

REVIEW



Overcoming barriers to HPV vaccination in rural Vermont through a multicomponent peer-based approach

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ABSTRACT

Human Papillomavirus (HPV) causes almost all cervical cancers and many cancers of the anus, vagina, vulva, penis, and oropharynx. The HPV vaccine provides protection to all adolescents from a broad spectrum of cancers, yet HPV vaccination rates remain lower than those of other routine vaccines. Developing effective HPV vaccine interventions is particularly important in rural areas, whose residents have lower rates of HPV vaccination and higher cervical cancer incidence and mortality; however, interventional research in these populations is relatively limited. Furthermore, though rural areas are heterogeneous in many regards, few interventions engage stakeholders to develop community-specific solutions to overcome obstacles associated with HPV vaccination. Based on a review of existing literature, we recommend a multicomponent peer-based approach that includes school-based vaccination and awareness, parental involvement, and stakeholder engagement to increase HPV vaccination in rural areas, and we provide an example of such an intervention in rural Vermont.

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Introduction

Human Papillomavirus (HPV) causes most cervical and anal cancers and many cancers of the vagina, vulva, penis, and oropharynx. The HPV vaccine is the only vaccine that prevents multiple types of cancer, and yet, over a decade after its inclusion in the Advisory Committee on Immunization Practices (ACIP) recommendations for all adolescents, HPV vaccination rates in the United States remain lower than those of most other routine vaccines.

Developing effective and appropriate strategies to reach rural, often underserved, populations is particularly important to reducing overall morbidity and mortality associated with HPV. Compared with urban populations, rural communities have lower rates of adolescent HPV vaccination and higher rates of cervical cancer incidence and mortality, particularly in Black, Indigenous, and People of Color (BIPOC) women.^{1,2}

This may in part be explained by unique barriers to HPV vaccination in rural communities, including parent or guardian characteristics. Older ages of caregivers in rural communities is associated with lower likelihood of initiating and completing HPV vaccination, perhaps due to differing attitudes about sexual health or knowledge of HPV vaccination among generations.^{3,4} Additionally, rural guardians may perceive that transportation issues will make multiple HPV vaccination appointments inaccessible, independent of intent to vaccinate.⁴

Lack of consistent and reliable access to broadband internet may also be a barrier to HPV vaccination in rural areas.⁵ This communication gap can prevent adolescents and their caregivers from learning about HPV or the HPV vaccine, since

social media can increase HPV vaccine-related knowledge and awareness.⁶ Additionally, lack of broadband internet access can block or impede healthcare providers from accessing the state immunization registry, which many physicians use to monitor HPV vaccinations.^{5,7}

Residents of rural areas also share wider challenges to HPV vaccination with their non-rural counterparts, including barriers associated with healthcare equity. In general, higher HPV vaccine uptake is associated with healthcare access metrics such as having health insurance, more healthcare utilization, receipt of childhood vaccines, and having a healthcare provider as a source of information.⁸ Adolescents (and adults) in rural areas have limited access to consistent healthcare appointments, both due to a shortage of providers and to long travel distances to care.

Rural healthcare inequities also extend to provider communication and clinical decision support, which may increase HPV vaccination.^{9,10} Many rural adolescents do not have “medical homes,” instead only seeing providers for sick visits or sports physicals.⁵ Thus, young people in rural areas may have fewer opportunities to be offered vaccination against HPV.^{11,12} Indeed, people who live in rural areas receive fewer recommendations about HPV vaccination, particularly if they are BIPOC, lower income, uninsured, or living in southern areas.^{13,14}

Lack of HPV knowledge is a significant barrier to HPV vaccination, both within rural communities and without. Residents of rural areas are less likely to know about HPV or its association with cervical cancer compared to their non-rural counterparts.^{4,15,16} A pilot study conducted in rural Florida exploring parental knowledge and hesitancy of HPV

vaccination found that low levels of knowledge about HPV vaccination was associated with low uptake of the vaccine.¹⁷

Stigma associated with HPV negatively impacts parents' decisions about whether to vaccinate their children against HPV.^{18,19} Parents are often concerned that vaccination against an STI will result in disinhibition of sexual behavior.^{4,19,20} Worryingly, 80% of rural Floridian parents in the above-mentioned study had a different fear: that HPV vaccination could leave their child sterile, a concern that, unsurprisingly, perpetuated HPV vaccine hesitancy.¹⁷

Though residents of rural areas bear a disproportionately high HPV disease burden, HPV interventional research in these communities is relatively limited, underscoring the need to identify appropriate strategies that address rural barriers to HPV vaccination.²¹ Additionally, most HPV interventions lack stakeholder engagement, which may result in failure to understand community-specific barriers to HPV vaccination.²² Rural communities are not uniform and present differing challenges such as geographic location, sociodemographic factors, and values, resulting in unique barriers to HPV vaccination and the need for locally appropriate solutions.⁴

Barriers to HPV vaccination in Lamoille County, Vermont

Lamoille County is a rural community in northern Vermont. A significant determinant of health in Lamoille County is healthcare access. The Vermont Department of Health (VDH) Behavioral Risk Factor Surveillance System (BRFSS) 2018 report found that among Vermonters, Lamoille County adults are the least likely to have had a doctor's visit in the last year, as depicted in [Figure 1](#).²³

Lamoille County's decreased healthcare access also extends to adolescent well-care and cancer prevention. Lamoille County has one of the lowest pediatrician-to-child ratios in Vermont, as shown in [Figure 2](#).²⁴

Furthermore, only 48.1% of Lamoille County youth aged 15 have completed their HPV vaccine series, compared with over 60% of 15-year-olds in other Vermont counties, depicted in [Table 1](#).²⁵ Notably, the five Vermont counties with the lowest rates of HPV vaccine series completion are all rural areas.

Community stakeholder input

Lamoille County community stakeholders were engaged to provide input regarding local barriers to HPV vaccination and opportunities to overcome them. Stakeholders included school administrators, teachers, school nurses, local healthcare providers, members of community health organizations, high school coaches, and parents. Due to limitations presented by the COVID-19 pandemic, stakeholder meetings were held via telephone or video call. All stakeholder participation was entirely voluntary and self-directed.

Stakeholder input provided insight regarding Lamoille County identity including parental concerns, trusted local organizations, and values. Stakeholders also served as local partners, engendering community support and buy-in critical to creating an intervention centered on potentially sensitive topics including sexually transmitted infections (STIs) and vaccine hesitancy.

Initial stakeholder conversations were specifically focused on identifying local barriers to HPV vaccination in Lamoille County. The following is a list of community stakeholder-identified barriers to HPV vaccination and a select stakeholder quotation:

- Lack of information about HPV
- Insufficient sexual health education
- Infrequent well-child visits
- Limited access to primary care providers
- Gender stereotypes (“*in our community, the gender roles are very much in place*”)

Lamoille County stakeholder perspectives on sexual health education

Another significant topic of stakeholder discussion involved determination of the extent to which sexual health should be emphasized in a local HPV vaccine intervention. Most literature and HPV prevention organizations suggest that presenting HPV as cancer prevention with minimal or no mention of HPV's sexual transmission is the most effective strategy to improve vaccination, likely to mitigate parental concern that vaccination against an STI may increase sexual behaviors.^{26,27}

However, Lamoille County community stakeholders identified that insufficient sexual health education was a significant barrier to HPV vaccination in their community, as listed above. Stakeholders were most concerned about STI prevention and curriculum inclusivity of lesbian, gay, bisexual, transgender, queer/questioning (LGBTQ) adolescents. When apprehension of parent receptivity was raised, stakeholders held steadfast in their belief that HPV vaccine intervention would not be effective in Lamoille County without also addressing inadequate sexual health education in the broader community.

The “Guard Your Health” intervention

Based on stakeholder-identified barriers to HPV vaccination in Lamoille County and a review of the literature, the primary author developed the “Guard Your Health” intervention, which contained the elements described herein.

The intervention centered around the Guard Your Health fair, named for Gardasil 9, the 9-valent HPV vaccine distributed in the United States. The fair was offered to three schools (a high school, a middle school, and a technical school for 10–12th grade students) that share a campus in Lamoille County. Select characteristics of the students at the high school ($N = 486$) and middle school ($N = 283$) are provided in [Table 2](#); population data was not provided for the technical school.²⁸

Peer-based education

Peer-based education was the central educational strategy of the Guard Your Health intervention.

Based on conversations with stakeholders, it was determined that educational topics at the fair would include but extend beyond HPV in order to improve parental reception,

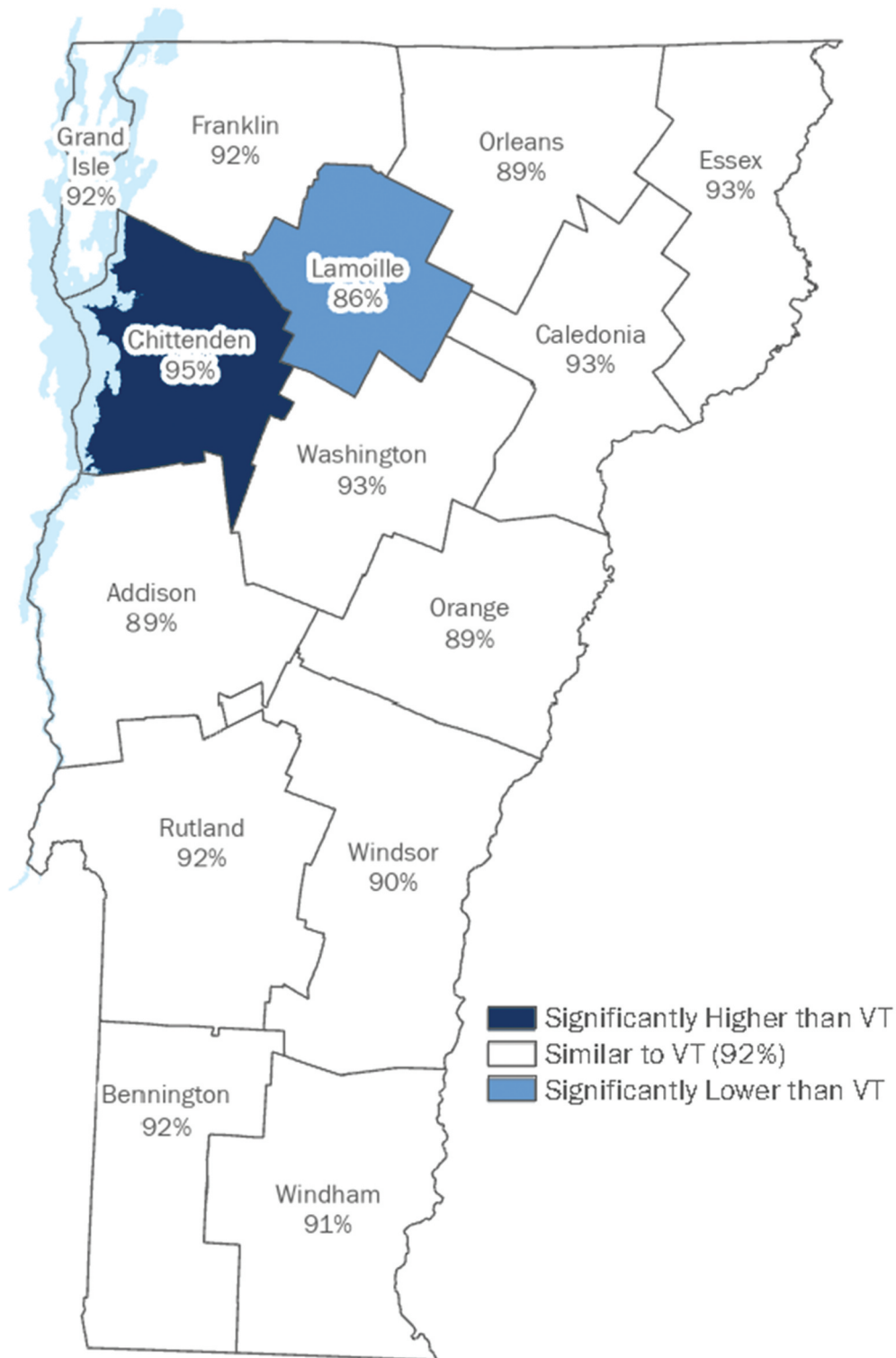


Figure 1. Vermont adults who had a routine doctor visit in the last year by County, 2017–2018. Figure from VDH, BRFSS, 2018 report²³.

particularly due to middle school student involvement. Thus, using student interests and community concerns identified by stakeholders, the following categories were selected for inclusion at the Guard Your Health fair:

- Category 1: HPV and sexual health
- Category 2: Disease prevention
- Category 3: Healthcare and emergency response

- Category 4: Vaping cessation

Three students identified by high school teachers (“youth stakeholders”) provided peer education related to Categories 1 and 2. Ten students from the technical school’s health program and one recent graduate of the program developed interactive booths related to Category 3, including airway management, splinting, wound dressing, taking vitals, disposable glove

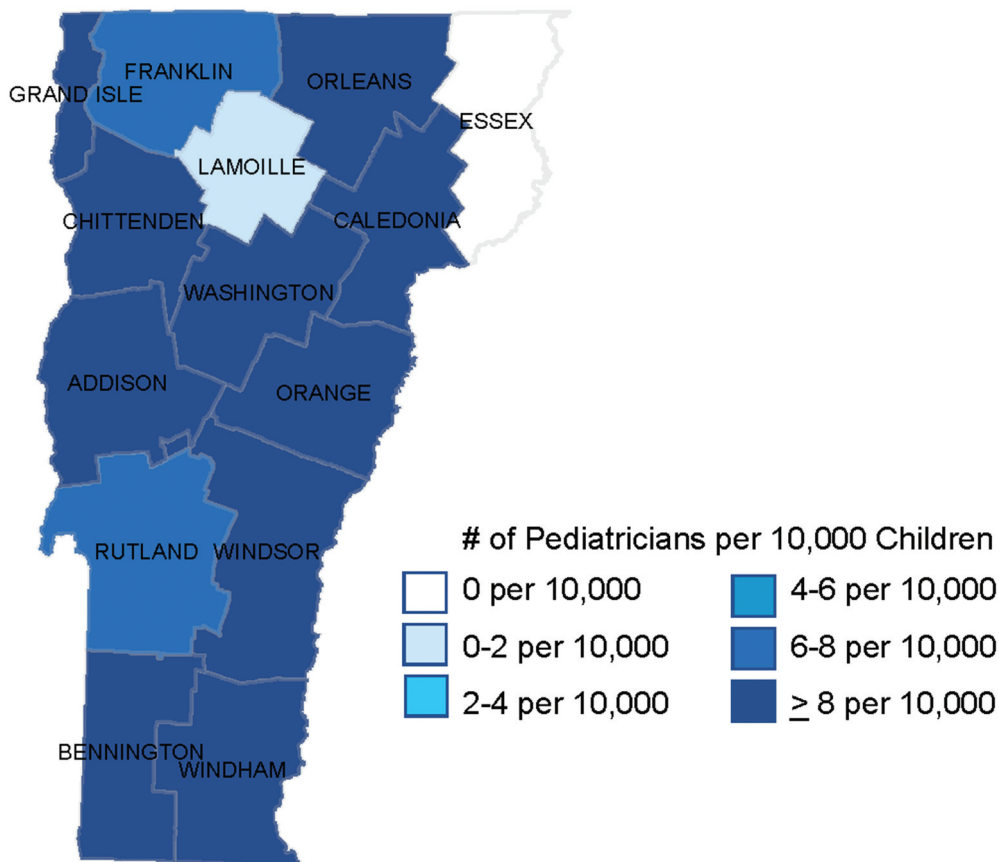


Figure 2. General pediatricians by county in Vermont. Figure adapted from American Board of Pediatrics, US Map of General Pediatricians by County²⁴.

Table 1. HPV vaccine series completion – Vermont teens born in 2005, by County. Data from Vermont IMR Annual Report, 2020²⁵.

Vermont County	HPV Series Completion (% of youth aged 15)
Addison	62.5
Orange	60.9
Chittenden	57.4
Grand Isle	55.9
Washington	55.7
Franklin	54.7
Orleans	53.6
Statewide	53.3
Rutland	51.7
Windsor	49.5
Lamoille	48.1
Caledonia	46.6
Bennington	45.9
Windham	45.1
Essex	29.9

Table 2. Student characteristics, provided as percentages of students, Data from State of Vermont Agency of Education, Vermont Education dashboard²⁸.

	Lamoille County High School	Lamoille County Middle School	Vermont Schools
Race/Ethnic Group			
White	96.91	95.41	88.74
Hispanic	1.65	1.06	2.63
Black	1.03	1.41	2.51
Asian	0.21	0.35	2.21
Multi-Racial	0.21	1.41	3.47
Native Hawaiian/Pacific Islander			0.13
American Indian/Alaskan Native		0.35	0.3
Family Income			
Free or Reduced Lunch	42.18	40.28	34.46
Student Support Services			
504 Plan	8.64	4.95	4.69
Education Support Team	15.23	20.14	6.4

donning and doffing technique, using an automated external defibrillator (AED), abdominal thrust (Heimlich maneuver), and blood donation.

The only exception to peer teaching was in the case of one student who was not able to be at their booth for the entire duration of the Guard Your Health fair. This student was a youth member of Healthy Lamoille Valley, a local organization aimed at reducing substance misuse that was cited by stakeholders as a trusted healthcare organization by the community. Thus, it was determined that an adult representative from Healthy Lamoille Valley would support peer teaching at

the fair in the context of Category 4, as youth vaping cessation was routinely cited by stakeholders as a significant community concern. The students who served as peer teachers at the Guard Your Health fair (hereafter referred to as the “Guard Your Health peer educators”) are summarized in Figure 3.

The fair featured a raffle, where, to enter a ticket, students had to correctly answer questions by learning from the Guard Your Health peer educators or posters made by students during the fair campaign (described below). Stakeholders and youth stakeholders helped identify raffle prizes that would be

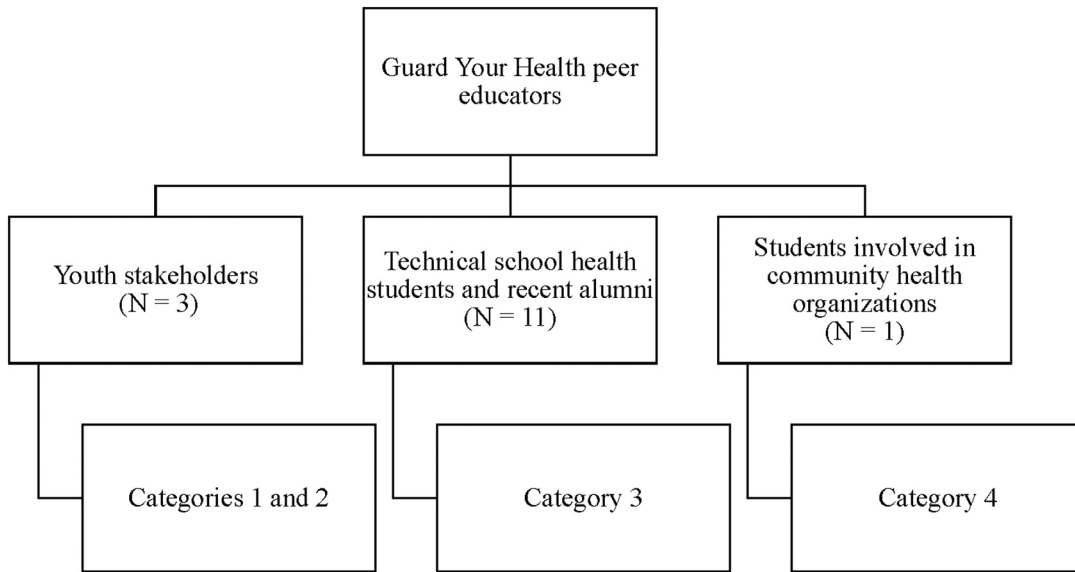


Figure 3. Description of Guard Your Health peer educators.

both motivating and health-promoting to the adolescents in Lamoille County, including an exercise bike, ski lift tickets, and a stand-up paddle board.

Each raffle ticket included four questions and a perforated edge to create a “ticket stub” with a QR code to UnhypedVT.com, a local vaping cessation resource. An example raffle ticket is provided in Figure 4. Guard Your Health peer educators

helped develop raffle ticket questions and were encouraged to discuss – either with their peers, teachers, or the primary author – information they would be teaching prior to their fair to ensure their comfort and confidence. A complete list of raffle ticket questions is provided in Appendix A. There were ten sets of raffle tickets and each ticket contained one question from each of the four categories. Only raffle tickets with

What is the leading cause of death in teenagers? _____


What number can someone text to get help with vaping cessation? _____

How many lives can you save with one blood donation? _____


HPV is the leading cause of cervical cancer. List 3 other types of cancer it can cause.

Don't forget to write your name on the back for your chance to win!

LOOK PAST THE VAPE HYDE.
GET THE **REAL FACTS** AT UNHYPEDVT.COM



guard your health.



Name: _____

School: _____

Home Base Teacher: _____

School Email: _____

Raffle prize drawing will be from 3-4 PM today
You do not need to be present at the draw to win a prize

Figure 4. Guard Your Health fair sample raffle ticket.

completely correct answers were eligible for a raffle prize and all students (including the Guard Your Health peer educators) were permitted one ticket each to enter the raffle.

The fair was held in an event space at the shared campus of the three schools over five hours during a typical school day. Due to capacity limitations of the event space and the COVID-19 pandemic, a sign-up sheet with nine 20- to 30-minute slots, each slot available to a maximum of three classes, was sent to teachers of the three schools prior to the Guard Your Health fair.

School-Based vaccination and awareness

The HPV awareness campaign began a month prior to the Guard Your Health fair with advertisement and promotion. Flyers were hung in hallways and in the school nurses' office, and classrooms were visited to discuss HPV and the HPV vaccine.

One week before the event, the high school held a remote schoolwide assembly for the students to hear the story of a male teacher at their school who was a survivor of an HPV-associated oropharyngeal cancer.

In his story, the students' teacher said he didn't remember anything about his diagnosis, except for the beginning of the appointment, and the end. He remembered the beginning because when he walked in, his doctor was crying. The rest was a blur, he said, but at the end, his doctor told him that there was good news:

The good news was that a vaccine had just been approved for HPV, so no one ever has to go through this again.

School-based HPV vaccination was offered to students by the local Vermont Department of Health office during the Guard Your Health fair. Students with a signed permission slip had the opportunity to receive a single dose of the HPV vaccine series. A nurse practitioner from a Lamoille County healthcare

office was present during vaccination to answer questions about vaccine dose scheduling or assuage parental concerns.

Parent or guardian involvement

Prior to the fair, the school nurse sent a letter home to the parents or guardians of the three schools. The letter provided HPV vaccine dosing and scheduling guidelines and recommended that adolescents who received a vaccine at the fair follow up with their primary care provider to ensure completion of the HPV vaccine series. The letter also included HPV educational materials and a consent form for HPV vaccination. Because parents view cancer prevention as the best reason to vaccinate their child against HPV, the letter presented the HPV vaccine as such with no mention of HPV's sexual transmission.²⁶

Sexual health education

The sexual health curriculum was delivered to four cohorts of 10th grade students at the high school over four 80-minute sessions, with the final day coinciding with the Guard Your Health fair. The sexual health curriculum was developed using materials from the Get Real High School curriculum and in accordance with Vermont's sexual health guidelines and the Centers for Disease Prevention and Control (CDC) Health Education Curriculum Analysis Tool (HECAT). Based on stakeholders' perceived limitations of the current health curriculum, highest emphasis was placed on STI prevention and destigmatization of sexual health, particularly in the context of gender stereotypes.

Local solutions to local problems

The multicomponent Guard Your Health intervention created solutions to address each of the local barriers to HPV

Local barrier to HPV vaccination	Community-informed solution (Intervention component)
Lack of information about HPV	<ul style="list-style-type: none"> • Category 1 raffle ticket questions taught by Guard Your Health peer educators (peer-based education) • HPV vaccine education included in updated health curriculum (sexual health education) • Letter to parents containing information about HPV vaccines (parent or guardian involvement) • HPV awareness campaign, including schoolwide assembly (school-based vaccination and awareness)
Insufficient sexual health education	<ul style="list-style-type: none"> • Category 1 raffle ticket questions taught by Guard Your Health peer educators (peer-based education) • Augmentation of health curriculum to include two weeks of inclusive safer sex education (sexual health education)
Gender stereotypes	<ul style="list-style-type: none"> • Discussion of gender roles (sexual health education) • Assembly to address sex-based HPV stigma (school-based vaccination and awareness)
Infrequent well child visits and limited access to primary care providers	<ul style="list-style-type: none"> • Categories 2-4 raffle ticket questions taught by Guard Your Health peer educators (peer-based education) • Access to HPV vaccination at Guard Your Health fair (school-based vaccination and awareness) • Nurse practitioner of local family medicine practice present at Guard Your Health fair (school-based vaccination and awareness)

Figure 5. Guard Your Health intervention solutions to Lamoille County stakeholder perceived barriers to HPV vaccination.

vaccination identified by Lamoille County community stakeholders. A summary of barrier-specific solutions provided by the intervention is provided in [Figure 5](#).

The Guard Your Health intervention was very well-received by the Lamoille County community. Almost all Guard Your Health fair raffle prizes were donated by local businesses in support of the intervention. At the fair, over 120 raffle tickets were collected corresponding to nearly 500 questions, the vast majority of which were answered correctly.

Many elements of the Guard Your Health intervention will persist in Lamoille County to support HPV vaccination long-term. For example, the Guard Your Health fair is planned to be an annual event in Lamoille County. Additionally, two of the Guard Your Health peer educators have continued sexual health peer teaching a self-directed project without outside support from the authors. They have taught classes and developed a social media account to educate their peers and normalize discussions of sexual health on an ongoing basis.

Recommendations

Based on our experience with the Guard Your Health intervention, we recommend rural HPV vaccination interventions that include the following components:

- (1) Peer-based education
- (2) School-based vaccination and awareness
- (3) Parent or guardian involvement
- (4) Stakeholder engagement

A review of evidence supporting these recommendations and their applicability to rural settings is provided herein.

Peers are an important facilitator of HPV vaccination, particularly in rural areas.^{4,19} Peer-based education can improve sexual health knowledge, including knowledge regarding HPV and cervical cancer.^{29–31} Effective peer educators can normalize HPV vaccination while enabling frank and open discussion of stigmatized topics like sexual health. Peer teaching can also take many forms, lending itself to implementation in diverse settings. In a study in rural North Carolina, adolescents who received a peer-to-peer sexual health education program adapted from urban and suburban schools felt that they learned better from peer education than from traditional health class.³²

While peer-based education can result in behavior change related to human immunodeficiency virus (HIV), it might not be sufficient to change other sexual health behaviors.^{29,31,33} Thus, peer teaching may improve HPV vaccination more effectively if part of a multicomponent strategy.^{34,35}

Providing vaccination is an important feature of many effective HPV interventions.³⁶ Schools play a central role in small rural communities and are a trusted source of information.⁵ It is unsurprising, then, that school-based programs that offer vaccination are most successful, and those that also raise awareness facilitate HPV vaccination in rural areas.^{4,35,37} Kaul et al. conducted a study comparing HPV vaccine initiation and completion in rural Texas middle schools that received community-based HPV educational interventions with or without school-based vaccination;

students who had access to on-site vaccination were over 3.6 times more likely to initiate and complete HPV vaccination than those who had only received community-based education.³⁸

HPV interventions are particularly distinct from other sexual health programs in that the desired behavioral change (i.e., vaccination in 11- to 12-year-olds) requires consent from a parent or guardian; thus, HPV interventions aimed at increasing vaccination should include parent or guardian involvement. Indeed, interventions that actively engage parents, including education by a healthcare professional, more effectively increase HPV vaccination than those which only focus on adolescents.³⁹

Rural areas are heterogeneous in terms of geographic location, sociodemographic factors, and values, leading to unique barriers to HPV vaccination and the need for locally appropriate interventions.⁴ Community identity may provide direction regarding certain elements of HPV interventions, including the extent to which sexual health should be emphasized as was the case for the Guard Your Health intervention. Similarly, religion or spirituality may influence parental decision-making regarding HPV vaccination in rural communities, suggesting some HPV interventions may benefit from faith-based interventions.^{40,41} Grass roots community engagement is particularly important for increasing HPV vaccination in BIPOC populations.³⁹

While multicomponent peer-based approaches should include each of the elements discussed above, they need not be restricted to them. Based on barriers or specific qualities of the target population, interventions may also incorporate other facilitators of HPV vaccination, including providing incentives or creating opportunities for students or parents to personally connect with someone affected by HPV.^{42–44} Educational film interventions may provide a means for parent or guardian involvement in rural areas with limited access to primary care providers and clinics.⁴⁵ Additionally, the student-directed sexual health peer teaching that began as a result of the Guard Your Health intervention indicates that social media may be a locally appropriate and effective tool to incorporate into HPV vaccine interventions, particularly as it is known to improve HPV and HPV vaccine knowledge.⁶

The multicomponent peer-based approach described in this review may prove beneficial beyond the scope of HPV vaccination, such as addressing hesitancy associated with other vaccines, or hesitancy to prioritize disease prevention and survivorship. Jarrett et al. found that multicomponent and dialogue-based interventions, particularly when developed in the context of specific target populations, were most effective at improving uptake of HPV, influenza, and childhood vaccines in vaccine hesitant populations.⁴⁴ Thus, our approach may be useful for improving non-HPV related vaccine hesitancy, thus addressing an indispensable need in the rising anti-vaccine sentiment associated with the onset of the COVID-19 pandemic.

Summary and conclusion

More than ten years after its inclusion in the ACIP recommendations for all adolescents, HPV vaccination remains

suboptimal. Identifying effective solutions to overcome these barriers is paramount to reducing incidence and mortality of cervical, anal, vaginal, vulvar, penile, and oropharyngeal cancers.

This is particularly important in rural areas, which have unique barriers to HPV vaccination and whose residents have lower rates of HPV vaccination and higher rates of cervical cancer incidence and mortality.^{1,2} Despite this, relatively limited interventional studies have been conducted in rural populations.²¹

Based on the Guard Your Health intervention in rural Vermont in conjunction with a review of the literature, we recommend a multicomponent peer-based approach that includes school-based vaccination and awareness, parent or guardian involvement, and stakeholder engagement to address barriers associated with HPV vaccination in rural areas.

More HPV interventional research is needed in rural areas. Future studies should aim to evaluate whether the multicomponent peer-based approach described in this review is associated with increased HPV vaccine uptake in rural communities. Ultimately, it is critical to continue to identify and implement effective solutions to address rural barriers to HPV vaccination to reduce morbidity and mortality associated with HPV.

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Appendix

Appendix A. Guard Your Health fair raffle ticket questions.

Category	Questions
Category 1: HPV and sexual health	<ul style="list-style-type: none"> • What does HPV stand for? • What is the best way to prevent cervical cancer? • HPV is the leading cause of cervical cancer. List 3 other types of cancer it can cause. • What does HIV stand for? • Which virus causes AIDS? • When someone's HIV status is positive and _____, they cannot transmit the virus to other people. • Which two STIs are routinely tested in urine? • Name five different types of birth control. • Why might someone take birth control other than for preventing pregnancy? • Do you need a prescription for Plan B ("the morning-after pill")?
Category 2: Disease prevention	<ul style="list-style-type: none"> • How often should you go to your doctor, at a minimum? • What is the leading cause of death in teenagers? • A teenager should aim to get between ___ and ___ hours of sleep per night. • What is the best way to prevent lung cancer? • Hypertension is defined as blood _____ greater than _____. • Diabetes is when you have high levels of _____ in your blood. Type ___ is the kind you can prevent through healthy habits. • What is the name of the vaccine for influenza? • How is polio most effectively prevented? • Which disease did we eliminate through vaccines in 1980?
Category 3: Healthcare and emergency response	<ul style="list-style-type: none"> • How long should you wash your hands? • When putting on and taking off gloves, when should you wash your hands? • How many lives can you save with one blood donation? • Where are the Automated External Defibrillators (AEDs) at your school? • What is the ratio of compressions: breaths for adults and child CPR? • Write two signs that someone is choking. • What material could you use for a splint? • What is your blood pressure? • What does AED stand for? • How much bleeding is considered life-threatening? • When is it safe to take off a splint?
Category 4: Vaping cessation	<ul style="list-style-type: none"> • What substance makes vaping so addictive? • Name a chemical that enters your lungs when you vape.* • One 5% vape pod can have as much nicotine as how many cigarettes? • Vaping four 5% pods is the equivalent to how many cigarettes? • Can vaping cause brain damage? • Can vaping increase your risk of a heart attack? • Name two organs vaping can cause long-term damage to.* • What number can someone text to get help with vaping cessation?

*Questions were included on two separate sets of raffle tickets.