

**Human Papillomavirus Immunization Promotion in a Children's Clinic: A Quality
Improvement Project**

Chunliu (Grace) Gong, DNP-PNP student

Oregon Health & Science University School of Nursing

NURS 703B: DNP Project

Spring Term, 2022

Submitted to: Dr. Rana Najjar - Chair

This paper is submitted in partial fulfillment of the requirements for
the Doctor of Nursing Practice degree.

Abstract

Human papillomavirus (HPV) is the most common sexually transmitted infection in the United States (US), with about 43 million cases in 2018, many of which occur in teenagers and young adults. There are 36,500 HPV-attributable cancers annually with over 90% preventable by HPV vaccination. However, the national vaccination coverage remains below 60%. The aim of this quality improvement (QI) project was to improve HPV vaccination rates in a pediatric clinic with low HPV vaccination coverage. The project used Plan-Do-Study-Act (PDSA) methodology for improvement. It developed a patient portal (MyChart) vaccination reminder/recall system (VRRS) to send out monthly recall messages automatically to eligible patients aged 11 years and older who had MyChart. Monthly overall HPV vaccine completion rates and vaccine initiation proportions were plotted on a run chart, and a before and after analysis was conducted to determine changes compared to the baseline. Over a three-month intervention period, overall HPV vaccine completion rates ranged from 43.4% to 46.3%, lower than the baseline (50.1%); compared to the pre-intervention median (7.3%), the vaccine initiation proportion increased in December 2021 and February 2022 (7.7% and 9.6%, respectively) and decreased (6.7%) in January 2022. The pooled post-intervention HPV vaccine completion rate was significantly lower than that of pre-intervention (44.9% post-intervention vs 50.2% pre-intervention, $p < 0.0001$); there were no significant differences in the pooled vaccine initiation proportions (8.0% post-intervention vs 7.8% pre-intervention, $p = 0.8083$). This project developed a convenient MyChart VRRS but potentially impacted by COVID-19, did not increase HPV vaccination rates.

Human Papillomavirus Immunization Promotion in a Children's Clinic: A Quality Improvement Project

Problem Description

Human papillomavirus (HPV) is the most common sexually transmitted infection in the United States (US) (Centers for Disease Control and Prevention [CDC], 2021b). According to CDC (2021b), there were 43 million HPV infections in 2018, many of which occurred in teenagers and young adults; there were 13 million new cases that year. No treatment is available for the virus. HPV can cause genital warts and cancers. It is responsible for 90% of cervical and anal cancers, 70% of oropharyngeal cancers, and 60% of penile cancers (CDC, 2021a). Each year, there are about 36,500 new cases of HPV-attributable cancers affecting both women and men (CDC, 2021a). Over 90% of them can be prevented by HPV vaccination (CDC, 2020). However, only 58.6% of adolescents aged 13 to 17 were up to date on the HPV vaccine in 2020 (Pingali et al., 2021). HPV immunization in the US has fallen short of the Healthy People 2020 and 2030 goal of 80% of adolescents aged 13 through 15 years receiving recommended doses of the HPV vaccine (Office of Disease Prevention and Health Promotion [ODPHP], n.d.). The HPV vaccination rate is one of the healthcare quality measures in Oregon. In 2020, the statewide HPV initiation and completion rates were respectively 57% and 30% among adolescents aged 13, and 73% and 55% among those aged 13-17 years (Oregon Health Authority [OHA], n.d.). The children's clinic where this quality improvement (QI) project was conducted is a nonprofit healthcare facility providing primary care services to publicly insured, uninsured, and privately insured children. The HPV vaccination rates at the clinic are much lower than the state level. In 2020, only 41% of patients aged 13 years initiated the HPV vaccine and 19% completed it. The

clinic wanted to implement effective interventions to improve HPV vaccination rates in adolescents aged 11 years and older.

Available Knowledge

Common barriers to HPV vaccination include lack of information about HPV and the vaccine, parental vaccine safety concerns, their concern that vaccination will encourage sexual activity, and lack of a strong recommendation from a health care provider (Dibble et al., 2019; Loke et al., 2017; Sriram & Ranganathan, 2019). To improve HPV vaccination coverage, the CDC and the American Academy of Pediatrics (AAP) suggest healthcare professionals provide a strong recommendation for the HPV vaccine, address parental concerns, and deliver a consistent message regarding HPV vaccination (Bernstein et al., 2017; CDC, n.d.). These two organizations also recommend developing standing orders and vaccination reminder/recall systems (VRRSs) to promote HPV vaccination (Bernstein et al., 2017; CDC, n.d.). A Cochrane review and a high-quality systematic review with meta-analysis have shown that VRRSs can improve childhood vaccination (Jacobson Vann et al., 2018; Mekonnen et al., 2019). Even though some of the studies in these reviews did not focus on the HPV vaccine, they provided evidence to support the use of VRRSs in clinical practice. A recent large randomized controlled trial (RCT) showed that an autodialer centralized VRRS from state immunization information systems (IISs) had small effects on HPV vaccination rates in Colorado but no significant effects in New York (Szilagyi, Albertin, Gurfinkel, et al., 2020). The possible reason for the different results in this RCT could be that intervention was not practice-based but state IIS-based. The family contact information in the state IIS might be inaccurate, which might be associated with the different results. In contrast to this RCT, the effectiveness of practice-based VRRSs in increasing HPV vaccination has been

found in prior studies (Acampora et al., 2020; Francis et al., 2017; Kempe et al., 2016; Rand et al., 2015).

The electronic health record (EHR) patient portal reminder is relatively new. A few RCTs have found EHR patient portal reminders effective in improving influenza vaccination rates (Cutrona et al., 2018; Szilagyi, Albertin, Casillas, et al., 2020; Wijesundara et al., 2020). However, its effects on HPV vaccination have not been studied.

The Advisory Committee on Immunization Practices (ACIP) recommends routine HPV vaccination at age 11 or 12 years; it can be initiated at age 9 (Meites et al., 2016). In contrast, the AAP and the American Cancer Society support the early initiation of the HPV vaccine at age 9 (O'Leary & Nyquist, 2019; Saslow et al., 2020). The clinic follows the ACIP's recommendation. At this clinic, the HPV vaccine, together with other adolescent vaccines, is recommended for patients aged 11 years and older at their well-child checkups (WCCs). Vaccine brochures are available for patients and families in each exam room and the waiting area. Epic, an EHR system, provides prompts when an adolescent is due for the HPV vaccine. During a WCC, nurses check patients' immunization status, inform families of needed vaccines, and offer them vaccine information statements (VISs). Physicians provide immunization consultations and address guardians' concerns. Additionally, there are standing orders and nurse visits for vaccination catch-up. Patients who initiate the HPV vaccine before the age of 15 need two doses 6 to 12 months apart (Meites et al., 2016). Those starting it at 15 or older need three doses, with the second dose 1 to 2 months after the first dose and the third dose 6 months after the first dose (Meites et al., 2016). The clinic has been applying the above strategies to promote HPV vaccination but did not have a VRRS before implementing this QI project. Rather, providers and

nurses relied on parents or patients to call back to schedule appointments to complete the HPV vaccine series.

Rationale

VRRSs are evidence-based interventions for HPV vaccination promotion. Given the limited resources available to the clinic, using a patient portal VRRS instead of other commonly used reminder systems could minimize the workload and costs. Additionally, the clinic had been actively promoting MyChart, a patient portal powered by Epic, and experiencing an increase in its usage. Over half of the patients had activated MyChart by the time the QI project was planned. Thus, it was the ideal time to implement a patient portal VRRS to promote HPV vaccination. A MyChart VRRS with links to the HPV educational materials could help address the barrier related to lack of information. The Plan-Do-Study-Act (PDSA) methodology was used to guide this project and identify contextual factors affecting outcomes. It provided a strong framework for developing MyChart VRRS, testing it, analyzing the findings, and making modifications based on findings from each PDSA cycle.

Specific Aims

This QI project aimed to improve the clinic's HPV vaccination rates in comparison to the medians in the pre-intervention period. By the end of February 2022, in children aged 11 years and older, the overall HPV vaccine completion rate would increase from 50.1% to the state level of 55% and the vaccine initiation proportion would rise from 7.3% to 10%.

Methods

Context

The QI project was conducted in a busy primary care pediatric clinic of a larger healthcare system. The clinic locates in a rural area and serves over 10,000 patients. In this area,

the HPV completion rate among White adolescents has remained the lowest (OHA, n.d.). In 2020, only 44% of White adolescents completed the HPV vaccine series while 50% of Hispanic adolescents completed them (OHA, n.d.).

The clinic offers free HPV vaccines supplied by the Vaccines for Children (VFC) program to publicly insured or uninsured patients. It utilizes EHR prompts for vaccines. Other facilitators include increased MyChart usage, immunization standing orders, nurse visits for vaccination, and transportation services provided by the local coordinated care organization (CCO) to its members who need help getting to their appointments.

This clinic has three part-time and six full-time physicians, one part-time and six full-time nurses, and five receptionists. Each nurse has tasks, such as ordering vaccines or supplies, in addition to nursing roles. Insufficient staffing is one of the barriers to the project. Even though MyChart VRRS does not need receptionists or nurses to send out recall messages, it requires receptionists to schedule appointments for the HPV vaccine and nurses to administer it. Another barrier is the current COVID pandemic. Some families may not want to go to the doctor's office during the pandemic. Additionally, the clinic has been focusing on providing the COVID vaccine to patients aged 5 and older.

Intervention

The QI project used MyChart to develop a patient portal VRRS to improve HPV vaccination. Receptionists checked patients' MyChart status at each office visit and helped them or their parents sign up for it if needed to promote MyChart activation. MyChart enrollment information was also listed in the after-visit summary. A recall message was created to inform families that their child was due for an HPV vaccine with a recommendation to contact the office to schedule an appointment (see Appendix). The message included links to HPV educational

materials for parents, the VIS, and children's immunization schedules. The IT team programmed MyChart to send out automated recall messages monthly to all eligible patients aged 11 years and older who had MyChart. When families called to schedule an appointment after receiving the message, receptionists offered appropriate appointments based on whether a patient needed a WCC or a nurse visit for the HPV vaccine. During a visit for the HPV vaccine, the nurse asked patients or their parents if they had received the recall message and if the message was the reason why they were at the clinic. Because of the lack of resources, there were no other vaccine reminders for patients without MyChart. Data on the overall HPV completion rates and vaccine initiation proportions were collected at the end of each month. Given that the recommended interval between the first and the last HPV vaccine is 6 months, the original plan was to run the project from September 1st, 2021, through February 28th, 2022 ((Meites et al., 2016).

Study of the Intervention

We kept track of changes in HPV vaccine uptake. A copy of physicians, nurses, and receptionists' monthly schedules was kept to observe staffing and schedule changes, and trends in COVID cases and deaths in the local area were monitored because these changes could affect the delivery of healthcare services and the implementation of the project. Additionally, we used field notes to monitor for any other unexpected effects.

Measures

This QI project aimed to improve HPV vaccination rates. The outcome measures included monthly HPV vaccine overall completion rates, which were auto-generated from Epic to evaluate the percentage of patients who finished the vaccine series, and the initiation proportion, which was calculated as the number of patients receiving the initial dose of the HPV vaccine over the number of patients who were eligible for it each month. The adolescent WCC

rate was expected to increase with the intervention. Thus, the percentage of adolescents aged 11-21 who had an annual WCC together with MyChart activation rates were process measures. They were also auto-generated from Epic. For comparison, baseline data on the same measures had been gathered before the start of the intervention. Process measures also included the number of patients who received the recall message via MyChart and the number of patients reporting getting the vaccine because of the message. Nurses tracked the number on a sheet without patient demographics whenever they gave an HPV vaccine during the intervention period. Since the clinic requested the recall message to be implemented, providers' attitudes and communication strategies were not measured in this PDSA cycle.

Analysis

Monthly HPV vaccine overall completion rates, vaccine initiation proportions, adolescent WCC rates, and MyChart activation rates were plotted on a run chart to detect improvement compared to the baseline. A before and after analysis was conducted to compare the pooled overall vaccine completion rate and initiation proportion in the intervention period to the pre-intervention period. A two-sample test of proportion was used for evaluating pre-post change. $P < .05$ was considered statistically significant. In patients receiving the HPV vaccine during the intervention period, the percentage of patients who got the vaccine because of the recall message was calculated.

Ethical Considerations

This QI project applied an evidence-based intervention to clinical practice to improve HPV vaccination. MyChart had been used as a communication tool between families and providers in this clinic. Sending a recall message via MyChart was safe and secure. It would not cause any harm. Even though the invention only targeted patients with MyChart access, it would

still benefit about half of the eligible patients based on the current MyChart activation rate. Continuing efforts were made to promote MyChart enrollment at the same time so that the intervention could benefit more patients. MyChart could not be set in families' preferred language rather than English. Sending messages in English could disadvantage and potentially create gaps in care for patients and families with limited English proficiency (LEP). Future PDSAs would explore ways to address language and internet access issues. This project was deemed quality improvement by Oregon Health & Science University (OHSU) Institutional Review Board. We had no conflicts of interest to declare.

Results

Evolution of the Intervention

The COVID pandemic increased the IT team's workload and delayed the development of the automated VRRS triggering modifications to project implementation and timeline. Instead of 6 months of data collection starting in September, the intervention ran from December 2021 to February 2022. After discussions with the call center, it was decided it would be more appropriate to send the recall message on the 16th of each month to avoid high call volume in the first half of the month.

Process Measures and Outcome

Figure 1 illustrated the upward trend of one of the process measures, MyChart activation rates, since the QI project was proposed in July. However, the uptrend did not occur in other process measures. Adolescent WCC rates were lower in the intervention period (see Figure 1). In HPV vaccine recipients assessed by nurses, 45.4% (20/44) of them had MyChart, but only 11.4% (5/44) reported receiving the recall and 4.5% (2/44) said that they got the vaccine because of the recall.

With MyChart VRRS, outcome measures of HPV vaccine completion rates ranged from 43.4% to 46.3%, lower than the median of the baseline (50.1%); the vaccine initiation proportion fluctuated from month to month. Compared to the pre-intervention median (7.3%), increased proportions were seen in December and February (7.7% and 9.6%, respectively) and a decreased proportion (6.7%) was seen in January (see Figure 2). The pooled post-intervention HPV vaccine completion rate was significantly lower than that of pre-intervention (44.9% post-intervention vs 50.2% pre-intervention, $p < 0.0001$); there was no significant difference in the pooled vaccine initiation proportion (8.0% post-intervention vs 7.8% pre-intervention, $p = 0.8083$) (see Table 1).

Noting that January experienced the highest completion rate but the lowest initiation proportion and February had the lowest completion rate but the highest initiation proportion in the intervention period, the vaccine uptake proportion, the percentage of eligible patients receiving either an initial or a noninitial dose, was calculated to further evaluate the effect of the intervention on the vaccine uptake. The uptake proportion also decreased, with the lowest uptake in January (see Figure 2). The pooled post-intervention HPV vaccine uptake proportion was significantly lower than that of pre-intervention (11.9% post-intervention vs 16.2% pre-intervention, $p < 0.0001$) (see Table 1).

Contextual Elements and Associations

The number of available appointments and staffing due to the pandemic and the winter weather impacted the outcomes of this project. WCC rates and vaccination rates almost always moved in the same direction and they both decreased in the intervention period as the Omicron variant started to surge in the US (see Figures 1 and 2). As the Omicron surge peaked in January, the HPV vaccine uptake reached the lowest percentage (9.4%) (see Figure 2).

Unexpected Consequences

It took longer than expected to build MyChart VRRS. During data collection, unexpected issues were found. Patients with MyChart who were one month or less overdue for the HPV vaccine did not get the recall. Instead of getting a monthly recall, more than half of patients got only one recall message in three months. A small percentage of them did not check MyChart messages even though a recall was sent to them. Additionally, a couple of patients called after receiving the recall message but could not get an appointment for the vaccine until March.

Details about missing data

The project did not have a fixed sample size since the number of patients aged 11 to 21 varied every month. Rather than tracking each participant, auto-generated data from Epic was used. We could not follow up on patients transferring in and out of the system. But they impacted both pre-and post-intervention periods. Nurses administered 174 HPV vaccines from December 2021 to February 2022, with 129 doses given after the first recall sent on December 16th, 2021, but asked only 44 patients about the recall. To recover the number of patients nurses forgot to ask and those who did not get the recall due to technical issues, a chart review was performed and found that 36% (46/129) of patients who got the vaccine after the first recall had MyChart. Of the 46 patients, only 48% (22/46) had received the recall and 17% (8/46) made WCC appointments before the message was sent.

Discussion

Summary

This was the first QI project utilizing a patient portal VRRS for HPV vaccination promotion and it involved all eligible patients rather than a small convenient sample size. A secure, convenient, and low-cost MyChart VRRS was implemented in a busy clinic, but it was not able to meet the project aims to increase overall HPV vaccine completion rates to 55% and

vaccine initiation proportions to 10%. With MyChart VRRS, the HPV vaccine uptake and the overall HPV completion rate decreased and there was no significant effect on the vaccine initiation proportion. This project demonstrated that contextual factors had a significant impact on the implementation and outcomes of a QI intervention and provided data for the next PDSA cycle.

Interpretation

In this QI project, the overall HPV completion rate was significantly lower than the baseline and there was no significant difference in the vaccine initiation proportion before and after MyChart VRRS implementation. These findings were contrary to studies that showed VRRSs were generally effective (Acampora et al., 2020; Francis et al., 2017; Kempe et al., 2016; Jacobson Vann et al., 2018; Rand et al., 2015). Even though an RCT showed no significant effect of the VRRS used in the study on HPV vaccination initiation or completion rates in one out of the two states where the study was conducted, it did not demonstrate decreased vaccination rates (Szilagyi, Albertin, Gurfinkel, et al., 2020).

We speculate multiple reasons for the negative findings of this project. First, some patients may not have wanted to go to a doctor's office solely for an HPV vaccine during the intervention period when new COVID cases dramatically increased due to the new Omicron variant. This theory is supported by evidence from a recent study which reveals that the HPV vaccination rates substantially decrease due to COVID; the lowest monthly vaccination rate is only 23% of the previous years' rate (Daniels et al., 2021). Even though both pre-and post-intervention periods of this project were affected by the COVID pandemic, there was a marked rise in new COVID cases, which could not have been predicted, in the intervention period.

A second possibility is the lack of nurse visits for the HPV vaccine secondary to the nursing shortage, the clinic's focus on influenza and COVID vaccination, and the clinic's closure for extra 3 days due to holidays and inclement weather during the intervention period. Two experienced nurses resigned from the clinic in the intervention period, and most of the time there were no available nurses to cover vaccination clinics. As a result, the number of available nurse visits for vaccination decreased by 50% in the intervention period. Additionally, the clinic had been using all vaccination appointments for influenza and COVID vaccines since November 2021 with HPV vaccine availability pushed back until March.

A third possible reason is that MyChart activation rates in adolescents are relatively low compared to the whole patient group. Less than half of patients aged 11 years and older have MyChart while the overall activation rate is above 60% (see Figure 1). Adolescents' authorizations are required for parents to have MyChart proxy access, which might contribute to lower MyChart activation rates in adolescents.

A fourth possibility is that the effects of MyChart VRRS have not been fully reflected in this short intervention period. The current findings were based on data collected in a three-month intervention period, which was much shorter than that of previously published studies running for at least 6 months. The clinic's WCC appointments were booked out for about two months. Given that some patients may schedule a WCC and get the HPV vaccine a couple of months after receiving the recall message, a longer post-intervention data collection period was warranted to determine the effects.

Another unexpected issue that occurred during the implementation may have impacted the project outcomes. Some patients with MyChart did not get the monthly recall message due to

technical issues. In patients who got the vaccine after the first recall sent on December 16, 2021, 46 patients had MyChart but only 22 of them received the recall.

The implementation of this QI project required the IT team to establish a MyChart VRRS and provide support to solve technical issues. However, workload and costs were minimized compared to other reminder systems since the recall was sent out automatically once it was set appropriately. The VIS linked to MyChart messages served as a reliable information source for patients and families. The intervention would not cause any harm to patients or the healthcare system. But there would be an added cost of time and transportation for patients to come to the clinic and the clinic would need to assign a nurse to cover visits for HPV vaccination.

Limitations

This project was conducted in a clinic of a larger healthcare system with an IT team available to help develop a patient portal VRRS. This may limit its generalizability to other clinics without IT support and to providers who do not use patient portals. Second, the recall message is in English only and may not benefit patients with LEP. Third, due to unexpected contextual factors, the intervention period had to be adjusted from 6 to 3 months preventing a thorough evaluation of the MyChart VRRS. Fourth, the first recall was not sent until December 16th, 2021 but post-intervention monthly data collection started on December 1st. Data collected in December included patients seen before the recall was sent. Fifth, most of the data were generated by Epic without patient demographics. It was uncertain if there were any significant demographic differences between pre-and post-intervention periods. Lastly, nurses asked 34% (44/129) of patients about the recall. We could not ascertain how many patients who were not assessed by nurses received the vaccine due to the recall. But this did not affect outcome measures.

Conclusions

This QI project added a tool, MyChart VRRS, for the clinic to promote HPV vaccination even though it did not improve HPV vaccination rates in the observed intervention period. It can be used as part of multiple component interventions for HPV vaccination promotion and provides a framework for utilizing patient portal reminders to support other health maintenance topics. Since contextual factors significantly affected the outcomes, we would recommend additional data collection for the following 3 months. Meanwhile, the IT team has been notified of the technical issues and is working on solving them. We will continue MyChart enrollment promotion. If aims are not met 3 months later, recommendations for future PDSA would be evaluating providers' attitudes and communication strategies, offering the HPV vaccine to eligible patients at each visit including sick visits when it is appropriate to do so, and exploring solutions for language and internet access issues associated with MyChart.

References

- Acampora, A., Grossi, A., Barbara, A., Colamesta, V., Causio, F. A., Calabrò, G. E., Boccia, S., & de Waure, C. (2020). Increasing HPV vaccination uptake among adolescents: A systematic review. *International Journal of Environmental Research and Public Health*, *17*(21). <https://doi.org/10.3390/ijerph17217997>
- Bernstein, H. H., Bocchini, J. A., Byington, C. L., Maldonado, Y. A., Barnett, E. D., Campbell, J. D., Davies, H. D., Lynfield, R., Bractic, J., Munoz, F. M., Nolt, D., Nyquist, A. C., O'Leary, S., Rathore, M. H., Sawyer, M. H., Steinbach, W. J., Tan, T. Q., & Zaoutis, T. E. (2017). Practical approaches to optimize adolescent immunization. *Pediatrics*, *139*(3). <https://doi.org/10.1542/peds.2016-4187>
- Centers for Disease Control and Prevention. (n.d.). *5 Ways to boost your HPV vaccination rates*. <https://www.cdc.gov/hpv/hcp/boosting-vacc-rates.html>
- Centers for Disease Control and Prevention. (2020). *Cancers caused by HPV are preventable*. <https://www.cdc.gov/hpv/hcp/protecting-patients.html>
- Centers for Disease Control and Prevention. (2021a). Cancers associated with human papillomavirus, United States—2014–2018. *USCS Data Brief*, *26*. <https://www.cdc.gov/cancer/uscs/about/data-briefs/no26-hpv-assoc-cancers-UnitedStates-2014-2018.htm>
- Centers for Disease Control and Prevention. (2021b). *Genital HPV infection - fact sheet*. <https://www.cdc.gov/std/hpv/stdfact-hpv.htm>
- Cutrona, S. L., Golden, J. G., Goff, S. L., Ogarek, J., Barton, B., Fisher, L., Preusse, P., Sundaresan, D., Garber, L., & Mazor, K. M. (2018). Improving rates of outpatient influenza vaccination through HER portal messages and interactive automated calls: A

randomized controlled trial. *Journal of General Internal Medicine*, 33(5), 659–667.

<https://doi.org/10.1007/s11606-017-4266-9>

Daniels, V., Saxena, K., Roberts, C., Kothari, S., Corman, S., Yao, L., & Niccolai, L. (2021).

Impact of reduced human papillomavirus vaccination coverage rates due to COVID-19 in the United States: A model based analysis. *Vaccine*, 39(20), 2731–2735.

<https://doi.org/10.1016/j.vaccine.2021.04.003>

Dibble, K. E., Maksut, J. L., Siembida, E. J., Hutchison, M., & Bellizzi, K. M. (2019). A

systematic literature review of HPV vaccination barriers among adolescent and young adult males. *Journal of Adolescent and Young Adult Oncology*, 8(5), 495–511.

<https://doi.org/10.1089/jayao.2019.0004>

Francis, D. B., Cates, J. R., Wagner, K. P. G., Zola, T., Fitter, J. E., & Coyne-Beasley, T. (2017).

Communication technologies to improve HPV vaccination initiation and completion: A systematic review. *Patient Education and Counseling*, 100(7), 1280–1286.

<https://doi.org/10.1016/j.pec.2017.02.004>

Jacobson Vann, J. C., Jacobson, R. M., Coyne-Beasley, T., Asafu-Adjei, J. K., & Szilagyi, P. G.

(2018). Patient reminder and recall interventions to improve immunization rates.

Cochrane Database of Systematic Reviews, 2018(1), CD003941.

<https://doi.org/10.1002/14651858.CD003941.pub3>

Kempe, A., O'Leary, S. T., Shoup, J. A., Stokley, S., Lockhart, S., Furniss, A., Dickinson, L. M.,

Barnard, J., & Daley, M. F. (2016). Parental choice of recall method for HPV

vaccination: A pragmatic trial. *Pediatrics*, 137(3). <https://doi.org/10.1542/peds.2015->

[2857](https://doi.org/10.1542/peds.2015-2857)

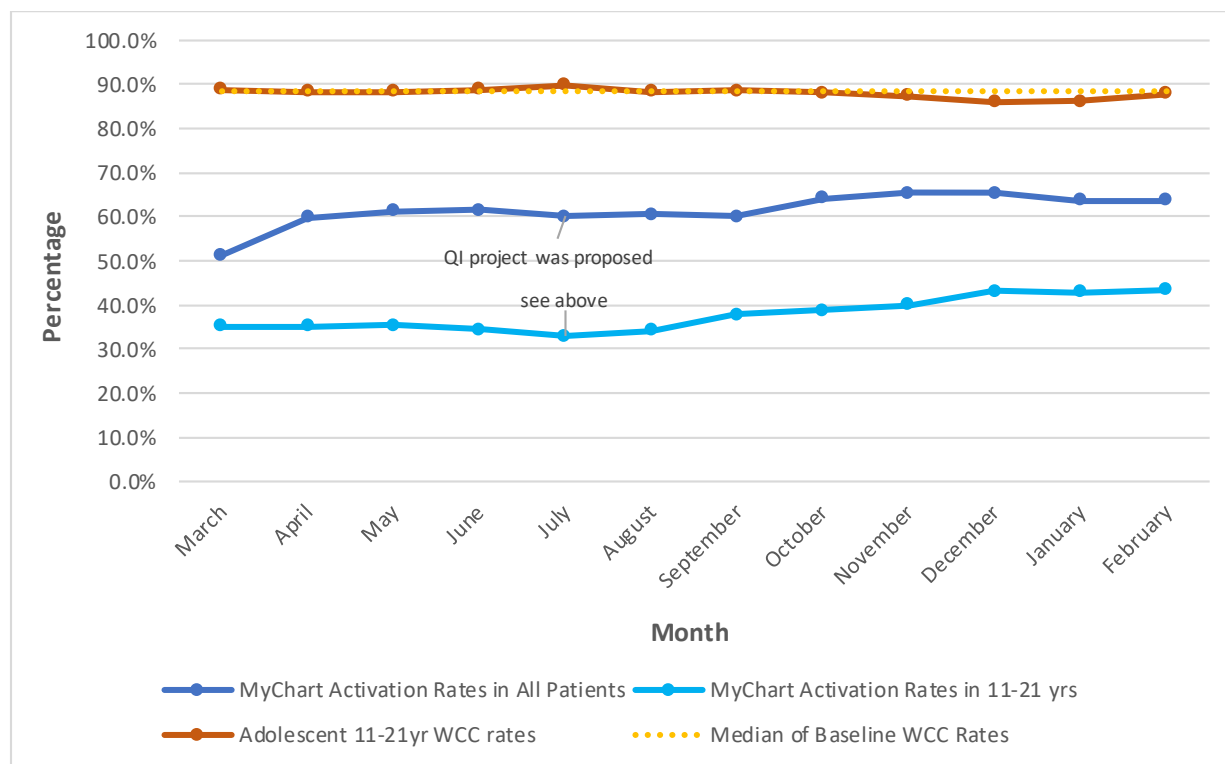
- Loke, A. Y., Kwan, M. L., Wong, Y. T., & Wong, A. K. Y. (2017). The uptake of human papillomavirus vaccination and its associated factors among adolescents: A systematic review. *Journal of Primary Care and Community Health, 8*(4), 349-362.
<https://doi.org/10.1177/2150131917742299>
- Meites, E., Kempe, A., & Markowitz, L. E. (2016). Use of a 2-dose schedule for human papillomavirus vaccination — Updated recommendations of the Advisory Committee on immunization practices. *Morbidity and Mortality Weekly Report, 65*(49), 1405–1408.
<https://doi.org/10.15585/mmwr.mm6549a5>
- Mekonnen, Z. A., Gelaye, K. A., Were, M. C., Gashu, K. D., & Tilahun, B. C. (2019). Effect of mobile text message reminders on routine childhood vaccination: A systematic review and meta-analysis. *Systematic Reviews*. <https://doi.org/10.1186/s13643-019-1054-0>
- Office of Disease Prevention and Health Promotion. (n.d.). *Healthy People*.
<https://health.gov/our-work/healthy-people>
- O'Leary, S. T., & Nyquist, A. (2019). Why AAP recommends initiating HPV vaccination as early as age 9. *AAP News*. <https://www.aappublications.org/news/2019/10/04/hpv100419>
- Oregon Health Authority (n.d.). *Oregon adolescent immunization rates*.
<https://www.oregon.gov/oha/ph/preventionwllness/vaccinesimmunization/pages/researchteen.aspx>
- Pingali, C., Yankey, D., Elam-Evans, L. D., Markowitz, L. E., Williams, C. L., Fredua, B., McNamara, L. A., Stokley, S., & Singleton, J. A. (2021). National, regional, state, and selected local area vaccination coverage among adolescents aged 13–17 years — United States, 2020. *Morbidity and Mortality Weekly Report, 70*(35), 1184–1190.
<https://doi.org/10.15585/MMWR.MM7035A1>

- Rand, C. M., Brill, H., Albertin, C., Humiston, S. G., Schaffer, S., Shone, L. P., Blumkin, A. K., & Szilagyi, P. G. (2015). Effectiveness of centralized text message reminders on human papillomavirus immunization coverage for publicly insured adolescents. *Journal of Adolescent Health, 56*(5), S17–S20. <https://doi.org/10.1016/j.jadoheal.2014.10.273>
- Saslow, D., Andrews, K. S., Manassaram-Baptiste, D., Smith, R. A., & Fontham, E. T. H. (2020). Human papillomavirus vaccination 2020 guideline update: American Cancer Society guideline adaptation. *CA: A Cancer Journal for Clinicians, 70*(4), 274–280. <https://doi.org/10.3322/caac.21616>
- Sriram, S., & Ranganathan, R. (2019). Why human papilloma virus vaccination coverage is low among adolescents in the US? A study of barriers for vaccination uptake. *Journal of Family Medicine and Primary Care, 8*(3), 866–870. <https://doi.org/10.4103/jfm.10719>
- Szilagyi, P. G., Albertin, C., Casillas, A., Valderrama, R., Duru, O. K., Ong, M. K., Vangala, S., Tseng, C. H., Rand, C. M., Humiston, S. G., Evans, S., Sloyan, M., & Lerner, C. (2020). Effect of patient portal reminders sent by a health care system on influenza vaccination rates: A randomized clinical trial. *JAMA Internal Medicine, 180*(7), 962–970. <https://doi.org/10.1001/jamainternmed.2020.1602>
- Szilagyi, P., Albertin, C., Gurfinkel, D., Beaty, B., Zhou, X., Vangala, S., Rice, J., Campbell, J. D., Whittington, M. D., Valderrama, R., Breck, A., Roth, H., Meldrum, M., Tseng, C. H., Rand, C., Humiston, S. G., Schaffer, S., & Kempe, A. (2020). Effect of state immunization information system centralized reminder and recall on HPV vaccination rates. *Pediatrics, 145*(5). <https://doi.org/10.1542/PEDS.2019-2689>

Wijesundara, J. G., Fukunaga, M. I., Ogarek, J., Barton, B., Fisher, L., Preusse, P., Sundaresan, D., Garber, L., Mazor, K. M., & Cutrona, S. L. (2020). Electronic health record portal messages and interactive voice response calls to improve rates of early season influenza vaccination: Randomized controlled trial. *Journal of Medical Internet Research*, 22(9). <https://doi.org/10.2196/16373>

Figure 1

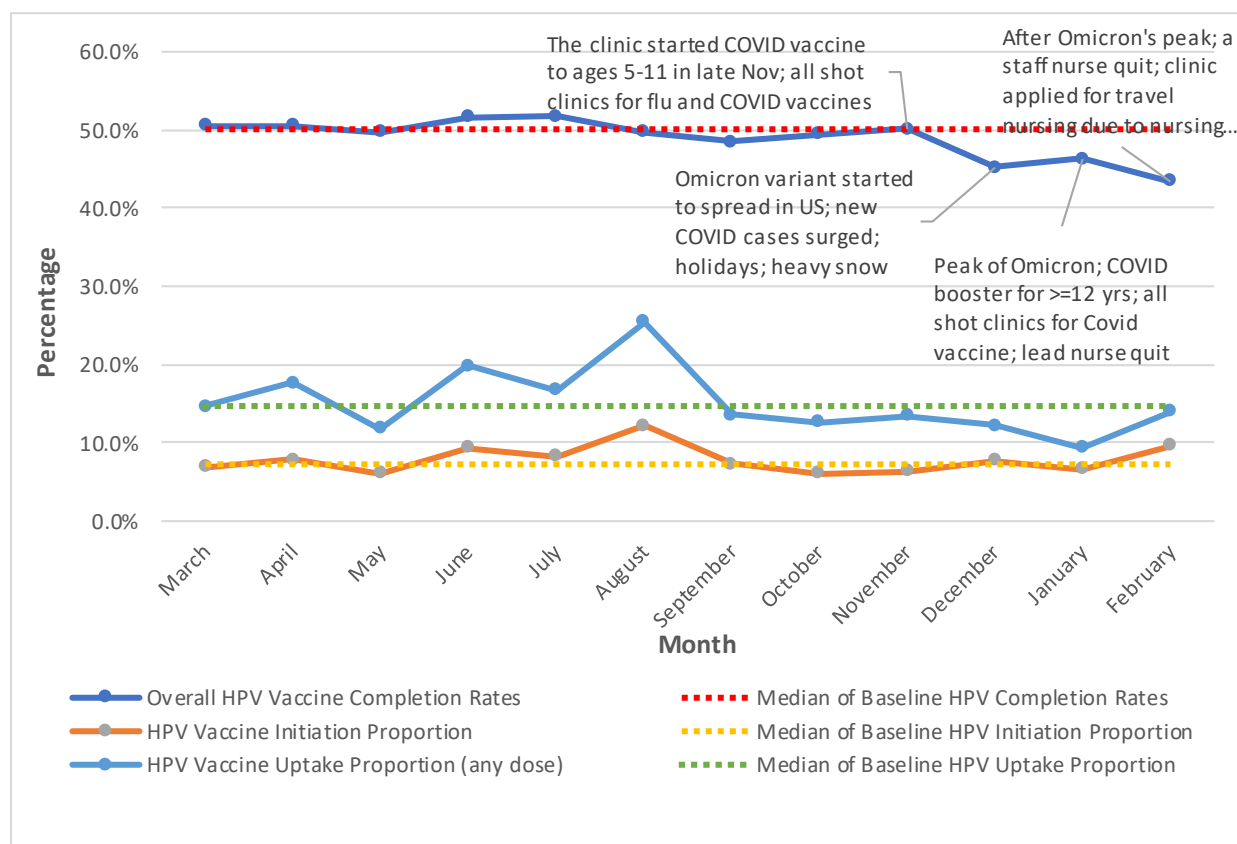
MyChart Activation and Adolescent WCC Rates from March 2021 to February 2022



Note. MyChart activation rates in all patients and those aged 11-21 are included. The QI project was proposed in July; the intervention was implemented in December, with the first recall message sent out on December 16th, 2021.

Figure 2

HPV Vaccination Rates in Ages 11-21 from March 2021 to February 2022



Note. Overall HPV vaccine completion rates refer to the percentage of patients aged 11-21 who have completed HPV among all patients aged 11-21. HPV vaccine initiation proportion is calculated as the number of patients who get the initial dose of the HPV vaccine over the number of patients who are eligible for it in a given month. HPV vaccine uptake proportion is the percentage of eligible patients receiving the HPV vaccine, either an initial or a noninitial dose. The intervention was implemented in December 2021.

Table 1*Before and After Analysis of Pooled HPV Vaccination Rates and Uptake Proportion*

Measures	Pre-Intervention	Post-Intervention	z-value	p-value
Pooled Completion Rate	50.2% (4585/9136)	44.9% (1381/3073)	5 .1	<0.0001
Pooled Initiation Proportion	7.8% (308/3947)	8.0% (117/1459)	0.2	0.8083
Pooled Uptake Proportion	16.2% (639/3947)	11.9% (174/1459)	3.9	<0.0001

Note. The pre-intervention period was from March 1st, 2021 to November 30th, 2021; the post-intervention period was from December 1st, 2021 to February 28th, 2022.

Appendix

HPV Vaccine MyChart Recall Message Template

[Office name & address:***]

[current date]:

Dear Parent or Guardian:

We are contacting you as our records indicate that your child is due for the human papillomavirus (HPV) vaccine. This vaccine helps protect against cancers caused by HPV infections. As your child's provider, we want to remind you of the importance of getting your child vaccinated to protect against serious diseases.

Please call our office at [office phone number ***] today to schedule an appointment for your child to receive the vaccine they need for the best protection. You may contact us with any questions about vaccines for your child.

To learn more about HPV and the HPV vaccine, click here:

<https://www.cdc.gov/hpv/parents/index.html>

<https://www.cdc.gov/vaccines/hcp/vis/vis-statements/hpv.pdf>

To learn more about recommended immunization schedules for children, click here

<https://www.cdc.gov/vaccines/schedules/easy-to-read/adolescent-easyread.html>

Sincerely,

[office name:***]