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Implementation and evaluation of a multilevel intervention to increase uptake of the human papillomavirus vaccine among rural adolescents

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Abstract

Purpose: Geographic disparities exist in uptake of the human papillomavirus vaccine (HPV). In 2020, the National Immunization Survey-Teen reported that adolescents living in nonmetropolitan statistical areas (MSAs) had lower HPV vaccination coverage (≥ 1 dose) compared to adolescents living in MSA principal cities. This paper describes the implementation and evaluation of a multilevel pilot intervention study to increase uptake of the HPV vaccine among adolescent patients ages 11–17 of a rural health clinic.

Methods: This parent, primary care team, and clinic multilevel pilot intervention was guided by evidence-based approaches to increase HPV vaccinations, formative research, and input from the community. HPV vaccination initiation and completion rates were analyzed at baseline and 23 months follow-up.

Findings: The proportion of adolescent patients ages 11–17 who had initiated the HPV vaccine series was significantly greater at follow-up compared to baseline, (82.7% compared to 52.4%), χ^2 (1, n = 498) = 49.2, $P < .0001$. The proportion of adolescent patients ages 11–17 who had completed the HPV vaccine series was also significantly greater at follow-up compared to baseline, (58.0% compared to 27.0%), χ^2 (1, n = 498) = 50.8, $P < .0001$.

Conclusions: The multilevel intervention significantly increased HPV initiation and completion rates among adolescent patients ages 11–17 at this rural health clinic. This study demonstrates the

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DISCLOSURES

The authors have no disclosures to report.

feasibility of utilizing a multilevel intervention to address low HPV vaccination rates among rural adolescents and the potential of employing this strategy for a large-scale randomizing-controlled trial.

Keywords

human papillomavirus vaccination; multilevel intervention; rural adolescents; rural health clinic

INTRODUCTION

Increasing uptake of the human papillomavirus (HPV) vaccine is a public health priority and is the optimal primary prevention strategy against HPV-associated cancers.[1] HPV causes about 34,000 cancers annually in the United States,[2] with HPV-associated cancers disproportionately affecting rural communities. A recent study by Zahnd et al reported that from 1995 to 2013, the incidence rate of HPV-associated cancers significantly increased in rural populations, but remained stable in urban populations (annual percent change = 0.724, $P < .05$).[3] Introduced over a decade ago, the HPV vaccine can prevent 92% of these cancer cases, and widespread adoption of the HPV vaccine has the potential to reduce HPV-associated cancer health disparities across all populations.[4] The Advisory Committee on Immunization Practices (ACIP) recommends HPV vaccination at age 11 or 12 and catchup vaccination for all persons through age 26 years.[1] Despite the public health implications of full vaccination coverage, adolescent HPV vaccination coverage for rural adolescents remains below the Healthy People 2030 goal of 80%.[5] In 2020, the National Immunization Survey-Teen reported that adolescents living in nonmetropolitan statistical areas (MSAs) had lower HPV vaccination coverage (≥ 1 dose) compared to adolescents living in MSA principal cities (68.0% vs 77.8% [−9.8 percentage points]).[6] Increasing uptake of the HPV vaccine among rural adolescents can reduce HPV-associated cancer disparities among these populations.

Lower rates of HPV vaccination coverage for rural adolescents can be attributed to a multitude of factors that includes geographical barriers,[7] limited knowledge and awareness of the HPV vaccine,[8] lack of a provider recommendation,[9] and concerns about side effects and efficacy.[10] Systematic reviews of interventions to increase HPV vaccine uptake suggest that implementing multiple strategies to address barriers at the various levels of influences (eg, community, parent, clinician, and clinic) may have greater and more sustainable effects on HPV vaccine uptake than interventions focused on a single level.[11–13] Additionally, few evidence-based HPV vaccination interventions focused on rural communities have been reported in the literature.[14] In contrast to the broader literature on HPV vaccination interventions,[11–13,15,16] a narrative review of literature reported only 15 HPV vaccination intervention research studies focused on rural US communities from 2011 to 2019.[17] Given the differences in HPV rural-urban vaccination rates[6] and disparities in HPV-associated cancers among rural communities,[3] more HPV vaccination interventions need to focus on rural adolescents.

This pilot study aimed to fill this research void by implementing and evaluating the effectiveness of a multi-level (ML) evidence-based intervention aimed at increasing HPV

vaccination coverage among rural adolescent patients ages 11–17 of a rural health clinic. This parent, primary care team and clinic ML intervention is based on: (1) a review of the literature that concluded provider and clinic-level strategies were most effective in increasing HPV vaccination rates;[11,18,19] (2) formative research that suggests a team-based clinic approach to HPV vaccination as well as the provision of an HPV educational primer for parents prior to their child's medical visit;[20] and (3) input from the community (eg, parents, clinic staff, and clinic providers). Our primary objective was to raise the HPV vaccination initiation and completion rates (52.4% and 27.0%, respectively) among adolescent patients ages 11–17 at this rural health clinic to the Healthy People 2030 goal of 80%.[5]

METHODS

Setting and participants

A rural federally qualified health center (FQHC) located in Glenn County, California participated in this study. This FQHC was selected based on an established relationship working on prior cancer control and prevention initiatives, an expressed interest from the FQHC to address low HPV vaccination rates among their adolescent patients, and grant funding. The majority of patients are from Glenn and Colusa counties (80%), while others came from other neighboring counties. Both counties are designated as rural by the US Rural-Urban Community Area (RUCA) codes.[21] RUCA codes classify US census tracts using measures of population density, urbanization, and daily commuting. Tracts with the codes 4–10 are considered rural. Glenn and Colusa counties have rural tracts with codes 7–10. Colusa and Glenn Counties combined have the highest age-adjusted HPV-attributable cancer rates in California (11.9 compared to 8.6 per 100,000).[22] In Glenn County, 32.0% of households do not have broadband internet, compared to 13.3% for California. Compared to other counties in California, Glenn County has the smallest number of physicians per 10,000 residents (2.5 physicians per 10,000 residents) and part of the county is in a health professional shortage area. Colusa County is 1 of 5 California counties where the entire county is in a health professional shortage area.[23] This Region is also home to California's largest wildfire (August Complex Fire, 2020), where 1,032,648 acres was burned, and 935 structures were destroyed.[24] This clinic employs 3.3 FTE primary care providers, 8 clinical assistants (1 registered nurse, 2 licenses vocational nurses, and 5 medical assistants), 8 operational staff (2 check in receptionists, 2 check out receptionists, 2 referral coordinators, a medical records scanner, and a records receptionist coordinator), and 5 community outreach staff. Additionally, the clinic has 10 medical examination rooms. The majority of patients (62.8%) are covered through Medi-Cal (California's Medicaid Program) and Indian Health Services, while others were covered through employer-based health insurance and self-pay. The clinic serves about 3,000 patients annually. This research was approved by the Institutional Review Board at the University of California, Davis.

Intervention

Our ML intervention was guided by evidence-based strategies known to increase uptake of the HPV vaccine[11–13,15,16,20,25] and were adapted for local context. We established a steering committee comprised of academic researchers and the clinic's Medical Director,

Quality Assurance Manager, and 2 Community Health and Outreach Directors. This steering committee convened monthly to discuss and approve proposed interventions and to review clinic HPV vaccination rates. During these meetings, the academic researchers provided overviews of appropriate evidence-based strategies for HPV vaccination and the clinic's Medical Director, Quality Assurance Manager, and 2 Community Health and Outreach Directors would provide input on the feasibility of implementing these strategies and on how these strategies would need to be tailored and adapted for their rural and Native American patients. Additionally, we convened 2 focus groups with rural Native American parents and caregivers to provide feedback on appropriate HPV vaccination messaging and education for parents and communication strategies for providers. During these sessions, parents and caregivers informed us that messaging and education for parents regarding the HPV vaccine should emphasize: (1) cancer prevention (in both boys and girls); (2) highlight the disparities of HPV-associated cancers in Native American and rural communities; and (3) that materials should have a short and long version. A short version for in office visits that is quick and easy to ready and a longer version for any parent who would like to learn more information to read at their leisure. As for communication strategies for providers, 1 participant shared that while she did get her granddaughter vaccinated at the request of the provider, she did not know why the HPV vaccine was needed. She would have liked to have known that the HPV vaccine prevented several types of cancers so that she can share that with other community members and advocate for its use. Another participant agreed and stated that while they trust their provider and followed through with the HPV vaccination recommendation, some of their community members are HPV vaccine hesitant, thus having the recommendation legitimized and advocated for by a fellow community member can assist these hesitant parents and caregivers make an informed decision. Participants also shared that a source of HPV vaccine hesitancy were other health professionals and community leaders within the town who have spoken out against the HPV vaccine. Participants suggested that providers should include presenting data on the safety and efficacy of the vaccine to address the concerns presented by these other individuals. All input from both the steering committee and community were incorporated into the final intervention activities and materials. Intervention activities occurred December 2018-May 2020. See Table 1 for ML intervention strategies.

Parent level

We created and distributed 3 HPV vaccination postcard reminders to prime families for when HPV vaccinations were due. The first postcard was a birthday postcard for patients turning 11 years of age. It contained educational information for vaccines recommended by the ACIP for inclusion in the adolescent immunization schedule for those 11–12 years of age (eg, HPV; diphtheria, tetanus, and acellular pertussis-TDAP; meningococcal-MenACWY vaccines).[26] The second postcard was designed for patients ages 11–17 who initiated the HPV vaccine series but did not complete the series with messaging emphasizing the importance of completing the series. The third postcard was for patients ages 11–17 who have not started the series with messaging focusing on the importance of starting the HPV vaccine series. The postcards were created by a marketing and communications specialist at the academic institution and included messaging on the importance of the HPV vaccine for cancer prevention. All images and messaging on the 3 postcards were vetted by the steering

committee for community appropriateness, by the Medical Director for medical accuracy, and by the clinic's media consulting company to ensure the postcards aligned with clinic branding guidelines. Working with the clinic's Quality Assurance Manager, a list of active adolescent patients was created that included: patient name, birthdate, mailing address, and HPV vaccination status. Active patients were defined as those who have had an appointment within the past 24 months. From that list, patients were classified into 3 categories: (1) patients who were about to turn 11 years old; (2) patients ages 11–17 who started the series but did not complete it; and (3) patients ages 11–17 who have not started the series. Postcards were mailed out to all active patients due for HPV vaccination according to their HPV vaccination categories.

Primary care team level

The first author delivered 3 1-hour in-service trainings to the clinic team (eg, providers, nurses, medical assistants, outreach staff, administrative staff, and front desk receptionists). The first training occurred at the beginning of the study, the second training was a refresher training 10 months into the study, and the third training occurred at the end of the study. The following topics were covered: overview of the HPV vaccine and HPV-associated cancers, the importance of reducing missed clinic opportunities for vaccination, strategies for bundling the HPV vaccine with other vaccines due at the same time, review of clinic HPV vaccinations rates, overview of HPV-associated disparities, and how to address concerns from vaccine hesitant parents. These trainings were designed to (1) educate the clinic team on the importance of HPV vaccination; (2) provide opportunities for clinic team to discuss and address challenges to recommending and administering the HPV vaccine; and (3) promote a united, clinic-wide approach to providing timely, yet strong HPV vaccine recommendations to all eligible adolescent patients.

Clinic level

The Medical Director of the clinic served as the immunization champion. He served as the clinic principal investigator and provided input on the ML intervention design, implementation, and the evaluation. During the clinic wide trainings, he facilitated the conversation among the clinic team, provided an overview of the clinic's HPV vaccination policies and procedures (eg, standing orders, age of vaccination, and electronic health system [EHS] functionality as it relates to HPV vaccination), reinforced the training messages, and provided local context to addressing clinic and patient-specific issues with recommending and administering the HPV vaccine. Resources to promote and reinforce HPV vaccination messaging (eg, HPV is cancer prevention) were also provided to the clinic. This included posters and handouts in all examination rooms and lanyards and pins for clinic staff and providers to wear.

Measures

Our primary outcomes of analyses were HPV vaccine initiation (proportion of adolescent patients ages 11–17 who received at least 1 dose of the vaccine) and HPV vaccine completion (proportion of adolescent patients ages 11–14 with 2 doses of the vaccine and the proportion of adolescent patients started the series between ages 15 and 17 with 3 doses of the vaccine) rates. To measure this outcome, data were extracted from the clinic's EHS.

Analysis

HPV vaccination initiation and completion rates were computed at baseline (April 2018) and again at 23 months follow-up (November 2020). The baseline rates were calculated utilizing a list of active adolescent patients as of April 2018. The follow-up rates were calculated utilizing a list of unique adolescent patients who had a medical visit between January 2019 through November 2020. For baseline and follow-up rates, patients were categorized as having initiated the HPV vaccine series (≥1 HPV), having completed the series, and lastly having received no doses of the vaccine. Chi-squared test was used to examine the relationship between those who initiated and completed the HPV vaccine series at baseline and at follow-up. Statistical analysis was performed using STATA v.14.[27]

RESULTS

The proportion of adolescent patients who had initiated the HPV vaccine series was significantly greater at follow-up (82.7% compared to 52.4%), χ^2 (1, n = 498) = 49.2, P < .0001. The proportion of adolescent patients who had completed the HPV vaccine series was also significantly greater at follow-up (58.0% compared to 27.0%), χ^2 (1, n = 498) = 50.8, P < .0001. See Table 2.

DISCUSSION

HPV vaccination initiation and completion rates increased significantly among adolescent patients of this rural health clinic after the implementation of the ML intervention. HPV series initiation increased by 30.3 percentage points and HPV series completion increased by 31.0 percentage points. Despite including the early months of the COVID-19 pandemic in our post intervention data collection efforts (March-November 2020), we achieved high HPV vaccination rates. The success of this pilot provides strong support for the feasibility and implementation of this approach for broader dissemination and implementation efforts to increase HPV vaccination among rural adolescents, even during the COVID-19 pandemic.

Our ML intervention included evidence- and practice-based strategies that have been shown to have an impact on HPV vaccination rates: (1) patient postcard reminders; (2) parent and clinic educational resources; (3) a clinic immunization champion; (4) a clinic-wide team-based HPV vaccination recommendation approach; (5) in-service trainings for all clinic team members; and (6) routine assessment and review of clinic HPV vaccination rates.[11–16,21,26] This study adds to the growing body of literature that suggests that the development and testing of ML and integrative approaches to address HPV vaccine hesitancy is needed to maximize impact on vaccination initiation and completion rates.[28–31] Our findings are consistent with a narrative review of HPV vaccination interventions in rural US communities, which reported that among the 12 studies using experimental designs that had positive HPV vaccination outcomes, 7 studies used ML intervention conditions.[17]

The authors attribute the significant increase in HPV initiation and completion vaccination rates to the clinic prioritizing HPV vaccination because of the strong partnership between the rural health clinic and the academic institution. This prioritization coupled with high engagement from the clinic's leadership (eg, Medical Director, Community Health

& Outreach Directors, and Quality Assurance Manager) was pivotal for reinforcing the implementation of our ML intervention and for tailoring our approach to local context. For example, during one of our primary care training sessions, a front desk staff person asked if they should be checking a patient's chart to find out if they need the HPV vaccination and as the physician champion for the study, the Medical Director was able to clarify and validate clinic vaccination policies and procedures during training sessions and encouraged clinic staff and providers alike to provide a strong HPV vaccination recommendation to all eligible adolescent patients. His support ensured that providers and clinic staff were on the same page regarding HPV vaccinations and helped create a pro-HPV-vaccination clinic culture. This finding supports research that suggest a team-based approach coupled with a vaccine champion can contribute to higher uptake of the HPV vaccine.[21,31–33]

While this study provides an anecdotal example of high engagement and cites the strong relationship between the rural health clinic and the academic institution as contributing to the success of the pilot study, future studies would benefit from a mixed methods approach to conceptualizing the nature of this dynamic partnership and assessing characteristics of high engagement. Several studies have utilized a mixed methods approach to understanding and assessing the effectiveness of community-academic partnerships.[34,35] Additionally, adaptation for local context was critical to the study's success. Our intervention strategies and materials were thoroughly vetted by both the steering committee and the focus groups to ensure cultural appropriateness for both rural and Native American patients. Future interventions should include community input through community advisory boards, focus groups, and/or key informant interviews.

Strengths and limitations

Inherent in the design of ML interventions, the components of our intervention were delivered as a package, making it difficult to know which components affected our primary outcome. Future studies should include methods and measures to assess implementation outcomes, including implementation fidelity, to ensure that the intervention is delivered as intended.

Additionally, as this was a pilot study, we had no control group to compare for intervention effects, nor did we have patient-level data at baseline to assess individual-level associations. Future studies should include collection of individual-level data at pre and post to assess associations between HPV vaccine uptake and patient sociodemographic data, provider characteristics, and visit characteristics. The data were also limited based on the timeframe for completion, as patients who started the series may have not yet been eligible for the second or third dose to complete the series during the timeframe of the study. For example, rates of completion at the end of the study would not take into account those who initiated but were not yet eligible to complete the series. Thus, we decided to collect and report both HPV initiation and completion rates.

However, the study does have numerous strengths. It is the first to develop, implement, and evaluate an HPV vaccination ML intervention for rural adolescents in a medically unserved region of California. This pilot study also demonstrates the feasibility of working in partnership with rural health clinics and the communities they serve to address disparities

in HPV vaccination rates. To the best of our knowledge, our study had one of the largest percentage points increase in HPV vaccination initiation and completion rates among rural HPV vaccination ML interventions research studies.[17]

CONCLUSIONS

We found evidence that an ML intervention focused on parents, the primary care team, and the clinic improved HPV vaccination initiation and completion rates among rural adolescents. Given the disparities in HPV-associated cancers in rural communities[3] and the lower rates of HPV vaccine uptake among rural adolescents,[6] the success of this pilot study contributes to the field of rural cancer control and prevention intervention research. This pilot study highlights the importance of having bidirectional community-academic partnerships to address rural health issues. Future studies should validate our results by employing a larger scale randomizing-controlled trial design in rural settings. Additionally, these future studies should include mixed methods designs to ensure that intervention activities are tailored to local context (eg, rural and Native American communities), improve implementation fidelity, and to validate research findings.

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TABLE 1

Strategies by intervention level

Level	Intervention strategies
Parent	• Tailored HPV vaccination reminder postcards
Primary care team	• 3 clinic-wide HPV vaccination trainings • Quarterly review of HPV vaccination data
Clinic	• Physician champion • Clinic visual cues (examination room posters, educational handouts, lanyards, and pins)

TABLE 2

Association between HPV vaccine status at baseline and at follow-up

		Yes		No		Chi-square	
HPV vaccination status		**N**	**%**	**N**	**%**	χ^2	***P*-value**
Initiated	Baseline	140	52.4	127	47.6	50.8	<.00001
	Follow-up	191	82.7	40	17.3		
Completed	Baseline	72	27.0	195	73.0	49.2	<.00001
	Follow-up	134	58.0	97	42.0		