM structure guides each pillar's recommendations, suggesting fidelity to the 4 Pillars™ Program toolkit (Wells et al., 2022; Zimmerman, Moehling, et al., 2017).

The pillars of the 4 Pillars™ Program toolkit intervention include convenience and easy access, patient communication, enhanced vaccination systems, and motivation (University of Pittsburgh School of Medicine, 2023). Implementing multiple strategies using the 4 Pillars™ Program toolkit increases HPV vaccination coverage rates (Hawk et al., 2017; Zimmerman, Moehling, et al., 2017). Using the pillar framework, robust strategies were developed for each category. Some effective strategies for the first pillar, convenience and easy access, include scheduling and clinic availability (Cox et al., 2022; Nissen et al., 2019; Szilagyi et al., 2021). Scheduling appointments for subsequent HPV vaccine doses is a strategy to address series completion (Szilagyi et al., 2021). Developing a designated monthly vaccine clinic and using standing orders improves vaccine administration and access efficiency (Cox et al., 2022; Nissen et

al., 2019). Recommendations for the second pillar, patient communication, include provider communication techniques and visual campaigns. Strategies focusing on professional communication are effective in increasing HPV vaccination initiation and series completion (Dempsey et al., 2018; Szilagyi et al., 2021). Using the presumptive communication approach (i.e., assumes vaccine acceptance) is a motivational interviewing technique beneficial to countering vaccine hesitancy (Bernstein et al., 2022; Dempsey et al., 2018; Kessler & Auwaerter, 2021). A similar communication strategy of introducing HPV vaccination in the same way as administering other adolescent vaccinations effectively avoids missed opportunities (Szilagyi et al., 2021). Visual vaccine campaigns, including handouts and posters in the waiting and exam rooms, support increasing immunization rates (Cox et al., 2022; Kessler & Auwaerter, 2021). Enhanced vaccination systems, the third pillar, utilize state immunization information systems (IIS) and electronic health record systems (EHR), which are valuable resources of vaccination data (Cox et al., 2022; Dempsey et al., 2018; Wells et al., 2022). These systems can facilitate the identification of patients needing vaccine appointments and follow-up reminder recalls (Cox et al., 2022; Siddiqui et al., 2022). Strategies for motivation, the fourth pillar, are varied. Identification of an immunization champion has proven successful in encouraging staff and facilitating the implementation of vaccine campaigns in clinical practices (Dempsey et al., 2018; Wells et al., 2022; Zimmerman, Raviotta, et al., 2017; Zimmerman et al., 2014). Visual displays comparing a clinic's immunization coverage of the HPV vaccine to the other adolescent vaccines are a valuable motivational technique to provide staff progress reports (Gilkey et al., 2023). Quality improvement coaching of staff, both virtually and in-person, is an effective communication method for motivation (Gilkey et al., 2023). Finally, goal setting is another beneficial strategy to motivate staff during vaccination campaigns (Gilkey et al., 2023).

The theoretical framework for this project was the Health Belief Model (HBM), a middle-range nursing theory focused on predicting health behaviors (LaMorte, 2022). The HBM was developed in the 1950s by social scientists studying preventive health behavior (Mikhail, 1981). Lewin's cognitive

psychological theory was the origin of the HBM with the premise that an individual's health decision is based on psychological readiness and a perceived cost-benefit analysis (Mikhail, 1981). The HBM development expanded to include self-efficacy, health motivation, and illness-avoidance behaviors (Rosenstock et al., 1988). Although the initial intent of the HBM was to understand individuals' engagement with preventive services, utilization of the HBM has successfully expanded to prevention measures such as immunization and health screenings (Glanz & Bishop, 2010). Using the HBM, Donadiki et al. (2014) found that students with increased perceived barriers and decreased perceived benefits to vaccination were more likely to refuse the HPV vaccine.

The HBM comprises six constructs based on the principle that health behaviors are determined by illness avoidance or health improvement coupled with the perception that preventive behaviors can benefit one's health (LaMorte, 2022). Perceived susceptibility and perceived severity refer to epidemiological measures of disease risk and virulence (LaMorte, 2022). Perceived benefits and perceived barriers assess the consequences of implemented actions (LaMorte, 2022). The final two constructs of the HBM are the cue to action, which is the impetus for action, and self-efficacy, defined as self-confidence to implement the action (LaMorte, 2022).

The HBM suggests perceptions influence actions to engage in health promotion activities. Specific to this clinical project, the HBM posited a description of HPV vaccination acceptance, or lack thereof, in South Carolina adolescents. The HBM was ideal for this project as the preventive health measure of vaccination is applicable to all six constructs. Perceived susceptibility is the risk assessment of acquiring HPV disease. Perceived severity is the medical consequences of vaccine refusal including potential infection and the sequelae of HPV-associated cancer. The perceived benefit of vaccination is the belief that vaccination will prevent infection and cancer. This construct parallels effective patient communication, the second pillar of intervention in the 4 Pillars™ Program toolkit. The perceived barriers to vaccination include the cost, time, and effort to obtain the vaccination. The first pillar of the 4

Pillars™ Program toolkit, convenience and easy access, correlates to this portion of the HBM. A desire for a positive, healthy lifestyle, as well as motivation to avoid cancer, was the cue to action. Self-efficacy was the confidence in taking action to obtain the vaccination.

The purpose of this quality improvement project was to determine if the addition of the 4 Pillars™ Program toolkit to a health clinic practice will increase adolescent HPV vaccination coverage rates by 10% over a three-month period. The adolescents were 11-17 years of age, and the health clinic was in the southeastern United States.

## Methods

The RE-AIM model guided the 4 Pillars™ Program toolkit framework for this project. Originally developed for public health, the model components include reach (R), effectiveness (E), adoption (A), implementation (I), and maintenance (M) (Glasgow et al., 2019). Using the RE-AIM model with the 4 Pillars™ Program toolkit is instrumental in increasing vaccination rates (Hawk et al., 2017; Wells et al., 2022; Zimmerman, Moehling, et al., 2017). The 4 Pillars™ Program toolkit was found in the literature to be a reliable and valid tool for improving vaccination rates (Hawk et al., 2017; Wells et al., 2022; Zimmerman, Moehling, et al., 2017; Zimmerman et al., 2014). The implementation strategies for each of the four pillars were tailored to this specific project and consistent with evidence-based best practices from the literature. The approach was based on a project timeline and a budget. Institutional Review Board (IRB) approval was obtained at the health clinic site. In contrast, a data-sharing agreement could not be secured with the facility. The project team included nurses employed at the health clinic site; however, participation was not conditional on employment.

The intervention steps for this project were supported by the toolkit pillars. The project lead initially met with the project team and site leadership staff to communicate the planned interventions. The project lead identified the project nursing team coordinator as the primary point of contact at the clinic site. Throughout the project period, the project lead and the project team coordinator were to

meet every two weeks for one hour via face-to-face or a video conferencing platform. In collaboration with the project team coordinator, the project lead established after-school teen vaccine clinics at the clinic. For the three-month project period, the teen vaccine clinics were conducted one afternoon every other week, and all teen vaccines, including HPV, Tdap, and meningococcal vaccines, were available. The project lead was to assess the HPV immunization data from the teen clinics and routine HPV immunization appointments at the clinic site. Tdap and meningococcal immunization data were also to be measured. The project lead obtained approval from site leadership to waive the administration fees at the teen clinics, like procedures conducted with other specialty clinic campaigns such as back-to-school efforts. A communication campaign targeting the adolescent population was conducted. One week before the start of the teen clinics, the project lead generated a list based on the IIS identifying patients who received their first HPV dose at the clinic site and needed a second dose of the vaccine. The project team contacted potential recipients via phone, notifying them of the teen vaccine clinics or offering an appointment to receive the second dose of the HPV vaccine. The project team coordinator also contacted local school nurses one to two weeks before the events to advertise the availability of teen clinics. The project lead developed promotional fliers for the teen clinics in English and Spanish and distributed them to the school nurses. The project team posted visual campaign materials from the Centers for Disease Control and Prevention throughout the clinic promoting HPV adolescent vaccination. The project nursing team utilized existing standing orders and motivational interviewing skills to facilitate a seamless vaccine administration process. Per clinic policy, the project team documented any decisions not to vaccinate. The project team coordinator served as the clinic immunization champion who motivated and encouraged staff throughout the project and promoted the HPV vaccination efforts.

The intended measures for this project included the aggregated HPV immunization coverage rate report and the dosage data report. The de-identified reports were to be electronically generated from the secure state immunization information system database (IIS) by the immunization data

management staff. The information in the IIS includes all administered vaccines in South Carolina for all persons. The data extracted from the IIS would have included only adolescents 11-17 years of age who received HPV vaccination at the clinic site during the project period. This age range was consistent with the ACIP recommendation for routine HPV vaccination at 11 years of age and completion of the series (Wodi et al., 2023). The state immunization division monitors the IIS registry for reliability and validity (South Carolina Immunization Registry, 1976/2019). The immunization coverage rate report was to be acquired at baseline, every other week, and ten days post-intervention. The ten-day period was necessary for the accuracy and completeness of the data as providers have ten business days to enter vaccines administered into the SIMON system (South Carolina Immunization Registry, 1976/2019). This data would have provided an outcome measure of the overall effectiveness of the toolkit intervention to increase immunization rates throughout the three-month period. The project lead was to share measure progress graphs with the project team via email or video conferencing every other week. Increasing the HPV vaccination coverage rate by 10% was the post-intervention goal for this project. The coverage rate was operationally defined as the percentage of adolescents 11-17 years of age having received two or more doses of HPV vaccine. The immunization rate report would have displayed HPV immunization coverage rate data via chart and exported to an Excel spreadsheet. For the second measure, the project lead would have acquired the dosage data report every other week and at the conclusion of the project. The dosage data was operationally defined as the number of HPV doses administered at the clinic site to adolescents 11-17 years of age. The dosage report would have shown raw numbers by aggregated age group.

Additional information was to be obtained during the project. Tdap and meningococcal dosage reports were to be generated for this population at the same intervals. Using the existing clinic form, the project team documented any decision not to vaccinate. Providing the reason for declination was optional on the form and free text. The project lead was to tally and summarize the reasons for

declination at the conclusion of the project. There was no baseline data regarding declination; the goal was to have 0% declinations during this project period. For this same population, the percentage of patients who received one or more doses of the HPV vaccine would have been obtained to account for patients initiating the HPV vaccination series. Gender and the funding sources (VFC and non-VFC) for doses administered would also have been assessed from the immunization rate report.

A chi-square test would have been conducted to determine the difference in the aggregated HPV coverage rates from baseline and post-intervention. Additional chi-square testing would have been done by comparing the HPV coverage rates throughout the intervention period. A p-value of $<0.05$ would have been considered statistically significant. Descriptive statistics would have been used to analyze gender and funding sources. Statistical analysis would have been conducted through the Statistical Analysis System (SAS). The qualitative information regarding the decision not to vaccinate data would have been reviewed for themes. Progress graphs would have been shared with the project team every two weeks via email or video conferencing, and the final results would have been shared with the project team and site leadership staff.

## Results

Six after-school teen clinics were conducted over a three-month period. The outreach efforts to school nurses and patients provided robust attendance at all six of the teen clinics. Given the strong attendance, additional interpreters were obtained for on-site assistance with non-English speaking adolescents to facilitate clinic flow. All vaccines administered were entered into the IIS. The reason for any vaccine declination was also collected per clinic policy. The project coordinator, designated immunization champion, provided encouragement to project team staff throughout the project period.

An unintended consequence of this project was the inability to obtain a data-sharing agreement with the facility. The goal was to increase HPV vaccination coverage rates by 10%. The lack of a data-sharing agreement impeded the ability to perform the planned chi-square testing of the aggregated HPV

immunization coverage rate reports and the dosage data reports to determine evidence of a coverage rate increase. Additionally, progress graphs of data could not be developed and shared with the project team as planned. Similar implementation of the 4 Pillars™ toolkit for adolescent HPV vaccination efforts found significant increases in HPV vaccination initiation and completion (Zimmerman, Raviotta, et al., 2017).

## Discussion

This project had several strengths. The multi-pronged approach of using the 4 Pillars™ Program toolkit components provided implementation organization. The ease of access using the teen clinic concept was well received by the community and staff. School nurses requested similar future vaccination clinic events. The timing of the teen clinics was advantageous as after-school hours appeared to work well for clinic attendance. The inclusion of several local school district nurses in the patient communication outreach efforts provided a targeted communication approach to the adolescent population. The school nurses and community gained from the project by providing an additional venue for their students to meet school vaccination requirements and receive the HPV vaccine. Also, the dedicated mass teen clinics alleviated existing challenges with routine clinic scheduling. The enhanced vaccination system IIS was successfully used to identify patients needing additional doses of the HPV vaccine. The identification of a clinic immunization champion for the project was also helpful in providing on-site just-in-time troubleshooting (i.e., the addition of on-site interpreters) and ongoing staff motivation for the project implementation. Staff expressed positive feedback with the team approach and patients expressed appreciation for clinic availability.

There were also limitations identified in this project. The project was conducted in only one health clinic in an urban area, limiting generalizability to a broader population. The provider's enrollment in the federal VFC program allowed for an additional reduction in the financial barrier of vaccine costs, which would not be available in non-VFC practices. Due to time constraints, there was a

limited sample size, with only six after-school teen clinics conducted in a limited three-month period. The information captured regarding reasons for vaccine declination was limited only to those adolescents attending the teen clinics and was not reflective of those adolescents who did not attend the clinic. Focusing on the completion of the HPV series, the operational definition of coverage rate included adolescents 11-17 years of age having received two or more doses of HPV vaccine. As the HPV vaccine can be given as early as 9 years of age, the operational coverage rate definition did not include persons initiating the HPV vaccination series or those vaccinated younger than 11 years of age.

There are also patient and system-level impacts from this project. For those completing the HPV vaccination series, the benefits include the prevention of cancers, financial burdens, and detrimental psychological implications of the disease (Shapiro, 2022). The system-level impacts of this project include the foundation for expanding vaccination partnership efforts between the health clinics, the local school districts, and school nurses. Additionally, this project exemplifies a planned approach to meet the Healthy People 2030 goal of 80% vaccination. This project can also serve as a pilot for other health clinics to utilize the 4 Pillars™ Program toolkit interventions to increase HPV vaccination.

## Conclusion

For future HPV vaccination initiatives, this project is sustainable using the 4 Pillars™ Program toolkit, as the implementation interventions can easily be tailored depending on the needs and capacity of the clinic site. For this project, the implementation strategy providing a waiver of the vaccine administration fee removed a financial barrier for vaccine recipients; however, this aspect may not be sustainable for the practice due to financial constraints. In this project, the implementation strategy for convenience and easy access focused on the hours of operation in conducting after-school clinics. In the future, this implementation strategy may be addressed by conducting mobile clinics to improve access. The toolkit could also be used in designated “Back to School” vaccine initiatives to increase vaccination rates for school-required vaccinations.

Future scholarly work includes using the interventions of the 4 Pillars™ Program toolkit in a variety of practice types, including pediatric, family, and public health settings. Additional collaborations with pediatric hospitals and oncology healthcare specialists would provide additional community resources to support HPV vaccination efforts. Dissemination of this project can provide implementation strategies that can be used by nurses who want an organized approach to immunization strategies to increase HPV vaccination coverage rates. The overall organization of this project using the 4 Pillars™ Program framework and the unique intervention strategies can be shared with healthcare providers in educational venues such as immunization coalition meetings. The results of this project will be presented to the Director of Nursing at the facility.

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**Appendix A: Evidence Table**

Among adolescent patients 11-17 years of age in a health department clinic (P), what is the impact of adding a vaccine program toolkit (I) to the current practice (C) on human papillomavirus vaccination rates (O) over three months (T)?

| Brief reference (author, date, title) Evidence Level & Quality | Design (descriptive, systematic review, observational, etc.) | Size, Population, & Setting | Purpose, Objective, & Outcome | Strengths / Weaknesses | Results, Conclusions, or Key Findings | Themes (for synthesis) |
|---|---|---|---|---|---|---|
| **Article: 1**<br><br>Dempsey et al., 2018. Effect of a health care professional communication training intervention on adolescent human papillomavirus vaccination.<br><br>Evidence Level: I<br><br>Quality: Good | RCT: Cluster, duration 12 months<br><br>Theoretical Framework: Precaution-Adoption-Process Model | 16 practices (4 family/ 12 pediatrics), 188 medical professionals.<br><br>16000 adolescents (8000 per arm)<br><br>Denver, CO, Metropolitan | To determine the effect of a 5-component health care professional HPV vaccine communication intervention<br><br>1° objective: change in adolescents initiating (≥1 dose) HPV vax<br><br>2° objective: uptake of MenACWY and Tdap<br><br>3° objective: completion of HPV series (≥3 doses)<br><br>IIS used<br><br>Fact sheet, parent education website, disease images, decision aid, communication training | Strengths<br>Statistically significant ($p < 0.001$)<br><br>Public and private practice sites<br><br>Specified specific strategies that were most used.<br><br>Weaknesses<br>Less effective in public clinics as compared to private practice.<br><br>Effect of having immunization champion was not assessed.<br><br>Single geographic area may limit generalizability | Initiating HPV series increased 11.3%, 9.5 PP for intervention group – stat sig.<br><br>Completing HPV series “stable” in both intervention and control groups.<br><br>Reduction in missed opportunities at WCC but not for sick visits – stat sig (OR, 0.61; 95% CI, 0.54-0.69)<br><br>98% healthcare professionals likely to continue use of fact sheets and 91% likely to continue communication techniques.<br>Analysis Plan<br>Intent-to-treat analysis and generalized linear mixed models | Multi-strategy/ intervention system<br><br>Motivational interviewing<br><br>Adolescents 11-17 years<br><br>IIS<br><br>Provider communication (presumptive approach)<br><br>WCC vs. Sick Visit |

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| **Article: 2**<br><br>Gilkey et al., 2023. Impact of brief quality improvement coaching on adolescent HPV vaccination coverage: A pragmatic cluster randomized trial<br><br>Evidence Level: I<br><br>Quality: High | RCT: Cluster, pragmatic, 12 months<br><br><u>Theoretical Framework</u>: Not included | 224 primary care practices in three states (IL, MI, WA) with adolescent patients 11-17.<br><br>Assigned to intervention (in-person clinics or virtual clinics) or control clinics. | To determine the effect of enhanced HPV vax-specific QI coaching during VFC-IQIP visit delivered in-person or virtually.<br><br>Health department staff implemented intervention.<br><br>QI coaching intervention produced small long-term improvement in HPV vax.<br><br>In-person and virtual coaching viable options for provider intervention.<br><br>1°: Initiation change 11-12 years of age<br><br>2°: Initiation change 13-17 years of age | <u>Strengths</u><br>Large, multistate sample.<br><br>Integrated into existing practice of VFC-IQIP visits to vaccine coordinators.<br><br>Clinics similar to national average – generalizable findings.<br><br>Use of IIS<br><br><u>Weaknesses</u><br>IIS limited data on demographics<br><br>Study done prior to COVID so virtual aspect less familiar than current. | HPV initiation higher in intervention group (both in-person and virtual) by 1.2% for 11-17 year old.<br><br>Both in-person and virtual should be considered for outreach efforts to increase HPV vax.<br><br><u>Analysis Plan</u><br>Mixed level Poisson regression. Two tailed tests with alpha = 0.05. | Adolescents 11-17 years<br><br>IIS<br><br>Health Department staff (VFC-IQIP visits with providers)<br><br>Intervention: In-person and virtual coaching |

Among adolescent patients 11-17 years of age in a health department clinic (P), what is the impact of adding a vaccine program toolkit (I) to the current practice (C) on human papillomavirus vaccination rates (O) over three months (T)?

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| **Article: 3**<br><br>Hawk et al., 2017. Using a mixed methods approach to examine practice characteristics associated with implementation of an adult immunization intervention using the 4 pillars™ practice transformation program.<br><br>Evidence Level: I<br><br>Quality: Good | RCT: Mixed-Methods evaluation<br><br><u>Theoretical Framework</u>: RE-AIM model (evaluation framework) | 24 primary care sites (intervention group year 1, then control group year 2 received intervention).<br><br>11 practices completed intervention with adult patients. | To determine the effect of practice characteristics on the implementation of the 4 Pillars™ program (toolkit).<br><br>Practices scored for readiness to implement practice change as high to low implementer (4 types).<br><br>High implementers used the most 4 Pillars™ strategies as compared to low implementers. | <u>Strengths</u><br>Statistically significant results<br><br>Assessed both private and public clinic sites.<br><br><u>Weaknesses</u><br>Limited generalizability related to the limited number of practices in each category.<br><br>Interviews were conducted by one researcher. | Practice characteristics are related to changes in immunization rates.<br><br>Assessment of practice typology prepares for implementation of 4 pillars™ program.<br><br>High implementer practices significantly increased influenza update (3.0 PP) and Tdap (9.3 PP).<br><br>Public/ University practices significantly increased Tdap (6.5 PP)<br><br><u>Analysis Plan</u><br>Paired samples t-test (alpha 0.05) | 4 Pillars™ Program toolkit<br><br>Adult immunization<br><br>Practice readiness for change<br><br>RE-AIM model |

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| **Article: 4**<br><br>Perkins et al., 2020. Improving HPV vaccination rates: A stepped-wedge randomized trial.<br><br>Evidence Level: I<br><br>Quality: High | RCT: stepped-wedge (pre-intervention, intervention, and postintervention)<br><br><u>Theoretical Framework</u>:<br>Not included | 5 pediatric and/or family practice sites with adolescents 9-17 years of age.<br><br>Participants were clinicians.<br><br>Total 16,136 adolescents' data was included in analysis. Equal male and female, racially diverse, >80% Medicaid or subsidized insurance.<br><br>Clinic sites in Boston – safety-net hospital and FQHCs. | To determine the effect of the Development of Systems and Education for Human Papillomavirus Vaccination (DOSE HPV), a multilevel 7 session program intervention, on vaccine series initiation and completion.<br><br>1° Outcome: likelihood that a pt due HPV vax would receive vax at visit<br><br>2° Outcome: rate of completion before 13th birthday<br><br>Consider initiation before age 11 | <u>Strengths</u><br>DOSE HPV interventions allow for sustained, system-level changes that can be integrated into existing clinical processes.<br><br>One of few studies showing sustained improvement 6-18 months post-intervention.<br><br>Statistically significant ($p<0.001$)<br><br><u>Weaknesses</u><br>Limited geographic scope<br><br>Population low income, minority, urban<br><br>Baseline vax rate high | Likelihood of vaccination increased >10 PP and completion increased by 4 PP ($p<0.001$).<br><br>Initiation coverage increase from 75% (preintervention), 84% (intervention), and 90% (post-intervention) ($p<0.001$)<br><br>Series completion increased from 60% (preintervention), 63% (intervention), and 69% (post-intervention) ($p<0.001$)<br><br><u>Analysis Plan</u><br>Longitudinal generalized linear models, regression | Multi-strategy system<br><br>Children/ Adol: 9-17 years of age<br><br>Public site: FQHC<br><br>Sustained improvement<br><br>Motivational interviewing<br><br>Initiating before 11 years |

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| **Brief reference (author, date, title) Evidence Level & Quality** | **Design (descriptive, systematic review, observational, etc.)** | **Size, Population, & Setting** | **Purpose, Objective, & Outcome** | **Strengths / Weaknesses** | **Results, Conclusions, or Key Findings** | **Themes (for synthesis)** |
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| **Article: 5**<br><br>Szilagyi et al., 2021. Effect of training pediatric clinicians in human papillomavirus communication strategies on human papillomavirus vaccination rates.<br><br>Evidence Level: I<br><br>Quality: Good | RCT: Cluster, duration 6 months<br><br><u>Theoretical Framework</u>: Not included | 48 AAP pediatric practices over 19 states: 24 intervention sites (188 clinicians) and 24 control sites (177 clinicians).<br><br>Participants were clinicians. | To determine the effect of online communication training for clinicians on adolescent missed opportunities for HPV vaccination rates at WCC and acute visits.<br><br>Intervention: 3 online modules to improve provider communication skills and weekly Quick Tips text messages.<br><br>1°: Missed opportunities to vax (visit level outcome)<br><br>2°: Initial and subsequent HPV vax (person level outcome) | <u>Strengths</u><br>Large number of practices improving statistical power.<br><br>Scalable as the number of modules and text messages can be increased or decreased.<br><br><u>Weaknesses</u><br>Potential selection bias<br><br>No data collected on race/ethnicity<br><br>May not be generalizable to all adolescent practices.<br><br>May have greater effect in settings with lower baseline HPV vax rates. | Intervention improved HPV initiation only (not subsequent doses): intervention group 3.4 PP more improvement in initiation of HPV vax than controls (95% CI)<br><br>Reduced missed HPV vax opportunities intervention group 6.8 PP more at WCC than controls (95% CI)<br><br>Suggest a combination of interventions might have optimal effect.<br><br><u>Analysis Plan</u><br>Logistic regression | Provider communication<br><br>“Same way, same day” approach<br><br>Missed vaccine opportunities<br><br>HPV initiation<br><br>Adolescent WCC – 11 – 17 years of age<br><br>Single intervention, suggest need combination |

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| **Article: 6**<br><br>Zimmerman et al., 2017. Improving adolescent HPV vaccination in a randomized controlled cluster trial using the 4 pillars™ practice transformation program.<br><br>Evidence Level: I<br><br>Quality: High | RCT: Cluster, duration 9 months<br><br><u>Theoretical Framework</u>: Diffusion of Innovations Theory (intervention design) and RE-AIM model (use of program) | Each practice site was considered a cluster with 9 intervention sites and 11 control sites (20 total). Family, pediatric & community medicine practices in Pennsylvania.<br><br>Each site has a minimum of 50 patients 11-17 years of age and vax rates less than national average. Intervention group = 4942, control group = 5919 (10,861 total). | To determine if the 4 Pillars™ Transformation Program increased adolescent HPV, MCV and Tdap vaccination rates in primary care.<br><br>1°: vaccination rates and percentage point changes.<br><br>Each site developed interventions based on 4 Pillars™ Program.<br><br>Each site identified Immunization Champion.<br><br>Practice Transformation Dashboard (PTD) | <u>Strengths</u><br>One of few RCTs to test combination strategies to increase HPV vaccination.<br><br>Generalizability given large sample size and diversity of settings.<br><br>Statistically significant results ($p<0.001$)<br><u>Weaknesses</u><br>Randomization of practice site did not confer randomization of baseline vaccination rates, race or insurance coverage.<br><br>Length of study was 9 months (HPV series completion in 6 months) limiting some completion observation. | HPV initiation increased 10.2 percentage points (PP) intervention group compared to 7.3 PP controls ($p<0.001$)<br><br>Using >10 strategies from the 4 Pillars™ program significantly improves rate of initiation (OR = 2.06, CI – 1.43, 2.96)<br><br><u>Analysis Plan</u><br>Chi-square, descriptive analysis, post hoc comparisons, two-sided tests, regression analysis | 4 Pillars™ Program<br><br>Increase strategies (>10)<br><br>Adolescents 11-17 years<br><br>RE-AIM model<br><br>Immunization Champion<br><br>PTD |

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| **Article: 7**<br><br>Zimmerman et al., 2014. Cluster randomized trial of a toolkit and early vaccine delivery to improve childhood influenza vaccination rates in primary care.<br><br>Evidence Level: I<br><br>Quality: High | RCT: Cluster<br><br><u>Theoretical Framework</u>: Diffusion of Innovations Theory (intervention design) | 20 clusters: family/ pediatric practices (10 intervention, 10 control), VFC providers. Stratified by location (urban/ rural) and discipline (family/ peds).<br><br>Children 6 months through 18 years. | To determine the effect of the 4 Pillars™ Transformation Program and early vax supply on disadvantaged children's (6 mo – 18 yrs) influenza vaccination rates.<br><br>Interventions included: convenient service (after hours clinics, walk-ins), CDC posters, notify parents of availability of flu vax, provider prompt through EHR, assess vax status with vital signs, immunization champion | <u>Strengths</u><br>One of few studies to evaluate intervention of entire span of childhood.<br><br>Statistically sig results (P<0.034)<br><br><u>Weaknesses</u><br>Rural sites randomly assigned were two offices of same practice.<br><br>Vaccination rates did not account for vaccines given outside of the practice (i.e., flu shot obtained elsewhere). | Toolkit and provision of early flu vaccine significantly improve vax rates.<br><br>Flu vax rates of intervention group greater by 7.9 PP compared to control (4.4, p<0.034).<br><br><u>Analysis Plan</u><br>Two-level generalized linear mixed modeling, Chi-Square | 4 Pillars™ Program<br><br>Multiple strategies used<br><br>Influenza vaccine<br><br>Children/ Adol – 6 months to 18 years<br><br>Immunization champion<br><br>Walk-ins<br><br>CDC posters |

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|---|---|---|---|---|---|---|
| **Article: 8**<br><br>Abdullahi et al., 2020. Improving vaccination uptake among adolescents.<br><br>Evidence Level: II<br><br>Quality: High | Quasi-Experimental: Systematic Review<br><br><u>Theoretical Framework</u>: Not included | 16 studies (8 RCT, 4 RCT-cluster, 3 non-randomized, 1 controlled before-after).<br><br>12 USA and one each from Australia, Sweden, Tanzania, UK<br><br>Adolescent boys and girls | To assess the effects of approaches to increase adolescent vaccination.<br><br>Areas assess: Health education, financial incentives, provider prompts, Provider education with performance feedback, school-vaccination, multi-component provider intervention. | <u>Strengths</u><br>Included all known types of interventions to improve vaccination coverage.<br><br><u>Weaknesses</u><br>Studies conducted in high-income countries.<br><br>Limited cost-effectiveness information.<br><br>No equity information. | Multi-component provider intervention (educational session, repeated contacts, individualized feedback, incentives) improves uptake of HPV vax compared to usual practice (moderate certainty of the evidence).<br><br>Multi-component targeting providers and parents may improve HPV vaccine uptake.<br><br><u>Analysis Plan</u><br>Random-effects meta-analysis: Review of all studies | Multi-component toolkit<br><br>Children/ Adol: 10 – 19 years |

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| **Article: 9**<br><br>Bernstein et al., 2022. Promoting strategies to increase HPV vaccination in the pediatric primary care setting.<br><br>Evidence Level: II<br><br>Quality: Good | Quasi-Experimental: Pre/ Post test design<br><br><u>Theoretical Framework</u>: Not included | 1 private pediatric practice, 128 patients (73 pre-intervention, 55 post-intervention), USA – New England<br><br>11 and 12 year old adolescents at WCC | To assess the effects of three strategies (standardize vaccine policy, pre-visit parent email, provider communication initiative) on HPV vaccination rates.<br><br>1° aim: educate providers to promote consistent, effective vax recommendations and implement standardized policy for HPV vax.<br><br>Includes presumptive messaging. | <u>Strengths</u><br>Strategies were cost-effective<br><br>Nurse-led project<br><br>Statistically significant ($p<0.001$)<br><br><u>Weaknesses</u><br>Fewer adolescents seen for WCC (occurred during COVID).<br><br>Limited generalizability | HPV vaccination rate increased significantly from 17.8% to 63.6% ($p<0.001$)<br><br><u>Analysis Plan</u><br>Fischer exact tests to determine % of eligible patients was sig. higher after implementation. Descriptive stats for parental reasons influencing decision | Multiple interventions<br><br>Adolescents: 11-12 years old<br><br>Provider communication education including presumptive messaging.<br><br>Policy |

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|---|---|---|---|---|---|---|
| **Article: 10**<br><br>Cox et al., 2022. Improving HPV vaccination rates in a racially and ethnically diverse pediatric population.<br><br>Evidence Level: II<br><br>Quality: Good | Quasi-Experimental: pre/post<br><br><u>Theoretical Framework</u>: Not included | Academic, hospital-based clinic and a community health center in MA.<br><br>Both practices serve Black and Hispanic populations.<br><br>Hospital-based clinic serves 16000 patients age 0-21 years. Community health center serves 6000 patients 0 to 25 years. Total in study: 6779 children age 10 years and 5491 children aged 13 years who attend any visit in 6 year period.<br><br>70% public insurance. | To assess the effect of a multi-level intervention evidence-based strategies for improving HPV initiation and completion.<br><br>Strategies<br>Systems level: monthly vax clinic, reminder cards/ phone calls, use of standing orders<br><br>Provider level: Motivational interviewing training<br><br>Patient level: Visual campaign with handouts and posters in waiting and exam rooms<br><br>1°: test evidence based strategies for improving HPV vax completion | <u>Strengths</u><br>Improvements exceeded national trend data.<br><br><u>Weaknesses</u><br>No randomized controlled design<br><br>Lack of generalizability as only 2 clinics in one metropolitan area | HPV initiation by 9 years increased from 1% to 52%.<br><br>HPV vaccine completion by 13 years increased from 37% to 77%.<br><br>Hispanic children more likely to initiate and complete the HPV series.<br><br><u>Analysis Plan</u><br>Utilized MA Immunization Information System (IIS)<br><br>Rates of HPV series completion by 13 years monitored using a control p chart. | Multilevel intervention approach (system, provider, patient)<br><br>Motivational interviewing<br><br>Reminder cards<br><br>Visual Campaign/ posters<br><br>IIS<br><br>Children/ Adol: 9 years and 13 years of age |

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| **Article: 11**<br><br>Kessler & Auwaerter, 2021. Strategies to improve human papillomavirus (HPV) vaccination rates among college students.<br><br>Evidence Level: II<br><br>Quality: Good | Quasi-Experimental: intervention and control with no randomization.<br><br><u>Theoretical Framework</u>: Not included | John's Hopkins college students (18-26 years old) visiting college health center.<br><br>Historical control group (2372), intervention (2479) | To determine the effect of the "HPV Campus vaccination campaign toolkit" on HPV vaccination rates in college health center.<br><br>1°outcome: HPV vax rate who received at least one dose<br><br>2° outcome: HPV vax rate per visit | <u>Strengths</u><br>Providers educated on use of presumptive recommendation.<br><br>Use of EMR form to trigger provider conversation.<br><br>Yard sign marketing materials.<br><br>Significant results ($p<0.001$)<br><br><u>Weaknesses</u><br>Student health center did not accept all insurance limiting sample.<br><br>Some students did not complete HPV vax history on pre-entrance health form. | Use of the toolkit increased HPV vaccination rates from 12.2% baseline to 20.8% ($p<0.001$)<br><br>Vax rate per visit increased 4.4% to 6.7%<br><br><u>Analysis Plan</u><br>Comparison testing not specified. | Multi-strategy vaccine toolkit<br><br>College students (18-26 years)<br><br>Presumptive recommendation from provider<br><br>Signage |

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| **Article: 12**<br><br>Loskutova et al., 2021. Evaluating a web-based adult toolkit for primary care physicians.<br><br>Evidence Level: II<br><br>Quality: Good | Quasi-experimental: pre and post test design<br><br><u>Theoretical Framework</u>: Not included | 97 providers from 6 practices (US: 2 Southeast, 2 Midwest, 1 Northeast, 1 Pacific Northwest).<br><br>"User" group and "Non-User" groups designated<br><br>Adult patients with ADHD | To assess the effect of the "AAFP Adult ADHD Toolkit" | <u>Strengths</u><br>High user satisfaction with toolkit<br><br>Simple, flexible, expedient toolkit allows for adoption into clinic practice routines.<br><br><u>Weaknesses</u><br>Limited generalizability due to only 6 practices in study. | 87% of providers reported toolkit addressed most of their needs relative to dx, treatment and management of Adult ADHD.<br><br>Baseline to midpoint increases: Knowledge (3.0 to 3.6), resources (2.9 to 3.3), management of ADHD (2.7 to 3.2).<br><br>Adding toolkit to routine care can increase healthcare professional knowledge.<br><br><u>Analysis Plan</u><br>Regression analysis, t-tests, mixed ANOVA | Successful use of toolkit<br><br>Adults ADHD |

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| **Article: 13**<br><br>Nissen et al., 2019. Increasing rates of human papillomavirus vaccination in family practice: A quality improvement project.<br><br>Evidence Level: II<br><br>Quality: Low | Quasi-experimental: pre/posttest design QI project<br><br><u>Theoretical Framework</u>: Not included | 39 clinics (7 family medicine Year 1 and 32 primary care Year 2)<br><br>Patients: 11-26 years of age<br><br>Location: South Dakota, one health system | To assess the effect of three evidence-based interventions (reminder/ recall, education for staff, & provider assessment and feedback) on HPV vaccination rates.<br><br>Goal was to increase completion of HPV vax and decrease the percentage of patients with zero doses of HPV<br><br>Interventions: client reminders, provider education, standing orders | <u>Strengths</u><br>Impact of multi-component interventions.<br><br><u>Weaknesses</u><br>No statistical analysis was discussed.<br><br>One healthcare system – limited generalizability. | HPV completion rates increased 13%<br><br>Zero HPV dose decreased 22% year 1 and 10% year 2.<br><br><u>Analysis Plan</u><br>Not included | Multiple interventions<br><br>Persons 11-26 years of age<br><br>Reminder/ recall system<br><br>Provider education and assessment<br><br>Standing orders |

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| **Article: 14**<br><br>Siddiqui et al., 2022. Interventions to improve immunization coverage among children and adolescents: A meta-analysis.<br><br>Evidence Level: II<br><br>Quality: Good | Quasi-experimental: systematic review, meta-analysis<br><br><u>Theoretical Framework</u>: Not included | 120 studies (81 RCT, 38 quasi-experimental, 1 controlled before-after)<br><br>All are in high-income countries including USA, Canada, UK, Italy, Israel, Sweden, Australia, Belgium, Netherlands.<br><br>Children and adolescents 5-19 years of age. | To assess the effectiveness of various interventions to improve vaccination coverage for children and adolescents.<br><br>Interventions:<br>Educational<br>Reminders<br>Inter. for providers<br>School-based<br>Financial<br>Policy/ Legislative<br>Multicomponent<br>Multilevel | <u>Strengths</u><br>Variety of immunizations in each study.<br><br><u>Weaknesses</u><br>All high-income countries reduce generalizability.<br><br>All studies could not be meta-analyzed as outcomes were not reported consistently. | Multi-level interventions may improve vax coverage by 25%<br><br>Provider-specific education (13%) and reminders (15%) may improve uptake.<br><br>Multi-component interventions can improve overall vaccination coverage in this age group.<br><br><u>Analysis Plan</u><br>Meta-Analysis, Statistical heterogeneity determined by chi-square.<br><br>Quality assessment using Cochrane risk-of-bias tool and Cochrane Effective Practice and Organization of Care criteria | Multi-component interventions<br><br>Children and Adolescents: 5 to 19 years<br><br>Provider education<br><br>Reminders<br><br>All types of vaccines |

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| **Article: 15**<br><br>Wells et al., 2022. An overview of implementing an evidence based program to increase HPV vaccination in HIV community clinics.<br><br>Evidence Level: II<br><br>Quality: Low | Pre-Post intervention design<br><br><u>Theoretical Framework</u>:<br>RE-AIM | 3 HIV community clinics in Georgia.<br>365 persons living with HIV (PLWH), 18-45 years of age<br><br>Historical control group and intervention group | To determine the effectiveness of 4 Pillars program on HPV vax initiation rate and HPV vax completion rate.<br><br>Used IIS (GRITS) system<br><br>1° outcome: increase HPV initiation<br><br>2° outcome: increase HPV completion | <u>Strengths</u><br>Use of Immunization champion.<br><br>Pre and post intervention strategies.<br><br><u>Weaknesses</u><br>Proposed study only<br><br>Only PLWH/ HIV clinics – limitation | Proposed study only – conclusions cannot be drawn<br><br>Useful to show study methods consistent with 4 pillars program<br><br><u>Analysis Plan</u><br>One-sample binomial exact test<br><br>Chi-square to compare the rate change between control and intervention<br><br>Paired tests (t-tests, McNemar). | 4 Pillars™ Program<br><br>Immunization Champion<br><br>RE-AIM<br><br>HIV clients/ adults: 18 – 45 years of age<br><br>IIS |

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| **Article: 16**<br><br>Zimmerman et al., 2017. Using the 4 pillars™ practice transformation program to increase adolescent human papillomavirus, meningococcal, tetanus-diphtheria-pertussis and influenza vaccination.<br><br>Evidence Level: II<br><br>Quality: Good | Quasi-experimental: pre/ post study<br><br><u>Theoretical Framework</u>: Diffusion of Innovations theory | 11 pediatric and family practice sites (*prior control group from RCT cluster trial*).<br><br>9473 adolescents, 11-17 years of age at baseline. | To determine if the 4 Pillars™ Transformation Program increased adolescent HPV, MCV and Tdap vaccination rates in primary care.<br><br>Practice Transformation Dashboard (PTD) | <u>Strength</u><br>Significant results ($p<0.001$)<br><br>Intervention shown previously to be effective in adults and adolescents.<br><br>Practices used the same EHR, enabling consistency for reporting.<br><br><u>Weaknesses</u><br>Pre/post design (parent study RCCT)<br><br>Single geographic region – limited generalizability.<br><br>As this was conducted one year after group was control, some of the vax can be attributable to increased age. | HPV vax initiation rates increased 17.1 PP.<br><br>HPV vax completion rates increased 14.8 PP.<br><br>Statistically sig. results ($p < 0.001$)<br><br><u>Analysis Plan</u><br>Descriptive analysis for demographic characteristics.<br><br>Paired t-tests and one-way ANOVA | 4 Pillars™ Program<br><br>Adolescents: 11-17 years of age<br><br>Immunization champion<br><br>PTD |

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| **Article: 17**<br><br>Hempel et al., 2019. Quality improvement toolkits: Recommendations for development.<br><br>Evidence Level: IV<br><br>Quality: High | Expert Panel review<br><br><u>Theoretical Framework</u>: Not included | 44 publications and 27 toolkits reviewed by panel.<br><br>Publications from Web of Science.<br><br>Panel comprised of healthcare stakeholders including developers, users and disseminators of toolkits. | To establish recommendations and suggestions for the content, development and evaluation of healthcare quality improvement toolkits.<br><br>Activities included literature review, pre/ post-panel survey, in-person meeting, | <u>Strengths</u><br>Diverse set of panelists with potentially conflicting viewpoints.<br><br>Consensus methods were anonymous to avoid “group think”<br><br><u>Weaknesses</u><br>Small number of panel participants. | Established a set of recommendations and suggestions to evaluate toolkit content, development and evaluation.<br><br>Toolkits are useful to effectively disseminate interventions and best practices in healthcare.<br><br><u>Analysis Plan</u><br>Modified Delphi process | Standardized review of toolkits<br><br>Toolkits useful in healthcare interventions. |

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| **Article: 18**<br><br>Hempel et al., 2019. Spread tools: a systematic review of components, uptake, and effectiveness of quality improvement toolkits.<br><br>Evidence Level: IV<br><br>Quality: Good | Summary Findings of QI Toolkit reviews<br><br>Theoretical Framework: Quality Improvement Theory | 77 studies involving 72 toolkits.<br><br>Studies obtained from PubMed, CINAHL, Web of Science from 2005-2018 | To summarize evaluations of toolkits used to improve healthcare quality.<br><br>4 Pillars™ included in the review from two studies. | <u>Strengths</u><br>Used consistent definition of QI to review all.<br><br>Various toolkits assessed all related to healthcare.<br><br><u>Weaknesses</u><br>No study met all QI-MQCS criteria<br><br>Large variations in utility of toolkit component ratings<br><br>No standard definition of toolkit so definition was "self applied"<br><br>Limited generalizable results (only searched for "toolkit") | Satisfaction with toolkits high.<br><br>Usefulness of individual components variable.<br><br>4 Pillars™: Improved efficiency of vaccinations. Use of toolkit increased vaccination rates.<br><br><u>Analysis Plan</u><br>Used QI-MQCS criteria for evaluation (appraisal tool for QI publications) | 4 Pillars™ Program<br><br>Usefulness of toolkits |

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| **Article: 19**<br><br>Thoele et al., 2020. Development and use of a toolkit to facilitate implementation of an evidence-based intervention: A descriptive case study.<br><br>Evidence Level: V<br><br>Quality: High | Descriptive Case Study<br><br>Theoretical Framework: Not included | Investigators and site coordinators from 14 acute care hospitals in Midwest (Indiana) | To describe the development and use of a toolkit used in a two-year study.<br><br>Process of developing toolkit while implementing SBIRT (tool for substance abuse disorders).<br><br>Final toolkit includes 54 tools developed across three phases. | <u>Strengths</u><br>Engaged end-users in toolkit development<br><br>Comprehensive<br><br><u>Weaknesses</u><br>Lacks scientific rigor<br><br>Descriptive only limiting generalizability<br><br>Use of one healthcare system | A comprehensive toolkit was developed to provide support for implementation of SBIRT.<br><br>Toolkits are effective in supporting implementation of evidence-based interventions.<br><br><u>Analysis Plan</u><br>N/A | Toolkit development<br><br>Supports EBP strategies like SBIRT |