ORIGINAL RESEARCH

Rural Adolescent Immunization: Delivery Practices and Barriers to Uptake

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Background: **Rural adolescent vaccination rates lag behind urban. We sought to assess rural-urban differences in barriers to adolescent vaccination, perceived parental vaccine attitudes, and immunization delivery practices among public health nursing (PHN), pediatric (Peds), and family medicine (FM) clinicians.**

Methods: **Internet and mail survey of Colorado PHN, Peds, and FM clinicians from June-August 2019. Study population was recruited from local health plans and the American Medical Association Physician Masterfile. Rural and urban responses were compared using Cochran Armitage trend, Fisher's exact, and chi-square tests.**

Results: **Response rate was 38% (163/433; 91 rural, 72 urban). Rural respondents were less likely than urban to agree most patients have insurance that covers vaccination (86% vs 97%; $P = .02$). Rural respondents were less likely than urban to indicate most parents in their practice would agree with statements about vaccine benefits ($P = .02$) and trust in medical providers ($P = .05$). Rural respondents were more likely than urban to report adolescents were somewhat/very likely to receive vaccines at public health departments (65% vs 28%; $P < .0001$) and less likely to report adolescents were somewhat/very likely to receive vaccines at pharmacies (26% vs 45%; $P = .02$). Fewer providers strongly recommended HPV vaccine (81% for females, 80% for males 11 to 12 years) than other adolescent immunizations (Tdap: 97%, MenACWY at 11 to 12 years: 87%; influenza at 11 to 17 years: 87%; each $P < .005$, rural-urban responses did not differ).**

Conclusions: **Rural barriers to adolescent vaccination include logistic issues and parental vaccine attitudes. Efforts to improve rural adolescent vaccination should include public health departments and address vaccine confidence and access barriers. (J Am Board Fam Med 2021;34:937–949.)**

Keywords: **Adolescent Health, Chi-Square Test, Colorado, Immunization, Pediatrics, Public Health Nursing, Rural Health, Surveys and Questionnaires**

Introduction

The Advisory Committee on Immunization Practices (ACIP) recommends routine immunization with tetanus, diphtheria, and acellular pertussis (Tdap), meningococcal conjugate (MenACWY), human papillomavirus (HPV), and seasonal influenza vaccines for all 11- to 12-year-olds, leading Healthy People 2020 to set a goal of 80% coverage for routine adolescent vaccines.[1,2] The 2019 National Immunization Survey-Teen (NIS-Teen)

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found that 90% of all 13- to 17-year-olds had received ≥1 dose of Tdap, 89% had received ≥1 dose MenACWY, 72% had received ≥1 dose HPV, and 54% had completed the HPV vaccination series.[3] In the same year, vaccination rates for 13- to 17-year-olds living in rural areas were 89%, 84%, 64%, and 47% for ≥1 dose of Tdap, ≥1 dose MenACWY, ≥1 dose HPV, and HPV series completion, respectively.[3] This gap in HPV vaccination coverage among rural adolescents has been a persistent disparity since at least 2013.[4] Even though rural-urban differences in influenza vaccination were not described in these studies, the National Immunization Survey-Flu (NIS-Flu) found that 52% of 13- to17-year-olds received an influenza vaccine during the 2018-19 season.[5]

Studies of adolescent vaccination, many focused on the HPV vaccine and conducted among urban and suburban populations, have identified a lack of a provider recommendation, financial and insurance concerns, questions about the need for vaccination and vaccine safety, and decreased access to care or low health care-seeking behavior as barriers to vaccination.[6–11] Less is known about barriers to vaccination for rural adolescents. Studies of rural adolescent HPV vaccination have identified the influence of race, religion, parental education, and lack of collaborative provider communication as barriers, along with some of the same issues noted across geographic settings.[12–17] While the gap between rural and overall vaccination rates is larger for HPV, rural adolescent Tdap and MenACWY rates also lag as research focuses on HPV. Rural adolescent vaccination must also be understood in the context of more general rural health challenges such as financial constraints, lack of health care providers, and transportation barriers.[18,19] More research is needed on barriers to vaccination among rural adolescents, including studies that address all adolescent vaccinations alongside HPV.

Colorado consists of 64 counties, of which 17 are urban, and 47 are rural (including a subset of 23 very sparsely populated frontier counties).[20] A majority of rural counties in Colorado had adolescent vaccination rates that were below the state average for Tdap, MenACWY, and HPV in 2018.[21] In this survey, our objective was to assess whether there were rural-urban differences in perceived logistic barriers to adolescent vaccination, perceived parental vaccine confidence and beliefs, and adolescent immunization delivery practices among Colorado vaccine providers, including public health nursing (PHN), pediatric (Peds), and family medicine (FM) clinicians. While most of the survey addressed adolescent vaccination in general, perceived parental HPV vaccine beliefs were measured separately because adolescent HPV vaccination rates continue to lag behind Tdap and MenACWY.[22]

Methods

Study Population

Between June and August 2019, we administered an Internet and mail survey to practicing PHN, Peds, and FM clinicians in Colorado. The Colorado Multiple Institutional Review Board approved this study. We recruited PHN, Peds, and FM clinicians from 16 rural counties in Colorado's Western Slope region and 4 urban Colorado counties. Rural counties in eastern Colorado were excluded due to the presence of concurrent adolescent vaccination projects that may have impacted provider attitudes and experiences in those locations. Counties were classified using the Office of Management and Budget definition: urban counties are part of a Metropolitan Statistical Area. All counties not part of a Metropolitan Statistical Area are rural.[20,23] Public health nursing clinicians were identified using a Colorado Department of Public Health and Environment (CDPHE) list of public health directors and immunization program leaders. Pediatric and FM clinicians were identified from the American Medical Association (AMA) Physician Masterfile supplemented with a local health plan provider list for Western Colorado to identify additional rural providers. To facilitate comparisons between rural and urban providers, we sampled roughly equally between the 2 groups (n = 227 rural, n = 210 urban providers). In rural counties, we included all Peds (because there are few Peds in rural locations[24]), filled the remainder of the sample with randomly selected FM clinicians, and included up to 2 PHNs per county. In urban counties, we filled 2-thirds of the sample with Peds and 1-third with FM clinicians (to reflect national trends in the distribution of adolescent vaccine visits by PCPs[25]), and we included up to 2 PHNs per county.

Survey Design

Logistic barriers to adolescent vaccination were measured using a 4-point Likert scale ("strongly agree," "somewhat agree," "somewhat disagree,"

"strongly disagree"). Perceived parental vaccine confidence was measured using an adapted version of the 8-item Vaccination Confidence Scale.[26] The Vaccination Confidence Scale has been validated using parent responses and was adapted for this survey to ask providers what proportion of parents in their practice would agree with each item in the scale: 0% to 25%, 26% to 50%, 51% to 75%, or >75%. We used the same response options to ask providers what proportion of parents in their practice, they thought believed several statements related to adolescent HPV vaccination. Respondents were asked whether they routinely administer each adolescent vaccine (Tdap, MenACWY, HPV, influenza), and responses were collapsed into yes ("Yes routinely") or no ("Yes, stock and administer on request" or "No"). Use of locations where adolescent patients are likely to go for vaccination was assessed using a 4-point Likert scale ("not at all likely," "a little likely," "somewhat likely," "very likely"). Use of evidence-based immunization delivery practices was measured with yes/no questions about whether a respondent's practice used standing orders for vaccination, walk-in or vaccine-only visits, and reminders or recall notifications for vaccination. Provider vaccine recommendation practices were measured separately for each adolescent vaccine and for patients of different ages using a 4-point response scale ("strongly recommend the vaccine," "recommend the vaccine, but not strongly," "make no recommendation," "recommend against the vaccine").

Survey Administration

Surveys were sent via e-mail (Qualtrics) and/or mail based on the contact information available from public health, AMA, and local health plan databases. Providers with only e-mail addresses available received an initial e-mail message followed by up to 8 e-mail reminders. Providers with only physical addresses available received an initial mailing with up to 2 mailed reminders. Providers with both e-mail and physical addresses available received up to 9 e-mail contacts interspersed with up to 3 mailings.

Statistical Analysis

We combined Internet and mail survey responses for analyses because prior work has shown that physician attitudes about vaccination are similar when obtained by either method.[27–29] Nonrespondent characteristics were obtained from the AMA and local health plan databases. We used descriptive statistics to summarize survey results. The chi-square test of proportions or Fisher's exact test was used to assess differences between responses from rural and urban providers for the use of evidence-based immunization delivery practices and vaccine recommendation practices. For items with Likert-type response scales, the Cochran Armitage trend test was applied to assess for differences between responses from rural and urban providers. For items in which too few respondents selected 1 or more Likert response categories, the Fisher's exact test was used instead. To preserve interpretability of results in the text, we combined response categories for perceived logistic barriers to vaccination ("strongly agree" with "somewhat agree" and "somewhat disagree" with "strongly disagree") and adolescent vaccination location items ("not at all likely" with "a little likely" and "somewhat likely" with "very likely") and used chi-square tests to compare rural and urban responses. Statistically significant results of rural-urban comparisons for these combined response categories are only presented in text when rural-urban comparisons of non-combined response categories using Cochran Armitage trend tests are also statistically significant ($P \leq .05$). All analyses were performed using SAS 9.4 (Cary, NC).

Results

From our survey sample of 437 providers, 30 opted out of additional contact, and 4 were unable to be contacted due to inaccurate e-mail or mailing addresses. The response rate was 38% (163/433; 91 rural, 72 urban); 15 surveys were incomplete, limiting most analyses to 148 respondents (79 rural, 69 urban). Compared with nonrespondents, respondents were more likely to work in public health or pediatrics (Table 1). Rural respondents were less likely than urban respondents to be physicians and work in pediatrics and were more likely to specialize in family medicine or public health (Table 2). Rural respondents saw fewer adolescent patients in their practice, had fewer Black/African American patients, and had more patients insured by Medicaid than urban respondents.

Perceived Logistic Barriers and Facilitators of Adolescent Vaccination

Overall, 59% of providers somewhat/strongly agreed that adolescents do not come to primary care for annual well visits, and 36% somewhat/

Table 1. Characteristics of Respondents and Non-Respondents for a Survey of Colorado in Clinicians 2019. Percentages May Not Add to 100 Due to Rounding

Characteristic	Respondents N = 163 n (%)	Nonrespondents N = 240 (%)	*P* value*
Location			.32
Rural	91 (56)	122 (51)	
Urban	72 (44)	118 (49)	
Provider specialty			<.001
Pediatrics	73 (45)	95 (40)	
Family Medicine	48 (29)	125 (52)	
Public Health	31 (19)	3 (1)	
Unknown	11 (7)	17 (7)	

*Chi-square test comparing respondents and nonrespondents.

strongly agreed that parents often take adolescents places other than their primary care doctor's office for vaccines. More than 85% of respondents somewhat/strongly agreed with statements describing facilitators for adolescent vaccination in their community (Figure 1). Rural respondents were less likely than urban respondents to agree with the statement, "Most of my patients have insurance that covers vaccination costs" (86% vs 97%, $P = .02$). Agreement with other statements about barriers and facilitators for adolescent vaccination did not differ by rural versus urban location.

Perceived Parental Vaccine Confidence and HPV Vaccine Beliefs

Provider Perceptions of Parental Vaccine Confidence

When asked about the proportion of parents in their practice who would agree with various statements indicating confidence in vaccines, most respondents indicated that >75% of parents would agree with statements about trust in medical providers and benefits of vaccines and that ≤25% of parents would agree with statements about harms related to adolescent vaccination (Figure 2). Rural respondents were less likely than urban respondents to indicate that large percentages of parents in their practice would agree that vaccines are necessary to protect the health of adolescents ($P = .02$) and that medical professionals in charge of vaccinations have their adolescent's best interest at heart ($P = .05$, Figure 2).

Provider Perception of Parental HPV Vaccine Beliefs

When asked about various HPV vaccine belief statements, the statements that most respondents reported large proportions of parents in their practice would agree with were "Parents experience discomfort talking with their adolescent about sex," "Their adolescent does not need the vaccine because they are not sexually active," and "Their adolescent is unlikely to get an HPV-related disease" (Figure 3). Responses to perceived parental HPV vaccine belief items did not differ by rural versus urban location.

Vaccine Availability/Location of Vaccination

Vaccine Administration/Stocking

Eighty-four percent of all respondents routinely administered MenACWY vaccine, 86% HPV vaccine, 88% Tdap vaccine, and 92% influenza vaccine. There were no differences in whether respondents routinely administered any adolescent vaccinations by rural-urban location.

Location of Vaccination

Ninety-four percent of all respondents indicated that adolescents were somewhat/very likely to receive vaccines from a primary care clinic. Overall, fewer respondents indicated adolescents were somewhat/very likely to receive vaccines at a public health department (48%), pharmacy (35%), or hospital-based immunization clinic (15%). Thirty-nine percent of respondents indicated adolescents might receive vaccinations at other locations, including school-based health, urgent care, and walk-in clinics. More rural respondents than urban respondents indicated that adolescents were somewhat/very likely to receive vaccines at a public health department (65% vs 28%, $P < .0001$). Fewer rural than urban respondents indicated that adolescents were somewhat/very likely to receive vaccines at a pharmacy (26% vs 45%, $P = .02$; data not shown in figures/tables).

Provider Vaccine Delivery and Recommendation Practices

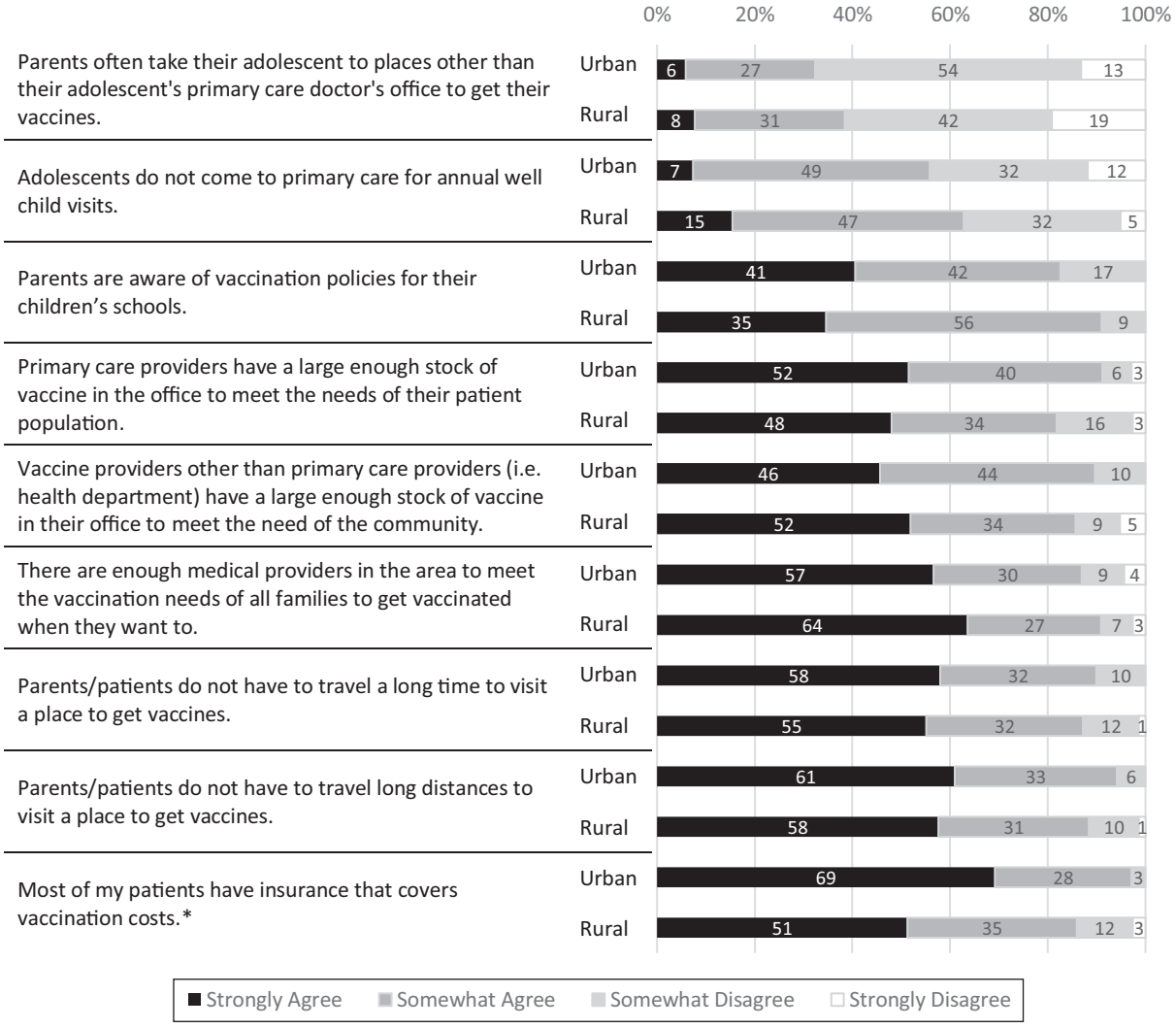
Evidence-Based Practices for Immunization Delivery

Alternative visit types (eg, walk-in or immunization-only visits) and standing orders for immunization were used by 90% and 75% of respondents,

Table 2. Respondent Characteristics for a Survey of Colorado Clinicians in 2019 (n = 148). Percentages May Not Add to 100 Due to Rounding. *Chi-Square Test Comparing Rural and Urban Respondents

Characteristic	All Respondents N = 148 n (%)	Rural N = 79 n (%)	Urban N = 69 n (%)	*P* value*
Female	95 (64)	53 (67)	42 (61)	.43
Job role				.0002
Medical doctor	119 (80)	54 (68)	65 (94)	
Advanced practice provider (nurse practitioner, physician assistant)	5 (3)	4 (5)	1 (1)	
Nurse or medical assistant	16 (11)	15 (19)	1 (1)	
Public health provider	8 (5)	6 (8)	2 (3)	
Medical specialty				<.001
Pediatric	73 (50)	22 (28)	51 (74)	
Family Medicine	50 (33)	37 (47)	13 (19)	
Public Health	23 (16)	19 (24)	4 (6)	
General/Internal Medicine	2 (1)	1 (1)	1 (1)	
Years practicing in current geographic area (n = 146)				.33
<10	47 (32)	29 (38)	18 (26)	
10 to 19	58 (40)	28 (36)	30 (44)	
≥20	41 (28)	20 (26)	21 (30)	
Number of adolescents practice sees in a typical week				.004
<50	67 (45)	43 (54)	24 (35)	
50 to 99	40 (27)	23 (29)	17 (25)	
≥100	41 (28)	13 (17)	28 (41)	
Percentage of patients Hispanic/Latino (n = 136)				.44
0% to 9%	27 (20)	16 (22)	11 (18)	
10% to 24%	43 (32)	19 (26)	24 (38)	
25% to 49%	36 (27)	22 (30)	14 (22)	
50% to 100%	30 (22)	16 (22)	14 (22)	
Percentage of patients Black/ African American (n = 136)				<.001
0% to 9%	111 (82)	70 (95)	41 (66)	
10% to 24%	23 (17)	4 (5)	19 (31)	
25% to 49%	1 (1)	0 (0)	1 (2)	
50% to 100%	1 (1)	0 (0)	1 (2)	
Percentage of patients insured by Medicaid (n = 136)				<.001
0% to 9%	13 (10)	3 (4)	10 (16)	
10% to 24%	30 (22)	9 (12)	21 (34)	
25% to 49%	35 (26)	24 (32)	11 (18)	
50% to 100%	58 (43)	38 (51)	20 (32)	
Percentage of patients uninsured (n = 129)				.12
0% to 9%	99 (77)	49 (69)	50 (86)	
10% to 24%	18 (14)	12 (17)	6 (10)	
25% to 49%	5 (4)	4 (6)	1 (2)	
50% to 100%	7 (5)	6 (9)	1 (2)	

Figure 1. Provider Agreement with Statements About Logistic Barriers and Facilitators of Adolescent Vaccination Among Colorado Clinicians in 2019 (n = 148). *$P = .02$, chi-square test comparing rural and urban responses between strongly agree or somewhat agree versus strongly disagree or somewhat disagree; $P < .01$, Cochran Armitage trend test comparing rural and urban responses across all 4 response categories.

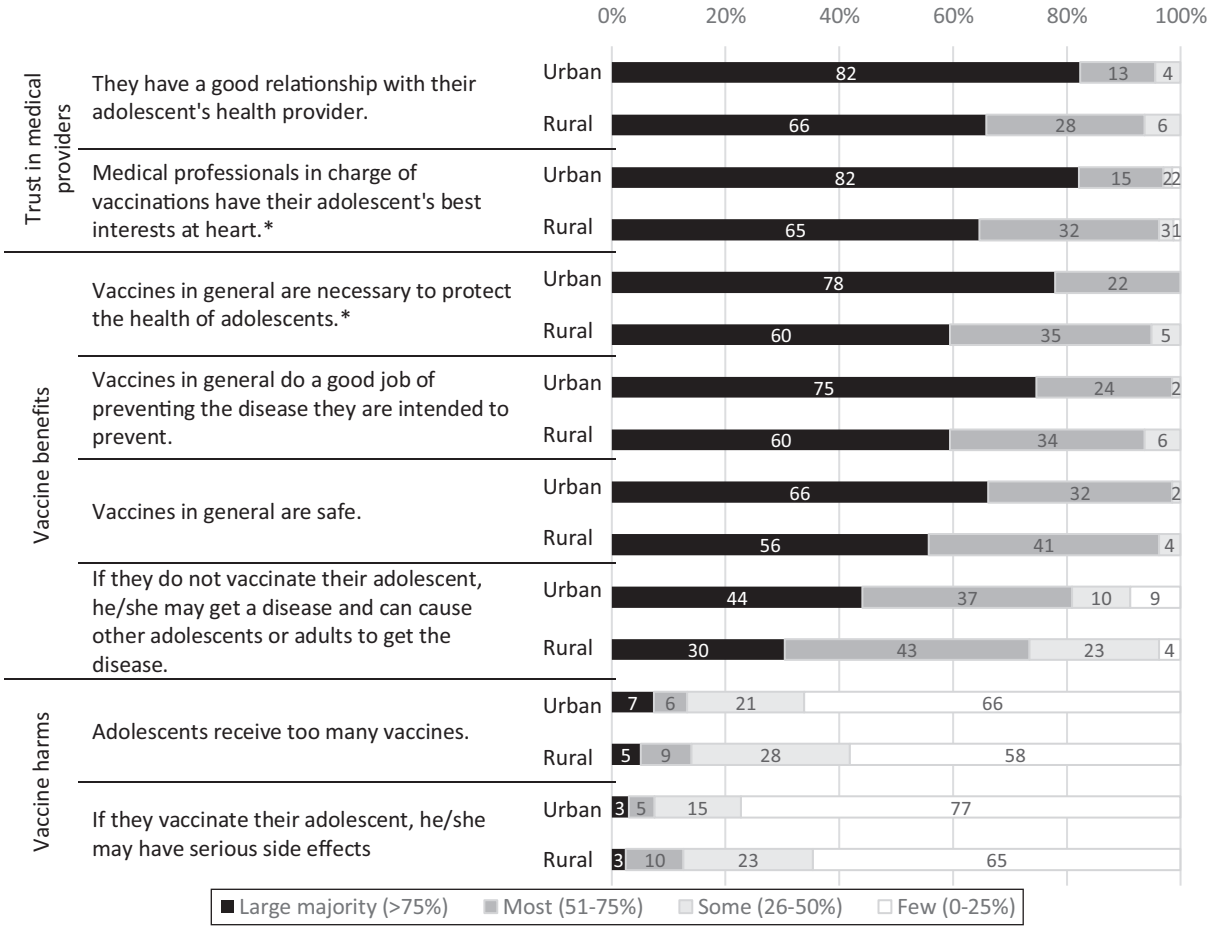


respectively, while fewer respondents used reminders for patients due for vaccination (49%) or recall notifications for patients overdue for vaccination (48%). There were no differences in reported use of evidence-based immunization delivery practices based on rural-urban location (data not shown in figures/tables).

Recommendations for Vaccination

Almost all respondents strongly recommended Tdap for unvaccinated 11- to 12- and 13- to 17-year-olds (97% for both, Figure 4). For MenACWY, 87% strongly recommend vaccination for 11- to 12-year-olds, and 94% strongly recommend vaccination for 13- to 17-year-olds. The proportion of respondents who strongly recommended HPV vaccination was 81% for 11 to 12-year-old females and 80% for 11 to 12-year-old males and increased to 87% for 13- to 17-year-old females and 85% for 13- to 17-year-old males. Eighty-seven percent of respondents strongly recommended influenza vaccination for 11 to 17-year-olds. The proportion of providers who strongly recommended HPV vaccine for 11- to 12-year-olds was lower than the proportion who strongly recommended Tdap for 11 to 12-year olds, MenACWY for 11 to 12-year-olds, and influenza for 11- to 17-year-olds ($P < .005$ for

Figure 2. Provider Report of the Proportion of Parents in Their Practice Who Would Agree with Adolescent Vaccine Confidence Statements Among Colorado Clinicians in 2019 (n = 147). *$P \leq .05$, Fisher's exact test comparing rural and urban responses across all response categories for each item.



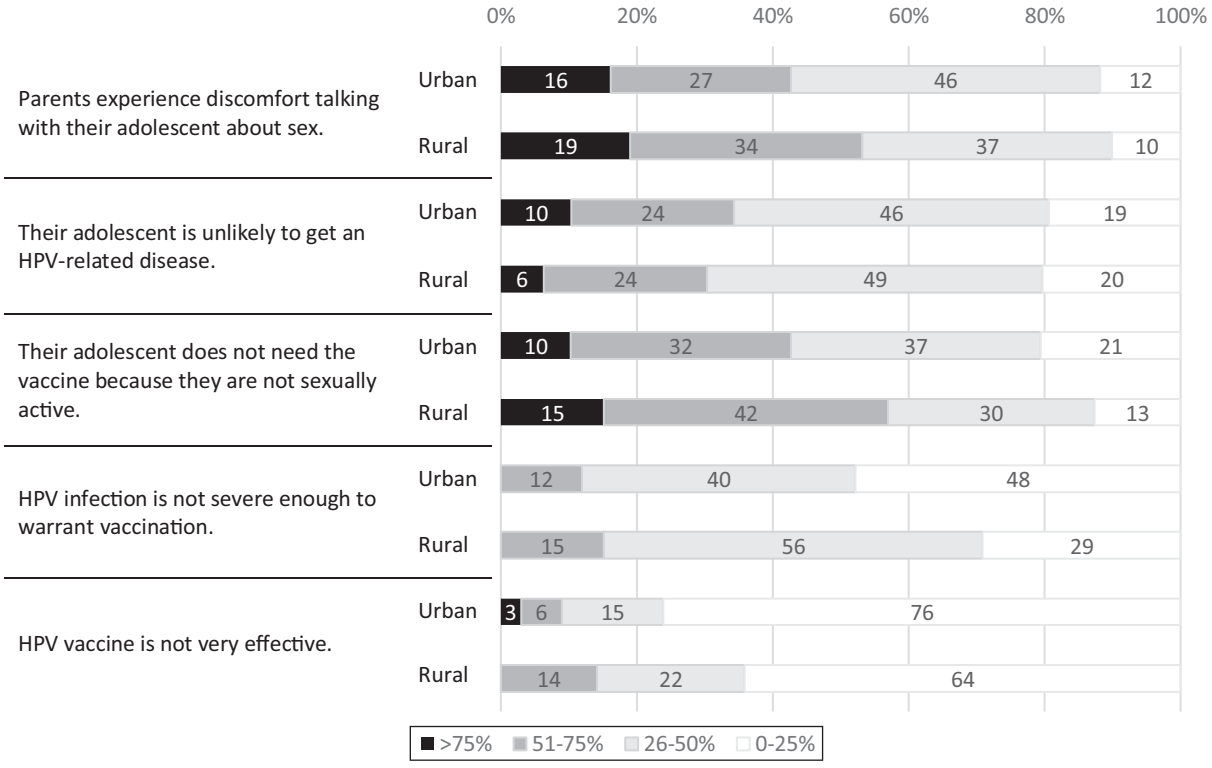
each bivariate comparison for females and males, Figure 4). Recommendation practices for Tdap, MenACWY, HPV, and influenza did not differ between rural and urban respondents.

Discussion

Rural and urban providers reported logistic and perceived parental attitude barriers to adolescent vaccination in Colorado. Rural providers were more likely than urban to identify insurance coverage and perceived parental vaccine confidence barriers. Rural respondents also reported an increased likelihood for adolescents to receive vaccines in a public health department compared with urban providers. Vaccine recommendation practices did not differ between rural and urban providers; across rural and urban groups, providers were less likely to strongly recommend HPV vaccine than other adolescent vaccines.

Our survey showed that providers perceived some concerns about vaccine benefits and the need for vaccination to be more common among parents of rural adolescents than urban. Parental questions about whether adolescent vaccines are necessary and uncertainty or lack of knowledge about the severity of disease prevented by these vaccines are commonly identified barriers to vaccination across geographic settings, particularly for the HPV vaccine.[6–10] Noting the increased perceived prevalence of these barriers in rural settings, evidence-based interventions to increase adolescent vaccination in rural areas must address parental vaccine confidence and vaccine attitudes alongside logistic barriers. Provider communication strategies that have been shown to increase HPV vaccine uptake include

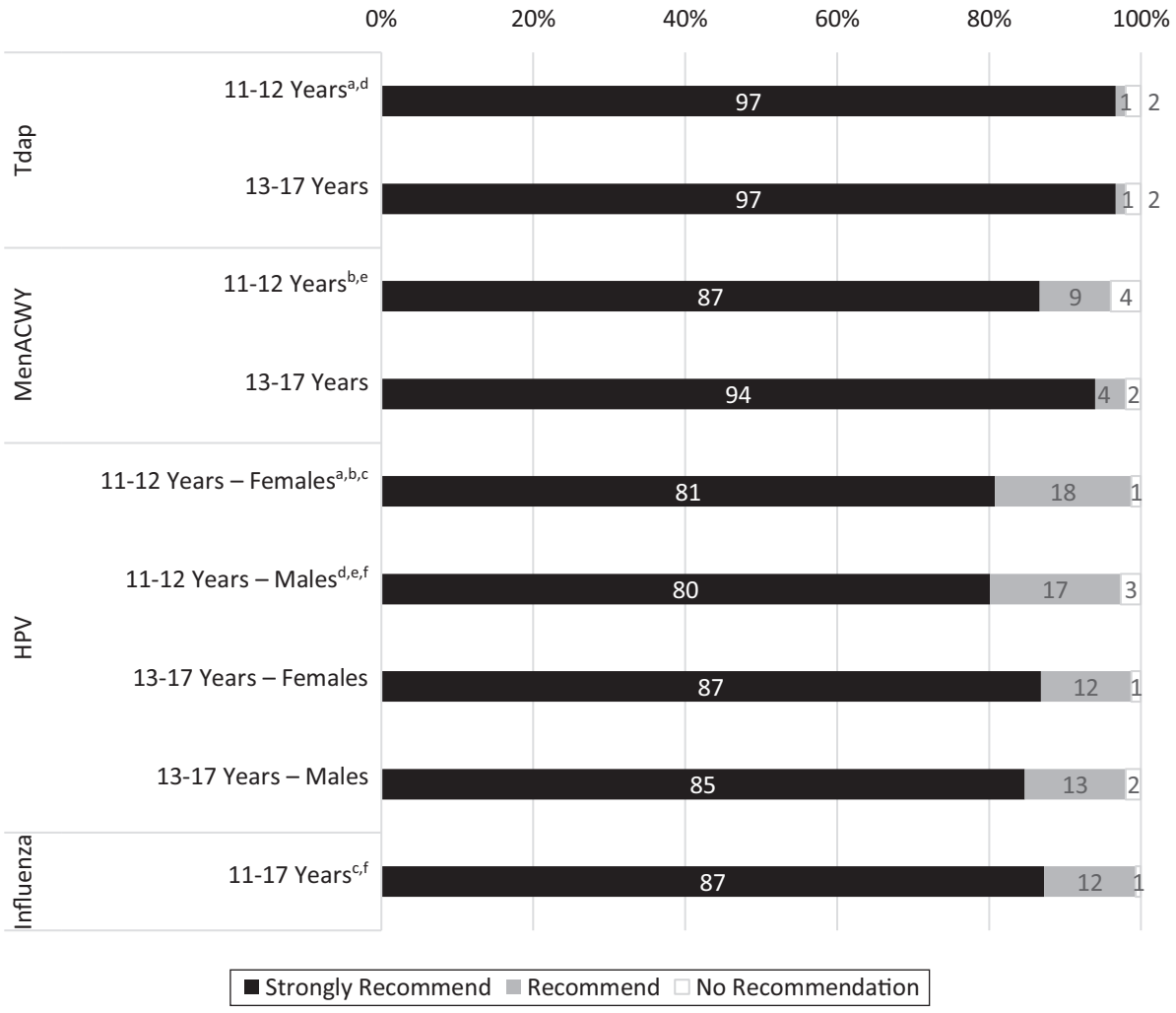
Figure 3. Provider Report of the Proportion of Parents in Their Practice Who Would Agree with Human Papillomavirus (HPV) Vaccination Belief Statements Among Colorado Clinicians in 2019 (n = 147). There were no significant differences between rural and urban responses for perceived parental HPV vaccination beliefs.



using an announcement approach[30] to vaccine recommendations or presumptive recommendation and motivational interviewing.[31] These strategies may need to be adapted to ensure effectiveness in rural settings as rural parents may have different underlying reasons for decreased vaccine confidence and different responses to these communication techniques. Studies in various rural settings have identified parental education and religion as factors associated with decreased vaccination; these might be prominent drivers of vaccine confidence in rural areas. For example, rural providers in Kentucky identified that a lack of HPV vaccine education and lack of promotional materials adapted for their location, and low parental literacy were barriers to vaccination.[15] In contrast, results from a study of national data from the Behavioral Risk factor Surveillance System showed girls whose mothers had lower income and educational achievement were more likely to receive HPV vaccine in rural areas than urban.[12] A survey of parents of adolescents in rural Ohio showed that increased religiosity was associated with vaccine refusal.[32] Another survey of African-American parents in rural Georgia found that Baptist parents were less likely to report intent to vaccinate for HPV;[16] interviews with African-American parents in rural Georgia found that religiosity was a prominent influence on vaccination decisions.[33] In addressing parental vaccine concerns and vaccine confidence among rural parents, messages adapted for a broad range of education levels and tailored to religious beliefs may be necessary.

Perceived logistic barriers more commonly reported by rural providers than urban ones included lack of insurance and differences in locations for adolescent vaccination. Fewer rural providers agreed that most of their patients have insurance covering vaccination costs, including uninsured or underinsured families. In a 2019 survey, 4.3% of Colorado children ≤18 years old were uninsured, and 16.9% had changed insurance, gained, or lost coverage within the preceding 12 months; direct rural-urban comparisons were not included in this report.[34] In general, a higher proportion of people in rural areas of the United States are uninsured[35], and a higher proportion relies on public insurance than in nonrural areas.[36]

Figure 4. Strength of Provider Recommendation for Vaccination by Vaccine type and Patient Age Among Colorado Clinicians in 2019 (n = 146). Proportion of respondents who strongly recommend HPV vaccine for 11- to 12-year-old females was significantly lower than the proportion of respondents who strongly recommend Tdap at 11 to 12 years([a]), MenACWY at 11 to 12 years([b]), and influenza at 11 to 17 years([c]) [Chi-square test, $P < .005$ for each bivariate comparison]. The proportion of respondents who strongly recommend HPV vaccine for 11- to 12-year-old males was also significantly lower than the proportion of respondents who strongly recommend Tdap at 11 to 12 years([d]), MenACWY at 11 to 12 years([e]), and influenza at 11 to 17 years([f]) [$P < .001$ for each bivariate comparison]. HPV, human papillomavirus; MenACWY, meningococcal conjugate, Tdap, tetanus, diphtheria, and acellular pertussis.



Rural communities often have fewer insurance options, and those insurers often have limited provider networks.[37] While commercial insurance plans must cover ACIP-recommended vaccinations under the Affordable Care Act,[38] grandfathered employer-sponsored insurance plans and alternative coverage arrangements (eg, health care sharing ministries and transitional policies) are not subject to the same regulation.[39] A lack of adequate health insurance options may lead rural families to choose alternative coverage arrangements, although data on this concern are lacking. Insurance barriers could be addressed with policy interventions to improve insurance coverage in rural markets or to tighten regulations on alternative coverage arrangements.[39] Some uninsured or underinsured rural adolescents may also be eligible for, but not enrolled in, Medicaid or the Children's Health Insurance Program (CHIP). Increasing Medicaid enrollment and access to free vaccinations for

uninsured families through the Vaccines for Children (VFC) program would not require policy changes and could be accomplished through improved communication about and linkage to existing services.

Rural providers were more likely than urban to report that adolescents were likely to receive vaccinations at the public health department, which may be another logistic barrier for some rural families. Rural providers also reported higher proportions of their patients covered by Medicaid. For some primary care providers, regulatory and record-keeping standards of the VFC program[40] and concerns about reimbursement for the administration of VFC vaccines[41] are deterrents for participation in the VFC program that provides vaccines at no cost for children and adolescents insured by Medicaid, among others. Rural primary care providers who see small numbers of children and adolescents may be even less motivated to participate in VFC if they must take on challenging regulatory requirements and concerns about reimbursement to provide a service to a small portion of their patient population. Rural families who are underinsured or covered by Medicaid may not be able to afford vaccination at their primary care clinic, particularly if that clinic does not participate in VFC. These families may seek medical care in the clinic and then need to make a second trip for vaccination at the public health department. Public health departments provide vital access to low- or no-cost vaccines; however, they cannot address the full spectrum of other pediatric and adolescent health needs. Some families accessing vaccinations through public health departments might forgo additional primary care services entirely, missing important medical and developmental care for these adolescents. A 2005 study of National Health Interview Survey data showed that rural adolescents were less likely than urban adolescents to report a preventive health visit in the prior year.[42] Efforts are needed to link vaccination services with primary medical care in clinics and public health department vaccination programs.

Fewer rural providers reported that adolescents were likely to receive vaccinations at pharmacies. Although pharmacies are unlikely to address the concern about disconnecting vaccination from primary care, pharmacies provide opportunities for vaccination access and seem to be less commonly used or less commonly available for rural adolescents. This finding may reflect poorer access to pharmacies in rural areas[43–45] or differences in services provided at rural pharmacies.

We did not find differences between rural and urban providers in evidence-based practices for immunization delivery or vaccine recommendation practices. There is room to increase the use of standing orders, reminders, and recall notifications among the providers surveyed (use reported by 75%, 49%, and 48%, respectively); however, relying on these strategies alone is unlikely to address the gap in rural and urban adolescent vaccination rates. The proportion of providers who strongly recommend Tdap, MenACWY, HPV, and influenza vaccination did not differ between rural and urban respondents. Both rural and urban providers were less likely to strongly recommend HPV vaccination than other adolescent vaccinations, as shown in prior research.[46] Continued efforts are needed to increase provider use of a strong recommendation for HPV vaccination for adolescents of all ages, highlighting the importance of recommending on-time vaccination for 11- to 12-year-olds. However, addressing provider recommendations alone is unlikely to address lagging HPV vaccine uptake in rural areas completely.

These survey results should be interpreted in the context of some limitations. Our response rate was low, and nonrespondents may have different vaccination practices, experiences, and views than respondents. Providers who do not stock and administer adolescent vaccinations or who see few adolescents in their practice may not have responded to the survey, and unique barriers among those providers may be missing from our data. Rural-urban differences in survey responses may reflect differences in geographic setting and may also be influenced by medical specialty; rural respondents were more likely to be FM or PHN clinicians. Survey data are based on provider self-report and may not reflect actual practice. We did not survey parents directly, and provider reports may not accurately reflect parental vaccine beliefs and attitudes. Providers may hold biases that impact their perceptions of rural and urban adolescents and parents differently and therefore influenced their survey responses. Surveys or interviews with parents could directly measure parental vaccine attitudes while investigating whether the provider and parental perceptions are similar and whether the accuracy of provider perceptions differs for rural adolescents and parents. Our study team has

conducted qualitative interviews with Colorado parents and providers to explore barriers to adolescent vaccination unique to rural areas; final data analysis is forthcoming.[47] Finally, these data may not represent experiences across all Colorado counties or among all types of Colorado clinicians. Results may not be generalizable outside Colorado, including in other rural settings.

Rural barriers to adolescent vaccination include unique logistic issues and prominence of perceived parental vaccine attitude barriers common to rural and urban settings. To improve rural adolescent vaccination uptake, interventions must address both of these domains. Efforts should include work by providers and health systems to increase awareness of the need for vaccination and bolster vaccine confidence and systemic solutions to minimize insurance barriers and improve access to vaccinations. Assessment of parental perspectives about vaccination directly from parents of rural adolescents is needed, along with studies of whether existing strategies to improve vaccination rates translate well to rural settings.

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To see this article online, please go to: http://jabfm.org/content/34/5/937.full.

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