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Barriers and facilitators to HPV vaccine uptake among US Rural Populations: A Scoping Review

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Abstract

Purpose Compared to US urban populations, rural residents have a higher incidence of HPV-related cancer and lower HPV vaccine coverage. This study determined what is known about barriers and facilitators to vaccine uptake in US rural settings.
Methods A scoping review was conducted to describe individual, interpersonal, organizational, and community/societal barriers and facilitators to HPV vaccine initiation and completion among US rural populations and to identify gaps in the current research. A systematic search was conducted using PubMed/MEDLINE and CINAHL databases.
Results A total of 1,083 abstracts were reviewed and 13 articles met the inclusion criteria. Major themes at the individual-level included caregiver and vaccine-recipient demographics, other immunizations received, pap test history, awareness/knowledge of cervical cancer, HPV vaccine, or HPV infection, attitudes and motivation to vaccinate, STD diagnosis, sexual behavior, cervical cancer history, contraceptive use, and cancer fatalism. Interpersonal themes focused on provider influence and communication, caregiver and peer influence, and social support for the caregiver. At the organizational-level, themes included health insurance, provider characteristics, school-based interventions, and provider/practice-based interventions. The only community/societal factor examined related to a social marketing campaign.
Conclusion Additional research is needed on interpersonal, organizational, and community/societal factors, as well as an expanded focus on rural males. Future studies should account for rural heterogeneity by expanding the geographic areas studied. Our findings detailing factors found to be associated with HPV vaccine uptake will help inform future clinical, health services, and community research, as well as interventions and policy efforts.

KEYWORDS: HPV Vaccine; Rural Health; HPV vaccine uptake; Human Papillomavirus; Disparities

Introduction

Human papillomavirus (HPV) is the most common sexually transmitted infection in the US [1], with lifetime probability of acquiring HPV ranging between 85% for women and 91% for men [2, 3]. HPV infection can cause genital warts [4] and oral [5], cervical [6, 7], vulvar, vaginal, anal, and penile cancers [8, 9]. HPV vaccination is an effective primary prevention strategy to reduce HPV infections that can lead to cancer [10]. The original vaccines protected against oncogenic HPV types 16 and 18, which account for the majority of cancers [11], as well as types 6 and 11, which are responsible for approximately 90% of genital warts [12]. The current 9-valent vaccine also protects against five additional oncogenic HPV types and is now the only vaccine available in the US [11]. A recent meta-analysis of ecologic studies from 14 high-income countries showed that HPV vaccination programs were associated with statistically significant decreases in HPV 16 and 18 infections, anogenital wart diagnoses, and cervical intraepithelial neoplasia grade 2+ in girls and women, as well as reductions in anogenital wart diagnoses in males [13]. Additionally, they showed evidence of cross-protection against infection with other oncogenic HPV types [13]. Currently, the US Advisory Committee on Immunization Practices recommends routine vaccination for children at ages 11 or 12 years, and as early as age 9, and also permits late vaccination up to age 26, as well as vaccination based on shared clinical decision-making for individuals ages 27 through 45 years who are not adequately vaccinated [14].

The most recent data from the National Immunization Survey–Teen indicate modest increases in HPV vaccine initiation and completion among US adolescents [15]. However, differences in vaccine coverage exist by race/ethnicity, sex, socioeconomic status, and most notably rural-urban location, with higher uptake in female, Hispanic or black, low-income, and urban adolescent populations [16, 17]. Rural US populations, in particular, lag behind their urban counterparts in both vaccine initiation and completion. HPV vaccine initiation in adolescents living outside metropolitan statistical area (MSA) central cities is 11% lower than in those living in MSA central cities [15]. Moreover, in states with a high percentage of the population residing in rural areas, HPV vaccine coverage is even lower. Vaccine initiation ranged from 61% to 79% in rural populations, compared with 73% to 85% in urban populations, and completion ranged from 44% to 65% in rural populations, compared with 55% to 70% in urban populations (Appendix).

This pattern of lower HPV vaccine coverage in rural populations is consistent across most rural US regions when compared with urban areas [18, 19]. Furthermore, although the incidence rates of many cancers are typically higher in urban settings, HPV-related cancer incidence is significantly higher in rural versus urban settings [20–22]. Importantly, rural residents experience barriers to health care that are distinct from their urban and semi-urban counterparts. Rural residents often lack resources such as reliable transportation [23] and nearby health care providers [24]. In addition, they may have limited information regarding cancer risks and prevention, experience significant fear and stigma associated with cancer and sexually transmitted infections, and express privacy concerns [25–29]. They also frequently have fewer health insurance options [30] and limited access to health care providers and preventive care [31, 32].

The goal of this study was to determine what is known about barriers and facilitators to HPV vaccine uptake in US rural settings, using a framework presented by Fernandez et al. describing factors that influence HPV vaccination [33]. This framework recognizes that individual-level factors influence health behaviors, and in turn, individual-level factors are impacted by the environment, including interpersonal, organizational, and community/societal. At the individual level, several factors can play a role in the willingness and intention to vaccinate one's child (or oneself), including knowledge about HPV and its relation to cancer and perceived

adverse behavioral consequences. Interpersonal factors relating to vaccine use include health care provider recommendation and parental/peer support for vaccination. At the organizational level, infrastructure and clinical procedures for implementing and maximizing vaccination may facilitate HPV uptake. Community and societal factors such as low vaccine cost, as well as policies and programs that increase vaccine access and availability, may also promote vaccination. A greater understanding of the barriers and facilitators that occur at these multiple levels is needed to guide the development of interventions that will increase vaccine uptake in rural populations.

Methods

Approach

Utilizing the aforementioned approach, a scoping review was conducted 1) to describe individual, interpersonal, organizational, and community/societal barriers and facilitators to HPV vaccination among US rural populations and 2) to identify gaps in the current research as well as to reveal opportunities for further research. A scoping review was selected in order to examine the extent, range, and nature of the current research evidence; summarize research findings; and identify gaps in the existing scientific literature. The methodological approach proposed by Arksey and O'Malley [34] was used to carry out this scoping review. The approach includes: (1) identification of the research questions to be addressed; (2) identification of studies relevant to the research questions; (3) selection of studies included in the review; (4) charting of information and data within the included studies; and (5) collating, summarizing and reporting results of the scoping review.

Identifying the Research Questions

Based in this approach, the following key questions were derived:
1) What are the key characteristics of existing studies?
2) Which individual-, interpersonal-, organizational-, and community/society-level factors have been examined with regard to their association with HPV vaccine uptake?
3) Which individual-, interpersonal-, organizational-, and community/society-level factors have been shown to be associated with vaccine uptake as either barriers or facilitators?

Identifying Relevant Studies

A comprehensive search of the literature was conducted using the PubMed/MEDLINE and CINAHL databases, examining references and citations from selected manuscripts in SCOPUS, and manual searching. These databases were chosen in order to broadly capture the health sciences literature where these studies are most frequently documented. Additionally, the team used the citation database Scopus as it broadly consolidates citations for health and social science literature and allows for identification across journals of articles related to this topic. The search strategy for PubMed and CINAHL involved keyword and controlled vocabulary combinations occurring in the titles, abstracts, and subject headings.

PubMed

((nine-valent) OR (nine valent) OR ("Papillomavirus Vaccines"[Mesh]) OR (quadrivalent) OR (Gardasil) OR ("Human Papillomavirus Recombinant Vaccine Quadrivalent, Types 6, 11, 16, 18"[Mesh]) OR ("Human Papillomavirus") OR ("Human papilloma virus") OR ("HPV Vaccination") OR (HPV AND Vaccine) OR ("Human papillomavirus Vaccination") OR ("Human papilloma virus Vaccination") AND ("Rural Nursing"[Mesh] OR "Rural Population"[Mesh] OR "Rural Health Services"[Mesh] OR "Rural Health"[Mesh] OR "Hospitals, Rural"[Mesh] OR "Population Dynamics"[Mesh] OR Appalachia OR Rural OR "Small town" OR "underserved community" OR "Residence Characteristics"[Mesh] OR "Regional health disparities" OR "Rural health disparities" OR "rural health"))

CINAHL

((nine-valent OR nine-valent OR (MH "Papillomavirus Vaccine") OR quadrivalent OR Gardasil OR human papillomavirus OR human papilloma virus OR hpv vaccination OR (HPV AND Vaccine) OR human papillomavirus vaccination OR human papilloma virus vaccination) AND (((MH "Rural Population") OR (MH

"Rural Health Personnel") OR (MH "Rural Health Centers") OR (MH "Rural Health Services") OR (MH "Rural Health Nursing") OR (MH "Rural Health") OR (MH "Hospitals, Rural") OR underserved populations OR underserved community OR small town OR regional health disparities))

Manuscripts were selected for review if they were published in a peer-reviewed journal and met the following criteria:
1) Published in 2006 or later (as it coincides with the introduction of the vaccine in the US);
2) Included results for a US rural population. (As there is no standard definition of "rural" available from the US Federal government, when determining a classification for a geographic region we relied on the authors' definition of rural);
3) Included information on associations between individual-, interpersonal-, organizational-, and community/society-level factors and HPV vaccination uptake. Uptake included initiation (defined as receipt of at least one dose) or completion (defined as receipt of two doses for girls and boys who received their first dose of HPV vaccine before age 15 years, or three doses for children who received their first dose at 15 years of age or older); and
4) English language.

Manuscripts were excluded if they were literature reviews, commentaries, purely qualitative studies, or descriptions of ongoing trials. Manuscripts focusing solely on acceptance of the HPV vaccine (e.g., wanting the vaccine, vaccination intent) were also excluded as there is no common definition for this outcome. Studies that included both urban and rural populations were excluded if the results were not stratified by rurality. Titles and abstracts were reviewed for relevance. If an abstract did not contain sufficient information to assess eligibility, the manuscript was reviewed. In an attempt to capture as much information as possible in the research field, the references and citations in selected manuscripts were obtained from SCOPUS and manually reviewed in order to identify further relevant documents.

Charting the Data
Two co-authors (AS, CP) developed the data-extraction form to ensure consistency with the research questions and purpose of the scoping review. The information abstracted included source of study (PubMed/MEDLINE, CINAHL), authors, publication year, title, study aims/purpose, geographic population (single-state, multi-state, national), Appalachian region included (yes, no, not stated), geographic region (rural, both urban and rural), study population, patient population focus (e.g., women ages 18 to 26), data collection methodology (e.g., survey, mixed-methods), study design, sample type (convenience, population-, clinic-, and school-based), HPV vaccine outcome (i.e., initiation and completion), variables examined, domains examined (i.e., individual-, interpersonal-, organizational-, and community-society-level factors), and facilitators and barriers that were statistically significantly associated with vaccine uptake.

All data were extracted independently by four co-authors, working in pairs at their respective institutions (AS/AB, CP/HH). Upon completion of the independent reviews, each pair of authors compared results for consistency and concurrence regarding inclusion/exclusion determinations. Once these were reconciled, the senior author in each pair (AS, CP) assessed the other pair's results and determinations, and refereed any discordant decisions.

Collating, Summarizing, and Reporting the Results
For this phase of the review, the approach suggested by Levac et al. [35] was followed. First, the general characteristics of the articles were reported. Second, the results related to each of the research questions were described. Third, the results were discussed and implications for further research, practice, and policy were proposed.

Data Analysis
Summary statistics were used to describe the characteristics of the studies in terms of geographic population, inclusion of Appalachian region, geographic type, study population, patient population focus, methodology,

study design, sample type, HPV vaccine outcome, domains examined, and analysis type (i.e., multivariate and/or bivariate). As this is a scoping review, the quality of the included studies was not assessed. Barriers and facilitators were organized into the aforementioned domains: 1) Individual-level factors such as knowledge, attitudes, and behavior; 2) Interpersonal processes, which include interactions within social networks such as family, peers, and providers; 3) Organizational processes, which include institutional factors that facilitate vaccination services and; 4) Community/societal factors that influence access to and availability of the vaccine. Factors examined were further categorized by theme. When statistical significance was assessed in both bivariate and multivariate models, we reported only those barriers/facilitators that were statistically significant in multivariate models; otherwise, bivariate results are reported.

Results

Search Results

Figure 1 represents the data extraction flow process. The PubMed/MEDLINE search was conducted on 02/14/2019 and identified 673 abstracts. The CINAHL search on the same date yielded an additional 91 manuscripts. All of the abstracts were systematically screened by four authors (AB, AS, CP, HH). Of the total number of abstracts reviewed, 64 met the inclusion and exclusion criteria during a title and abstract review. After an independent assessment of the full text by the two senior author reviewers (AS, CP), 13 papers were selected for inclusion into the study. The two reviewers also screened the titles of the references in the 13 included papers. An additional 383 abstracts were identified and reviewed by AB, AS, CP, and HH. However, no additional studies met the inclusion criteria. The entire review process resulted in the selection of 13 papers.

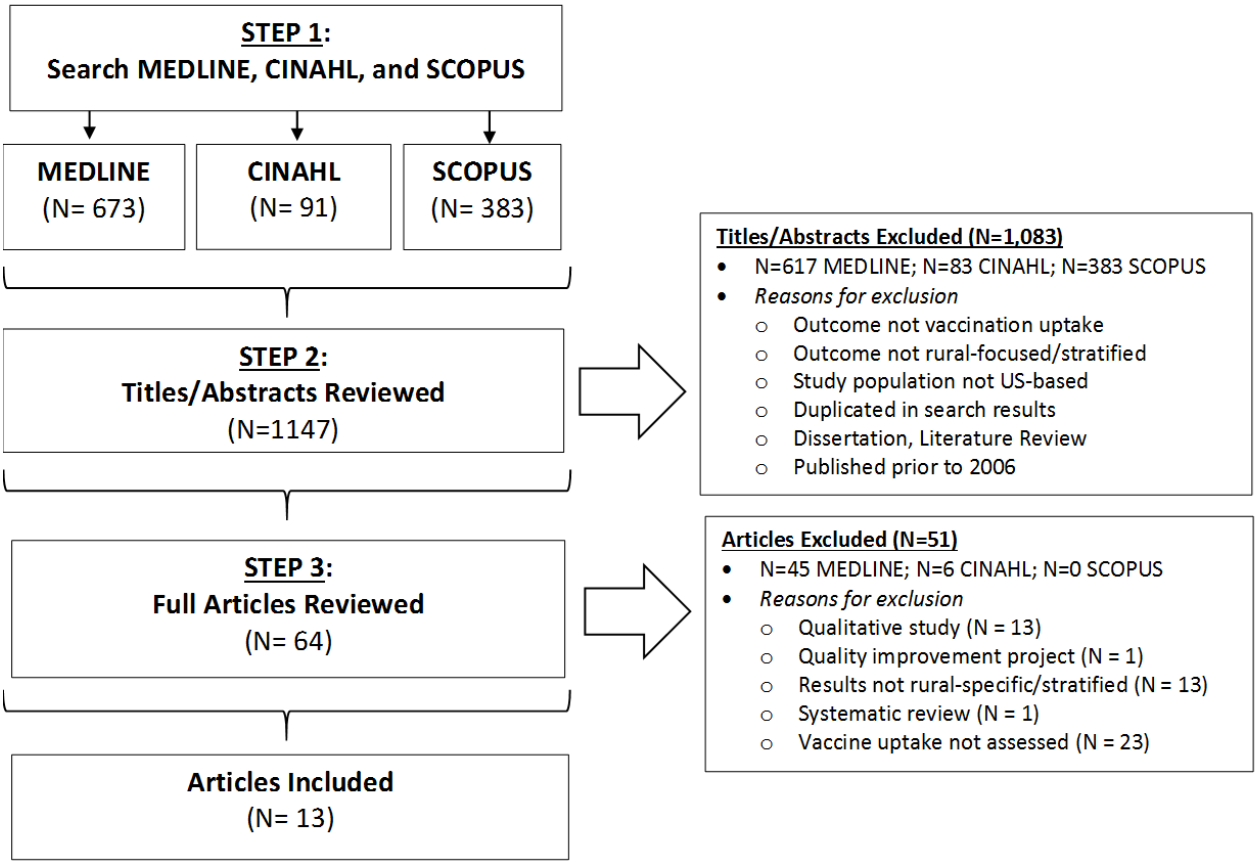

Fig 1. Flow diagram of the search and study selection process

Study Characteristics

Eleven of the 13 included studies occurred in counties of single-states [36–46], another was national in scope [47], and one included several states [48] (Table 1). Among the 11 single-state studies, six took place in

Kentucky [37, 40, 42, 44–46], three in North Carolina [38, 39, 43], one in Ohio [36], and another in Washington [41]. Six of these 11 single-state studies covered territory in Appalachia [36, 37, 40, 42, 45, 46].
Although all 13 studies took place in rural regions, two also included urban comparisons [38, 43]. Six of the studies included adults, age 18+ [37, 40, 42, 45–47], four included caregivers (primarily mothers) of vaccine-eligible children [38, 41, 43, 48], and three included girls or boys up to age 18 [36, 39, 44]. The target patient populations for all 13 studies included females; six included women age 18-26 [37, 40, 42, 45–47]; six included adolescent girls age 13-17 [36, 39, 41, 43, 44, 48]; and five included girls age 9-12 [36, 38, 39, 41, 43]. Males were included in the target patient population for four studies: one included men age 18-21 [47]; three included adolescent boys [36, 39, 44]; and two included boys age 9-12 [36, 39]. In terms of data collection methodology: nine used primary data [37, 40–47], two used secondary data [36, 48], and two used both primary and secondary data [38, 39]. Nine studies were cross-sectional [36–38, 41–43, 46–48], three were longitudinal [39, 44, 45], and one was a randomized controlled trial [40]. The most common method of sampling was convenience (n=6) [38, 40–42, 45, 47], followed by population-based (n=4) [36, 39, 43, 48], clinic-based (n=2) [37, 46], and school-based sampling (n=1) [44]. Eleven studies assessed HPV vaccine initiation [36–39, 41–44, 46–48], and only five assessed completion [39, 40, 44, 45, 48]. Eleven studies assessed individual factors [36–38, 40–44, 46–48], five assessed interpersonal [36, 37, 41, 43, 47], two assessed organizational [44, 48], and four assessed community/societal factors [37–39, 48].

TABLE 1. Key Elements of the 13 Included Studies

Study	Study Population (N)	Target Patient Population/s	Methodology	Study Design	Sample Type	Outcome	Domain/s Examined
Bednarczyk et al (2017) [47]	Women or men ages 18+ (N=660)	Women ages 18-26; Men ages 18-21	Survey (primary)	Cross-sectional	Convenience	Initiation	Individual; Interpersonal
Bhatta et al (2015) [36]	Girls, boys, & adolescents ages 11-17 (N=1299)	Girls & boys ages 9-12; Adolescent girls & boys ages 13-17	Survey (secondary)	Cross-sectional	Population-based	Initiation	Individual; Interpersonal
Casey et al (2013) [37]	Women ages 18-26 (N=495)	Women ages 18–26	Survey (primary)	Cross-sectional	Clinic-based	Initiation	Individual; Interpersonal; Community/Societal
Cates et al (2011) [38]	Mothers of girls & adolescent females ages 9-13 (Not Stated)	Girls ages 9-12	Survey (primary); Survey (secondary)	Cross-sectional	Convenience	Initiation	Individual; Community/Societal
Chung et al (2015) [39]	Adolescent girls or boys ages 11-17 (Not Stated)	Girls & boys ages 9-12; Adolescent girls & boys ages 13-17	Survey (primary); Survey (secondary)	Longitudinal	Population-based	Initiation; Completion	Community/Societal
Kepka et al (2012) [41]	Mothers of girls & adolescent females ages 9-17 (N=78)	Girls ages 9-12; Adolescent girls ages 13-17	Survey (primary)	Cross-sectional	Convenience	Initiation	Individual; Interpersonal
Lai et al (2016) [48]	Caregivers of adolescent girls ages 13-17 (N=1291)	Adolescent girls ages 13-17	Survey (secondary)	Cross-sectional	Population-based	Initiation; Completion	Individual; Organizational; Community/Societal
Mills et al (2011) [42]	Women ages 18-26 (N=495)	Women ages 18-26	Survey (primary)	Cross-sectional	Convenience	Initiation[a]	Individual
Reiter et al (2009) [43]	Caregivers of girls & adolescent females ages 10-17 (N=889)	Girls ages 9-12; Adolescent girls ages 13-17	Survey (primary)	Cross-sectional	Population-based	Initiation	Individual; Interpersonal
Vanderpool et al (2011) [46]	Women ages 18-26 (N=247)	Women ages 18-26	Survey (primary)	Cross-sectional	Clinic-based	Initiation	Individual
Vanderpool et al (2013) [40]	Women ages 18-26 (N=344)	Women ages 18-26	Survey (primary)	Randomized controlled trial	Convenience	Completion	Individual
Vanderpool et al (2015) [44]	Adolescent girls or boys ages 14-17 (Not Stated)	Adolescent girls & boys ages 13-17	Survey (primary)	Longitudinal	School-based	Initiation; Completion	Organizational
Vanderpool et al (2015) [45]	Women ages 18-26 (N=344)	Women ages 18-26	Survey (primary)	Longitudinal	Convenience	Completion[b]	Individual

[a] HPV vaccination outcome was defined as "initiation" if participant redeemed vouchers for at least one free vaccine and "refusal" if participant did not redeem the vouchers. The authors modeled "refusal." The results presented were adjusted to describe the direction of the relationship between the independent variables and "initiation."

[b] HPV vaccination outcome was defined as "non-completion" if participant with one dose did not complete the additional two doses and "completion" if participant completed the additional two doses. The authors modeled "non-completion." The results presented were adjusted to describe the direction of the relationship between the independent variables and "completion."

HPV Vaccine Initiation

Summary of Factors Examined

Table 2 summarizes the findings related to barriers and facilitators of HPV vaccine initiation. Most of the examined factors were at the individual- or interpersonal-levels. The most common individual-level factors evaluated were those related to demographics of the vaccine recipient or the caregiver, knowledge about HPV or the vaccine, and attitudes or motivation to vaccinate. The interpersonal-level factors that were most commonly assessed were related to provider communication/influence, caregiver and peer influence, and social support. The relatively few organizational- and community/societal-level factors examined focused on provider characteristics and interventions (organizational) and marketing campaigns (communit,y/societal).

Individual-level Barriers & Facilitators Identified

Individual-level *barriers* to vaccine initiation included older age of caregiver [48], ever having had a Pap test and ever having had an abnormal Pap test [42], caregivers' perceptions that the vaccine would be harmful [43] or painful [46], parents' perceptions that their daughters were at risk for cervical cancer [43] and feelings that their daughters were too young to receive the vaccine [41]. Sexual behavior, namely participation in mutual masturbation was also found to be a significant barrier to vaccine initiation [42].

Individual-level *facilitators* included older age of vaccine recipient [47], female and transfemale gender identity [47], receipt of other vaccines [48], current hormonal contraceptive use [37, 42], caregivers' awareness about cervical cancer and the HPV vaccine, and having heard about the vaccine on radio/television [41]. Knowledge- and awareness-related facilitators included caregivers' knowledge of vaccine recommendations [41], awareness that medical plans and coupons covered vaccine costs, belief that the vaccine was covered by insurance [41, 43], and belief that vaccines were beneficial [46].

Interpersonal-level Barriers & Facilitators Identified

No interpersonal-level *barriers* were found. *Facilitators* of vaccine initiation largely centered on parent/patient/provider relationships and included providers discussing the vaccine with the parent or patient [36] and suggesting [37] or recommending [43, 47] vaccination. The positive influences of parents [37, 41] and peers [37] were also found to be significantly associated with vaccine initiation.

Organizational-level Barriers & Facilitators Identified

No organizational-level *barriers* were noted. Significant *facilitators* included school-based programs to raise awareness and offer vaccinations [44], county-wide provider and health practice training, and use of school-generated patient reminders to improve vaccination delivery [39].

Community/Societal-level Barriers & Facilitators Identified

No community/societal -level *barriers* were found. A county-wide social marketing campaign to raise vaccine awareness [38] was the only *facilitator* of vaccine initiation.

TABLE 2. Barriers and Facilitators of HPV Vaccine Initiation: Examined and Identified

INDIVIDUAL		
Factors Examined[a]	**Barriers Identified* [a,b]**	**Facilitators Identified* [a,b]**
DEMOGRAPHICS: Age, [36, 37, 47, 48] gender, [47] sex, [36, 47] education, [36] race/ethnicity,[36, 48] relationship status, [42] caregiver age, [41, 48] caregiver education, [48] caregiver marital status, [41, 48] caregiver birthplace,[41] caregiver acculturation, [41] caregiver income/poverty, [41, 48] caregiver occupation [41]	Caregiver older age [48]	Older age, [48] *female*, [47] *transfemale* [47]

OTHER IMMUNIZATIONS RECEIVED: Flu,[48] tetanus/diphtheria/pertussis,[48] meningitis [48]		Had received flu vaccine, [48] had received meningitis vaccine, [48] had received tetanus/diphtheria/pertussis vaccine [48]
PAP TEST HISTORY: Ever had Pap test, [37, 42] ever had abnormal Pap test, [37, 42, 45] ever had HPV [42]	Ever had abnormal Pap test, [42] ever had Pap test [42]	Ever had abnormal Pap test [37]
CERVICAL CANCER/VACCINE AWARENESS OF CAREGIVER: Heard of HPV vaccine, [36, 41] heard of cervical cancer, [41] heard of vaccine on TV or radio [41]		*Caregiver heard of vaccine*,[41] *caregiver heard of cervical cancer*, [41] *caregiver heard of vaccine on TV or radio* [41]
CAREGIVER KNOWLEDGE ABOUT HPV OR THE VACCINE: HPV causes cervical cancer, [41] HPV is common, [41] HPV is detectable, [41] HPV vaccine age recommendation, [41] HPV vaccine doses required, [41] medical plans and coupons cover cost [41, 43]		*Caregiver knew HPV vaccine age recommendation*,[41] *caregiver knew only one injection needed for the HPV vaccine*,[41] caregiver knew/believed that medical plans and coupons cover cost [41, 43]
ATTITUDE AND MOTIVATION TO VACCINATE: Considers HPV serious enough to justify vaccination, [46] believes vaccine may cause side effects, [46] considers vaccine to be safe, [46] believes vaccines are good, [46] believes vaccines will be painful, [46] frequency of worry about having HPV, [46] perceives likely to be infected with HPV within 2 years, [46] caregiver considers vaccine to be safe, [43] caregiver perception of vaccine effectiveness, [43] caregiver perception of barriers to getting vaccine, [43] caregiver anticipation of regret over increased vaccine-related sexual activity of daughter, [43] caregiver perception of daughter's likelihood of getting cervical cancer, [43] caregiver belief that it is important to protect daughter from cervical cancer, [41] caregiver belief that vaccine may increase likelihood of daughter having sex, [41] caregiver feeling that daughter is too young for vaccine[41]	Greater caregiver perception of harms associated with HPV vaccine, [43] greater belief that vaccine will be painful, [46] greater caregiver perception of daughter's likelihood of getting cervical cancer, [43] *caregiver feeling that daughter was too young for vaccine* [41]	Belief that vaccines are good [46]
SEXUAL BEHAVIOR: Sex in past 12 months, [37, 42] sex with two or more partners in past 12 months, [37, 42] condom use with partner in past 12 months,[42] mutual masturbation in past 12 months[42]	Participated in mutual masturbation in past 12 months[42]	
STD DIAGNOSIS: Sexually transmitted disease (STD), [42, 45] (friends/family with) genital warts [42, 43]		
(CERVICAL) CANCER DIAGNOSIS: Had cancer diagnosis, [42] friend/family member diagnoses with cervical cancer [37, 42, 43]		
CONTRACEPTIVE USE: Hormonal contraceptive, [37, 42] intrauterine device[42]		Current hormonal contraceptive use[37, 42]
INTERPERSONAL		
PROVIDER COMMUNICATION: Provider talked to patient about HPV vaccine [36]		Provider talked to patient about HPV vaccine [36]
PROVIDER INFLUENCE: Provider recommendation, [43, 47] provider talked about vaccine, [36] provider suggested vaccination [37]		Provider recommendation, [43, 47] provider talked about vaccine, [36] provider suggested vaccination[37]
CAREGIVER INFLUENCE: Parents talked to patient/offspring about vaccine, [36] mom/dad would "definitely want me" to be vaccinated [37, 41]		Parents talked to patient/offspring about vaccine, [36] mom/dad would "definitely want me" to be vaccinated[37]
PEER INFLUENCE: Friends would "definitely want me" to be vaccinated[37]		Friends would "definitely want me" to be vaccinated[37]
SOCIAL SUPPORT FOR THE CAREGIVER: Can talk to healthcare provider, [41] need to communicate with daughter's father before vaccinating, [41] father would want daughter to receive vaccine [41]		*Mother feels father would want daughter to receive vaccine* [41]
ORGANIZATIONAL		
HEALTH INSURANCE: Source (public or private)[48]		
PROVIDER CHARACTERISTICS: Provider practice type, [48] provider health department vaccine source[48]		
SCHOOL-BASED INTERVENTION: Raise awareness and vaccinate [44]		*School-based immunization program implemented in high schools to raise awareness and vaccinate*[44]
PROVIDER-/PRACTICE-BASED INTERVENTION: Improve vaccine delivery [39]		*County-wide provider/practice training to improve vaccine delivery and school-generated phone reminders for (parents of) students to seek vaccination* [39]
COMMUNITY/SOCIETAL		
SOCIAL MARKETTING CAMPAIGN: Raise awareness of vaccine and reduce barriers [38]		*County-wide social marketing campaign to raise awareness of vaccine and reduce barriers* [38]

[a] Unless otherwise noted, barriers and facilitators refer to those of the vaccination recipient/target; [b] Italics denote facilitators/barriers identified in studies that carried out bivariate analyses only (no multivariate).*p<0.05

HPV Vaccine Completion

Summary of Factors Examined

Table 3 summarizes the findings relevant to barriers and facilitators of HPV vaccine completion. The most common individual-level factors that were evaluated included those related to demographics of the vaccine recipient or the caregiver; knowledge about HPV or the vaccine; attitude and motivation with respect to vaccination; and cancer fatalism. The most commonly examined interpersonal factors were provider, peer, and caregiver influence. Organizational-level factors included those related to provider characteristics and interventions. No study evaluated community/societal–level factors

Individual-level Barriers & Facilitators Identified

Barriers to vaccine completion included older ages of caregivers [48] and caregivers' perception that transportation issues would prevent the return for vaccine completion [40]. *Facilitators* included older ages of vaccine recipients [48], receipt of other vaccines [9], intention to complete the 3-dose series [45], perceived lack of control over cancer [40], and receipt of an intervention DVD on the importance of the HPV vaccine [45].

Interpersonal-level Barriers & Facilitators Identified

There were no statistically significant interpersonal *barriers* to completion. However, being accompanied to vaccination by a friend was a *facilitator* for vaccine completion [40].

Organizational Barriers & Facilitators Identified

There were no statistically significant *barriers* to vaccine completion at the organizational level. However, school-based programs to raise awareness and offer vaccinations [44], county-wide provider and health practice training, and use of school-generated patient reminders to improve vaccination delivery [39] were significant *facilitators* of vaccine completion.

TABLE 3. Barriers and Facilitators of HPV Vaccine Completion: Examined and Identified

INDIVIDUAL		
Factors Examined[a]	**Barriers Identified*[a,b]**	**Facilitators Identified*[a,b]**
DEMOGRAPHICS: Age, [45, 48] education, [45] race/ethnicity , [48] caregiver age, [48] caregiver education, [48] caregiver marital status, [48] caregiver income/poverty[48]	Caregiver older age[48]	Older age[48]
OTHER IMMUNIZATIONS RECEIVED: Flu, [48] tetanus/diphtheria/ pertussis, [48] meningitis[48]		Had received flu vaccine, [48] had received meningitis vaccine, [48] had received tetanus/diphtheria/pertussis vaccine [48]
PAP TEST HISTORY: Ever had abnormal Pap test [40, 45]		
KNOWLEDGE ABOUT HPV OR THE VACCINE: Receipt of DVD containing information about HPV, the vaccine, importance of completion, and pointers for overcoming obstacles[45]		Receipt of DVD with information about HPV, the vaccine, importance of completion, and pointers for overcoming obstacles[45]
ATTITUDE AND MOTIVATION TO VACCINATE: Willingness to return for completion if accompanied by friend, [45] perception that transportation issues would prevent return for completion, [40, 45] perception that work schedule would prevent return for completion, [40, 45] belief that 3 doses decrease cervical cancer risk[40, 45] intention to complete 3-dose series, [40, 45] considers vaccine to be safe, [40] a special appointment is required, [40] childcare issues[40]	Perception that transportation issues would prevent return for completion [45]	Intention to complete 3-dose series, [40, 45] belief that 3 doses decrease cervical cancer risk [40]
CANCER FATALISM: Perceived lack of control over cancer, [45]belief that cancer is inevitable[45]		Perceived lack of control over cancer [45]
STD DIAGNOSIS: Sexually transmitted disease[45]		
INTERPERSONAL		
PROVIDER INFLUENCE: Provider reminder call[40]		
PEER INFLUENCE: Return if accompanied by friend, [40] friends have been vaccinated, [40] friends failed to complete series[40]		Being accompanied by a friend[40]

CAREGIVER INFLUENCE: Father encouragement for vaccination completion, [40] mother encouragement for vaccination completion [40]		
ORGANIZATIONAL		
HEALTH INSURANCE: Source (public or private) [48]		
PROVIDER CHARACTERISTICS: Provider practice type, [48] provider health department vaccine source[48]		
SCHOOL-BASED INTERVENTION: Raise awareness and vaccinate [44]		*School-based immunization program implemented in high schools to raise awareness and vaccinate* [44]
PROVIDER-/PRACTICE-BASED INTERVENTION: Improve vaccine delivery [39]		*County-wide provider/practice training to improve vaccine delivery and school-generated phone reminders for (parents of) students to seek vaccination* [39]
COMMUNITY/SOCIETAL		
NOT APPLICABLE		

[a] Unless otherwise noted, barriers and facilitators refer to those of the vaccination recipient/target; [b] Italics denote facilitators/barriers identified in studies that carried out bivariate analyses only (no multivariate).*$p<0.05$

Discussion

Based on the findings of 13 studies, this scoping review summarizes the individual-, interpersonal-, organizational-, and community/societal- level barriers and facilitators to HPV vaccine uptake in US rural settings. The factors examined in the included studies were further organized into major themes, and with some exceptions these themes were applied to both HPV initiation and completion. At the individual level, themes included caregiver and vaccine-recipient demographics, other immunizations received, pap test history, awareness of cervical cancer and the HPV vaccine (initiation only), knowledge about HPV infection or the vaccine, attitudes and motivation to vaccinate, STD diagnosis, sexual behavior (initiation only), cervical cancer history (initiation only), contraceptive use (initiation only), and cancer fatalism (completion only). Interpersonal themes focused on provider influence and communication (initiation only), caregiver and peer influence, and social support for the caregiver (initiation only). At the organizational-level, themes included health insurance, provider characteristics, school-based interventions, and provider/practice-based interventions (completion only). The only community/societal factor examined was related to a social marketing campaign (initiation only). These studies identified several significant barriers and facilitators to HPV vaccine uptake, many of which are amenable to intervention, particularly at the individual- and interpersonal- levels. However, there are several important gaps in the current literature.

Eleven of the 13 included studies took place in just three of the nine US Census divisions. Individual states and Census divisions with large proportions of residents living in rural areas remain unstudied. Although historically rural US communities have been viewed as largely “white,” rural populations are becoming increasingly racially and ethnically diverse[49]. Moreover, there is significant racial and ethnic heterogeneity among rural populations. For example, rural non-Hispanic blacks tend to live in the South Atlantic and the East South Central divisions. Although rural non-Hispanic whites cluster in these same regions, they also cluster in both the West North Central and West South Central divisions, whereas rural Hispanics and rural Native Americans cluster in the West South Central and Mountain divisions, respectively [50]. There are important racial and ethnic differences in health care access and utilization, and health-related behaviors, among rural residents [51] that may differentially influence HPV vaccine uptake. Future studies assessing barriers and facilitators to HPV vaccine uptake should account for racial and ethnic differences by expanding the geographic areas studied.

Another important area for further research is a greater focus on rural males. US boys are significantly less likely to initiate and complete HPV vaccination compared with girls [52]. Past studies of non-rural populations have demonstrated important gender differences which contribute to the observed variation in vaccine uptake. For example, compared to parents of daughters, parents of sons were more likely to report not getting a provider's recommendation or not being aware that the vaccine was available for their child, but less likely to report concerns about vaccine safety [53]. Only four of the studies included males, and thus we know little about gender-specific barriers and facilitators in rural populations.

Notably, only two of the studies assessed organizational-level factors [44, 48] . The expansion of alternative vaccine-administration sites for adolescents, including pharmacies [54, 55] and school health centers [56, 57] , may increase HPV uptake in rural populations once feasibility issues are addressed [58, 59]. Additional studies are warranted to determine whether these and other organizational-level factors will prove acceptable and adoption in rural populations. Further studies investigating the expansion of rural vaccine-administration sites and providers such as dentists are also warranted.

Community/societal factors that relate to broadly defined "culture," policies, and programs that increase acceptance and availability of the HPV vaccine, such as the adoption of school-entry requirements that permit opt-out provisions, [60, 61] were examined in just four of the included studies [37–39, 48]. There is a longstanding view that rural populations hold a distinct perspective of health that is associated with the "ability to work" [62, 63]. This definition of health may contribute to barriers to certain health-promoting behaviors [64], which could include primary prevention such as vaccinations. Importantly, rural populations are not homogeneous in terms of culture, economic hardship, community identity, and values. Thus, it is critical to assess barriers and facilitators of HPV vaccine uptake in the context of these community/societal dimensions, and across a diverse sample of US rural populations.

Finally, only five of the included studies considered barriers and/or facilitators to vaccine completion. Post-licensure studies report higher effectiveness with vaccine completion (i.e., two and three doses) [65]. Although research is underway to determine the effectiveness of a single-dose strategy [66, 67], the current recommendations consider two to three doses to be full protection [14]. Across demographic groups, initiation rates are consistently higher than completion rates[52, 68], suggesting that there may be different drivers of vaccine completion and highlighting the importance of investigating barriers and facilitators to both vaccine outcomes in US rural populations.

Limitations of this scoping review include the possibility that studies were missed. Our ability to identify all of the relevant literature was limited by the manner in which geographical locations are indexed in databases such as PubMed. For example, MeSH terms and geographic locations are not always captured by the indexers. This was further confounded by fact that many abstracts did not note whether the studies took place specifically among rural populations. Although our initial search captured numerous studies set in the Appalachian Region, which includes rural, semi-urban, and urban settings [69], after reviewing the articles we could not confirm that they were set in rural Appalachia. It is worth noting that only four of the 13 included studies assessed barriers and facilitators in multivariate models, with the rest conducting less statistically rigorous bivariate analyses. Finally, studies set in rural regions that were either qualitative (N=13), did not present results stratified by rurality (N=13), did not specifically assess vaccine uptake (N=23), or were either quality improvement projects (N=1) or systematic reviews (N=1) were excluded from the final group of included articles.

Conclusions

This scoping review is the first effort in the recent literature to delineate barriers and facilitators to HPV vaccine uptake in US rural populations across multiple studies. In line with the global movement to eliminate HPV-related cancers, it is critical to optimize efforts aimed at increasing HPV vaccination coverage [70]. Our findings intend to inform action in the clinical and community environments, the research world, and the policy sphere. Our study determined that more research is needed at the interpersonal, organizational, and community/societal levels, in order to supplement the research focused on individual-level factors. We have identified compelling factors at the interpersonal level, such as caregiver- and peer- influence factors, as well as social support for caregivers. Promising facilitators identified at the organizational level include a school-based immunization program in high schools and a county-wide provider/practice training program. We are hopeful that our findings detailing the factors that have been shown in this scoping review to be associated with HPV vaccine uptake will inform future clinical, health services, and community research, as well as interventions and policy efforts.

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