

Support for Pharmacist-Provided HPV Vaccination: National Surveys of U.S. Physicians and Parents



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Abstract

Background: State laws about pharmacists providing human papillomavirus (HPV) vaccines vary considerably, limiting many pharmacists' ability to provide this important cancer prevention service. We characterized physician and parent support for pharmacist-provided HPV vaccination for adolescents who are past due for vaccination.

Methods: In 2014 to 2015, we conducted two national U.S. surveys of 776 primary care physicians (PCPs) and 1,504 parents of adolescents. Respondents indicated the extent to which they supported pharmacist-provided HPV vaccination for 13- to 17-year-olds who are past due. Respondents could endorse the provision unconditionally, or only if certain conditions were met, such as pharmacists receiving proper vaccination training. We used multivariable logistic regression to assess correlates of support.

Results: Most physicians (79%) and parents (81%) endorsed pharmacist-provided HPV vaccination if pharmacists had received proper vaccination training, reported vaccine doses to adolescents' PCP, and referred adolescents

to PCPs for other health services. Family medicine physicians were more likely than pediatricians to support trained pharmacists providing HPV vaccination [OR = 1.62; 95% confidence interval (CI) 1.17–2.22]. Support was also higher among physicians who practiced in Western states (OR = 2.11; 95% CI, 1.30–3.40). Parents' odds of endorsing trained pharmacists provision of HPV vaccine increased with higher overall satisfaction with their pharmacy's services (OR = 1.10; 95% CI, 1.02–1.19), belief in pharmacists' competence in vaccination practices (OR = 1.42; 95% CI, 1.18–1.70), and overall vaccine confidence (OR = 1.30; 95% CI, 1.15–1.48).

Conclusions: To increase support for HPV vaccination services, pharmacists should raise awareness about their immunization training and standardize vaccination protocols that ensure coordination with primary care.

Impact: Stakeholders' feedback and buy-in is important to help guide expansion of HPV vaccination in pharmacies. *Cancer Epidemiol Biomarkers Prev*; 27(8); 970–8. ©2018 AACR.

Introduction

Human papillomavirus (HPV) is responsible for more than 31,000 new cancer cases each year in the United States (1), but most of these cases are preventable by highly effective HPV vaccines first introduced in 2006. The U.S. Advisory Committee on Immunization Practices recommends routinely vaccinating all

adolescents with HPV vaccine beginning at ages 11 to 12 and providing catch-up doses through age 21 for males and 26 for females (2). As of 2016, only 50% of U.S. girls and 38% of boys ages 13 to 17 were up-to-date with the recommended HPV vaccine series (3). These levels are well below the Healthy People 2020 goal of 80% for adolescents ages 13 to 15 (4). To close this gap in HPV vaccine uptake, the President's Cancer Panel and the National Vaccine Advisory Committee have recommended including pharmacies as a site for HPV vaccination (5, 6). Pharmacies can play a meaningful role in increasing opportunities for HPV vaccination for adolescents, as 93% of U.S. residents live within five miles of a community pharmacy (7), and make around 250 million visits to pharmacies each week (8). Currently, 50 states and U.S. territories allow pharmacists to administer HPV vaccine, but the level of autonomy pharmacists have to vaccinate age-eligible adolescents varies greatly (9). For instance, pharmacy practice laws may restrict vaccination practices to certain ages (9) or by the mechanism by which pharmacists can administer HPV vaccine (e.g., independent authority, standing order protocol, or by prescription only; ref. 10). A recent study found close to 30% of parents would get their adolescent children HPV vaccine at pharmacies (11), implying parents and potentially other stakeholders like primary care physicians (PCPs) may be open to pharmacist-provided HPV vaccinations for adolescents.

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Note: Supplementary data for this article are available at *Cancer Epidemiology, Biomarkers & Prevention* Online (<http://cebp.aacrjournals.org/>).

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The current literature around pharmacist-provided HPV vaccination does not clearly address (i) the level of support parents and physicians have for pharmacist-provided HPV vaccination; (ii) under what conditions these stakeholders would likely support pharmacist-provided HPV vaccination; nor (iii) what PCPs believe to be benefits and concerns of pharmacists taking a more central role in HPV vaccination for adolescents. The purpose of this study is to better characterize physicians' and parents' views on pharmacist-provided HPV vaccinations to adolescents who are past due for vaccination, defined as adolescents who are age 13 years or older and have not started or not completed the HPV vaccine series. Our study focused on adolescents who are past due because they had not completed the HPV vaccine series by age 12. Studies suggest that a larger percentage of older adolescents do not routinely attend preventive health care visits with PCPs (12–14), making it likely more difficult to provide opportunities to catch-up older adolescents with HPV vaccination. Pharmacy-located vaccination presents advantages for older adolescents over vaccination in traditional medical settings given pharmacies' convenient locations within communities (15–17), longer operating hours (15), and ability to administer vaccines with no appointment and short wait times (16). Empirical findings from national studies of PCPs and parents can help illuminate perceived benefits of and concerns about pharmacist-provided HPV vaccinations and inform state policies aimed at expanding access to vaccinations while preserving the integrity of the medical home.

Materials and Methods

Data sources and procedures

Data came from two separate surveys: The Physician Communication about HPV Vaccination Study (physician study) and the Adolescent Vaccination in Pharmacy Study (parent study). The institutional review board at the University of North Carolina at Chapel Hill approved both study protocols, and all participants provided informed consent. More detailed descriptions of survey protocols are published elsewhere (18) and are briefly described here.

Physician study. The physician study was an online survey of U.S. pediatricians and family medicine physicians conducted in 2014. Participants were members of an existing national panel of physicians maintained by a survey company (<https://www.askpcn.com/index.php?id=883>). Eligible panel members were practicing pediatricians or family medicine physicians who provided vaccinations to adolescents ages 11 to 12. We emphasized these two medical specialties because most of HPV vaccine doses in the United States are given in the context of these two specialties (19). The survey company sent email invitations to 2,368 pediatricians and family medicine doctors. Of these, 1,022 physicians responded by accessing the survey site and providing informed consent. Of these, 776 (76%) met eligibility criteria and completed the survey. The unadjusted response rate was 33% (776/2,368); we were unable to assess the eligibility for all physicians contacted (ineligible physicians vs. eligible physicians who did not respond), and thus unable to calculate response rates for online probability panels using the American Association for Public Opinion Research definitions (18). The survey was cognitively tested among a convenience sample of nine physicians to ensure the clarity of survey items, and pretested with 60 physicians from the national panel. Physician characteristics are found in Table 1. Survey instruments for physician and parent studies are available online at <http://www.unc.edu/~ntbrewer/hpv.htm>.

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Parent study. The parent study was an online, cross-sectional survey of U.S. parents of adolescents conducted from 2014 to 2015. Study participants were members of an existing, national panel of noninstitutionalized adults maintained by a survey company (<http://www.gfk.com/products-a-z/us/knowledgepanel-united-states/>). The national panel was created through probability-based sampling of U.S. households using a combination of random-digit dialing and address-based sampling frames. Eligible respondents were parents of at least one child ages 11 to 17 who lived with them at least half of the time. Parents answered survey items about one child in their households who they identified at the beginning of the survey. The survey company randomly contacted 2,845 parents from a panel composed of members from all 50 states and the District of Columbia. About 14% ($n = 391$) of invited panelists were not eligible to complete the survey. Of the 2,454 eligible parents, 1,518 completed some portion of the survey. After we excluded 14 panelists who did not complete at least two thirds of the survey, our final analytic sample contained 1,504 parents. The overall response rate was 61% using American Association for Public Opinion Research response rate five calculation (20). The survey was cognitively tested among a convenience sample of 18 parents of adolescents ages 11 to 17 and pretested with 26 parents from the national panel. Parent characteristics are found in Table 1.

Physician study measures

Outcome. To introduce pharmacist-provided HPV vaccination for adolescents ages 13 to 17, the survey prompted physicians:

Many pharmacists are trained to give vaccines. The training covers how to screen patients for vaccine eligibility, educate them, and monitor for side effects. Forty-five states allow these specially trained pharmacists to give the HPV vaccine. These laws often apply to 13- to 17-year-olds who are past due for the HPV vaccine.

The survey then assessed support for pharmacist-provided HPV vaccination by asking how much physicians agreed or disagreed with the statement: "It benefits 13–17-year-olds who are past due for the HPV vaccine to receive it from specially trained pharmacists" [item one, "strongly disagree" (1) to "strongly agree" (5)]. Any physicians who disagreed or neither agreed or disagreed received a follow-up question assessing what stipulations needed to be made for them to endorse pharmacist-provided HPV vaccination (item two): (1) report doses back to primary care provider; (2) refer adolescent back to primary care provider for other services; (3) enter HPV vaccine doses into a registry; (4) have proper training in vaccination and monitoring side effects; (5) create a vaccination protocol with physicians; (6) give only second and third doses; (7) other; or (8) would not endorse.

We created the dichotomous outcome variable of endorsement of pharmacist-provided HPV vaccination based on the previous two survey items. Physicians who agreed with

Table 1. Sample demographic characteristics

Physician (n = 776)	n (%)
Physician characteristics	
Medical specialty	
Pediatrics	410 (53)
Family practice	366 (47)
Sex	
Male	526 (68)
Female	250 (32)
Years in practice	
≤19	352 (45)
≥20	424 (55)
Adolescent patients seen per week	
≤9	129 (17)
10–24	351 (45)
≥25	296 (38)
Vaccine doses provided by VFC	
≤9%	290 (37)
10%–49%	274 (35)
≥50%	152 (20)
Not sure	60 (8)
Clinic or practice characteristics	
Type	
Private practice (solo, group, HMO)	660 (85)
Other	116 (15)
Total physicians	
Solo practice	115 (15)
2–4	283 (36)
5–9	217 (28)
≥10	161 (21)
Stock HPV vaccine	
No	73 (9)
Yes	703 (91)
Region	
Northeast	184 (24)
Midwest	165 (21)
South	275 (35)
West	152 (20)
Parents (n = 1,504)	n (%) or avg (SD)
Parent characteristics	
Sex	
Male	668 (44)
Female	836 (56)
Age	43.9 (7.84)
Race/ethnicity	
Non-Hispanic white	1058 (70)
Non-Hispanic black	135 (9)
Hispanic	212 (14)
Other race/ethnicity	99 (7)
Education	
High school diploma or less	576 (38)
Some college or more	928 (62)
Primary health care decision maker	
Participant	974 (65)
Spouse, partner, child, or other	530 (35)
Child characteristics	
Sex	
Male	765 (51)
Female	739 (49)
Age	14.0 (2.01)
Perceived health status (1–5)	4.4 (0.74)
HPV vaccination status	
0 doses	809 (54)
≥1 dose	695 (46)
Vaccinated in alternative settings	
No	997 (66)
Yes	507 (34)

(Continued on the following column)

Table 1. Sample demographic characteristics (Cont'd)

Parents (n = 1,504)	n (%)
Household characteristics	
Household income	
Less than \$35,000	329 (22)
\$35,000–\$74,999	470 (31)
\$75,000 or more	705 (47)
Urbanicity	
Rural	236 (16)
Urban	1268 (84)
Region	
Northeast	261 (17)
Midwest	393 (26)
South	499 (33)
West	351 (23)

pharmacist-provided HPV vaccination for adolescents past due (from item one) or would allow provision if "pharmacists have proper training in administering vaccines and monitoring for side effects" (from item two) were coded as "1," endorsing the provision. All other physicians were coded as "0," not endorsing the provision. We included physicians who selected the "proper training" condition in survey item two as supporting pharmacist-provided HPV vaccination because pharmacy practice laws in all 50 states and Washington, DC, require standardized vaccination training for pharmacists who immunize.

Covariates. The survey assessed physician support of HPV vaccine school entry requirements for 11- and 12-year-olds ["strongly disagree" (1) to "strongly agree" (5)], and physicians' perceived benefits and concerns of pharmacist-provided HPV vaccination with two check-all-that-apply items. For socio-demographic characteristics, the survey assessed physicians' sex, medical specialty, years in practice since residency, number of adolescent patients they see in a typical week, and percentage of vaccine doses delivered through the Vaccines for Children (VFC) program. VFC is a federally funded program that provides free vaccines to vulnerable populations, including uninsured and Medicaid-eligible youth (<https://www.cdc.gov/vaccines/programs/vfc/index.html>). For clinical practice characteristics, physicians indicated their practice type [private practice vs. other, defined as a federally qualified health center (FQHC), hospital-based clinic, public health department-operated clinic, or military clinic], the total number of physicians in the clinic, whether the clinic regularly stocks HPV vaccine, and the state in which the clinic is located categorized into national regions using U.S. Census classifications (<https://www.census.gov/geo/reference/terms.html>).

Parent study measures

Outcome. The survey asked parents the same two survey items from the physician study about endorsing pharmacist-provided HPV vaccination for adolescents who were past due. We created the dichotomous outcome variable of endorsement of pharmacist-provided HPV vaccination using the same coding method from the physician study.

Covariates. The survey assessed parents' overall satisfaction with the health services received at the pharmacy where they usually get their child's prescription medications ["completely

dissatisfied" (1) to "completely satisfied" (7)]. Parents also answered six questions about immunizing pharmacists' competence in vaccination: two items assessed pharmacists' ability to counsel about vaccinations; two items assessed pharmacists' ability to administer vaccines safely; and the last two items assessed pharmacists' ability to manage potential minor and major side effects from vaccination. To create a scale for parental belief about pharmacists' competence in vaccination, we averaged responses to the six questions. Additionally, the survey assessed parents' beliefs in care coordination and health care utilization. The survey first assessed whether they believed immunizing pharmacists routinely report administered vaccine doses to adolescents' doctors or health care providers. The survey then asked if parents would still go to their child's doctor just as often if their child received a vaccine from an immunizing pharmacist. The survey also asked if parents believed getting their child vaccinated from an immunizing pharmacist gave their child more opportunities to get care in addition to their child's doctor's care. We averaged responses to these three questions to assess overall care coordination and health care utilization beliefs. Finally, parents responded to four items assessing their confidence in vaccines using a validated scale (21). All items had a five-point response scales ranging from "strongly disagree" (1) to "strongly agree" (5).

The survey company provided parent and household demographic characteristics including parent sex, age, race and ethnicity, education, household income, urbanicity ("non-metropolitan statistical area" or "metropolitan statistical area"), and U.S. region of residence. For demographic and health characteristics for the parent's index child (reported by the parent), the survey assessed sex, age, HPV vaccinations status ("0 doses" or " ≥ 1 dose"), and previous use of an alternative vaccination setting (defined as the child previously vaccinated at a pharmacy, school, or health department).

Statistical analysis

First, we used descriptive statistics to identify parent and physician endorsement of pharmacist-provided HPV vaccination for adolescents ages 13 to 17 who were past due for HPV vaccination by looking at unconditional endorsement (item one) and conditional endorsement (item two). We used logistic regression to identify bivariate correlates of endorsement for pharmacist-provided vaccination using the dichotomous outcome variable of endorsement. We included statistically significant bivariate correlates in two separate multivariable logistic models for physicians and parents. Finally, we conducted proportions tests to evaluate any differences between pediatrician and family medicine physicians' perceived benefits and concerns of pharmacist-provided HPV vaccinations. We conducted our analyses using Stata Version 13.1. Statistical tests were two-tailed with a critical α of 0.05.

Results

Endorsement of pharmacist-provided HPV vaccination

Thirty-nine percent of physicians (303/776) and 29% of parents (436/1,504) would unconditionally endorse pharmacists-provided HPV vaccination for adolescents who are past due (Fig. 1). Another 25% of physicians (194/776) and 46% of parents (692/1,504) would support the provision if pharmacists had proper training in vaccination and monitoring for side

effects. An additional 15% of physicians (116/776) and 6% of parents (90/1,504) would support the provision if pharmacists reported administered vaccine doses to, and made referrals for adolescents to get other health care services from their PCPs. In total, 79% of physicians (613/776) and 81% of parents (1,218/1,504) would support pharmacist-provided HPV vaccination for adolescents who are past due when accounting for these conditions for endorsement. Proportion of physicians and parents who made endorsements based on the different conditions is found in Supplementary Table S1.

Physicians' perceived benefits and concerns of pharmacist-provided HPV vaccination

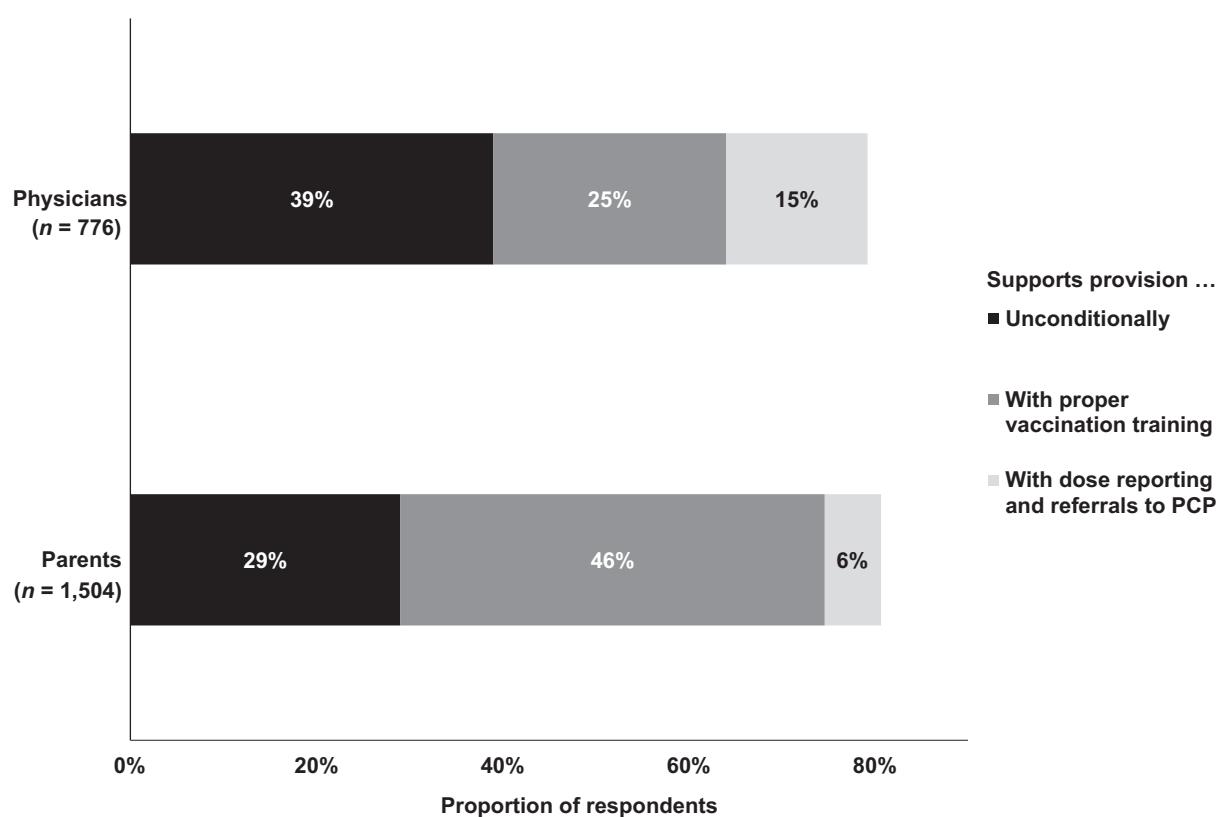
More family medicine physicians reported benefits of pharmacist-provided HPV vaccine than pediatricians (Table 2). Notably, the majority of family medicine physicians (60%) thought that pharmacist-provided HPV vaccinations created more opportunities to vaccinate adolescents compared with half of pediatricians (50%, $p < 0.001$). While the other benefits had lower levels of endorsements by both medical specialties, more family medicine physicians endorsed all other benefits compared with pediatricians (all $p < 0.05$), including providing opportunities to refer patients who have missed a well visit to primary care clinics (35% vs. 24%) and helping physicians meet vaccination coverage and quality guidelines (34% vs. 23%). Fewer family medicine physicians reported not seeing benefits to pharmacist-provided HPV vaccination compared with pediatricians (23% vs. 37%, $p < 0.001$).

More pediatricians reported concerns with pharmacist-provided HPV vaccinations than family medicine physicians (Table 2). Pediatricians were chiefly concerned with pharmacists not reporting administered doses to a primary care provider compared with a little over half of family medicine physicians (72% vs. 54%; $p < 0.001$). A larger proportion of pediatricians marked more concerns than family medicine physicians (all $p < 0.05$), particularly with reducing primary care providers' opportunities to screen adolescents for other health issues (65% vs. 45%) and not monitoring patients for post vaccination side effects (54% vs. 45%). Finally, a larger proportion of family medicine physicians reported no concerns with pharmacist-provided HPV vaccination compared with pediatricians (21% vs. 6%; $p < 0.001$).

Correlates of support for trained pharmacists providing HPV vaccination

Among providers (Table 3), family medicine physicians were more likely than pediatricians to support trained pharmacists providing HPV vaccination [adjusted odds ratio (OR) = 1.62; 95% confidence interval (CI), 1.17–2.22; Table 4]. Physicians who practiced with five to nine physicians (OR = 1.67; 1.02–2.74) or ten or more physicians (OR = 1.74; 1.02–2.97) were more likely to support trained pharmacists providing HPV vaccination than physicians in solo practices. Physicians who practiced in Western states more often supported pharmacist-provided HPV vaccination (OR = 2.11; 1.30–3.40) compared with physicians who practiced in Northeastern states. Additionally, physicians more often endorsed pharmacist-provided HPV vaccination as agreement with HPV vaccination school entry requirements increased (OR = 1.15; 1.03–1.28).

Among parents (Table 4), those whose children have received a previous vaccination in alternative settings had higher odds of

**Figure 1.**

Physician and parent endorsement of pharmacist-provided HPV vaccination for adolescents who are past due.

supporting trained-pharmacist-provided HPV vaccination ($OR = 1.43; 1.09\text{--}1.87$) than parents whose children have not been vaccinated in alternative settings. Additionally, parents who indicated their household income was \$75,000 or more had higher odds of endorsing pharmacist-provided HPV vaccination ($OR = 1.43; 1.10\text{--}2.18$) compared with parents who indicated their

household income was less than \$35,000. Finally, parents more often endorsed pharmacist-provided HPV vaccination as overall satisfaction with their pharmacy's services ($OR = 1.10; 1.02\text{--}1.19$), agreement in a pharmacist's competence in vaccination practices ($OR = 1.42; 1.18\text{--}1.70$), and agreement with overall vaccine confidence ($OR = 1.30; 1.15\text{--}1.48$) increased.

Table 2. Physicians' perceived benefits and concerns related to pharmacist-provided HPV vaccination

	Pediatricians (n = 410)	Family medicine (n = 366)	p
Benefits			
Pharmacist provision of HPV vaccine could ...			
Give my patients more opportunities to get vaccinated	51%	60%	<0.001
Provide opportunities to refer patients who have missed a well visit to primary care clinics	24%	35%	0.001
Help me meet vaccination coverage and quality guidelines	23%	34%	<0.001
Give me more time to focus on other aspects of patient care	13%	24%	<0.001
Reduce burden on my administrative and clinical staff	13%	28%	<0.001
Give me more time to focus on better reimbursed services	8%	13%	0.015
None of the above	37%	23%	<0.001
Concerns			
What concerns do you have about pharmacist provision of HPV vaccine?			
Not reporting administered doses to a primary care provider	72%	54%	<0.001
Reducing primary care providers' opportunities to screen adolescents for other health issues	65%	45%	<0.001
Not monitoring patients for post-vaccination side effects	54%	45%	0.006
Not reporting administered doses to immunization registry	52%	33%	<0.001
Not having a good place to discuss and deliver vaccines	44%	36%	0.026
Not being properly trained vaccinators	31%	28%	0.440
No concerns	6%	21%	<0.001

Table 3. Correlates of physician endorsement of pharmacist-provided HPV vaccination for adolescents who are past due

	PCPs supporting laws/total PCPs in category (%)	Bivariate OR (95% CI)	Multivariable aOR (95% CI)
Physician characteristics			
Medical specialty			
Pediatrics	248/410 (61)	Ref.	Ref.
Family practice	252/366 (69)	1.44 (1.07–1.94) ^a	1.62 (1.17–2.22) ^b
Sex			
Male	341/526 (65)	Ref.	—
Female	159/250 (64)	0.95 (0.69–1.30)	—
Years in practice			
≤19	228/352 (65)	Ref.	—
≥20	272/424 (64)	0.97 (0.72–1.30)	—
Adolescent patients seen in typical week			
≤9	85/129 (66)	Ref.	—
10–24	234/351 (67)	1.04 (0.68–1.59)	—
≥25	181/296 (61)	0.81 (0.53–1.26)	—
Vaccine doses provided by VFC			
≤9%	179/290 (62)	Ref.	—
10%–49%	177/274 (65)	1.13 (0.80–1.59)	—
≥50%	101/152 (67)	1.23 (0.81–1.85)	—
Not sure	43/60 (72)	1.56 (0.85–2.89)	—
Clinic or practice characteristics			
Type			
Private practice (solo, group, HMO)	413/660 (63)	Ref.	Ref.
Other	87/116 (75)	1.79 (1.14–2.81) ^a	1.53 (0.97–2.45)
Total physicians			
Solo practice	67/115 (58)	Ref.	Ref.
2–4	175/283 (62)	1.16 (0.75–1.81)	1.26 (0.80–2.00)
5–9	144/217 (66)	1.41 (0.89–2.25)	1.67 (1.02–2.74) ^a
≥10	114/161 (71)	1.74 (1.05–2.87) ^a	1.74 (1.02–2.97) ^a
Stock HPV vaccine			
No	54/73 (74)	Ref.	—
Yes	446/703 (63)	0.61 (0.35–1.05)	—
Region			
Northeast	103/184 (56)	Ref.	Ref.
Midwest	105/165 (64)	1.37 (0.89–2.12)	1.25 (0.81–1.95)
South	178/275 (65)	1.44 (0.98–2.11)	1.43 (0.97–2.10)
West	114/152 (75)	2.36 (1.48–3.77) ^c	2.11 (1.30–3.40) ^b
Physician attitudes			
Support of HPV vaccine school entry requirement		1.17 (1.05–1.31) ^b	1.15 (1.03–1.28) ^a

Abbreviations: HMO, health maintenance organization; STI, sexually transmitted infection; VFC, Vaccines for Children program.

Dashes (—) indicate the variable was not included in the multivariable model because it was not statistically significant at the bivariate level.

^a $p < 0.05$.

^b $p < 0.01$.

^c $p < 0.001$.

Discussion

While prior studies have documented parents' attitudes of pharmacy-located vaccination for adolescents, this is the first study, to our knowledge, that surveys national samples of physicians and parents on their perceptions of pharmacist-provided HPV vaccination and quantitatively evaluates endorsement for this provision across several key domains for acceptance. We found that most physicians and parents would support pharmacist-provided HPV vaccination for adolescents who are past due for vaccination given a few stipulations. These considerations fall generally into two categories and should be addressed when proposing pharmacists' expanded role in HPV vaccination: (i) physicians and parents are not aware of the vaccination training pharmacists receive; and (ii) physician and parents expect a certain level of care coordination between pharmacists and primary care providers.

Physicians and parents' support for pharmacists-provided HPV vaccination for adolescents who are past due dramati-

cally increased when accounting for those who would support provision as long as pharmacists were properly trained in vaccination and monitoring for side effects. Of note, more physicians than parents endorsed pharmacists-provided HPV vaccination at baseline, and a smaller proportion of physicians than parents stipulated proper vaccination training as a condition for their endorsement. This discrepancy may be driven by PCPs having greater understanding of pharmacist scope of practice. The perception that pharmacists may not be adequately trained immunizers, leading to lower endorsement of pharmacist-provided HPV vaccination, could be due to public image of pharmacists' primary role in medication dispensing and counseling. A recent qualitative study of parents cited the most frequently expressed barrier and concern about using community pharmacies for HPV vaccination for adolescents was apprehension of pharmacists' clinical training in vaccination (22). Moreover, a national survey of parents found that 70% did not know if pharmacists could vaccinate adolescents as young as 11 at the pharmacy they

Table 4. Correlates of parent endorsement of pharmacist-provided HPV vaccination for adolescents who are past due

	Parents supporting laws/total parents in category (%)	Bivariate OR (95% CI)	Multivariable aOR (95% CI)
Parent characteristics			
Sex			
Male	480/668 (72)	Ref.	Ref.
Female	647/836 (77)	1.34 (1.06–1.69) ^a	1.27 (0.95–1.71)
Age		1.01 (0.99–1.03)	—
Race/ethnicity			
Non-Hispanic white	799/1,058 (76)	Ref.	—
Non-Hispanic black	104/135 (77)	1.09 (0.71–1.66)	—
Hispanic	149/212 (70)	0.77 (0.55–1.06)	—
Other race/ethnicity	75/99 (76)	1.01 (0.62–1.64)	—
Education			
High school diploma or less	410/576 (71)	Ref.	Ref.
Some college or more	717/928 (77)	1.38 (1.09–1.74) ^b	1.21 (0.92–1.59)
Primary health care decision maker			
Participant	750/974 (77)	Ref.	Ref.
Spouse, partner, child, or other	377/530 (71)	0.74 (0.58–0.94) ^a	0.86 (0.64–1.15)
Child characteristics			
Sex			
Male	566/765 (74)	Ref.	—
Female	561/739 (76)	1.11 (0.88–1.40)	—
Age		1.04 (0.98–1.09)	—
Perceived health status		0.98 (0.83–1.14)	—
HPV vaccination status			
0 doses	587/809 (73)	Ref.	Ref.
≥1 dose	540/695 (78)	1.32 (1.04–1.67) ^a	1.23 (0.96–1.58)
Vaccinated in alternative settings			
No	722/997 (72)	Ref.	Ref.
Yes	405/507 (80)	1.51 (1.17–1.97) ^b	1.43 (1.09–1.87) ^a
Household characteristics			
Household income			
Less than \$35,000	226/329 (69)	Ref.	Ref.
\$35,000–\$74,999	350/470 (75)	1.33 (0.97–1.82)	1.32 (0.95–1.84)
\$75,000 or more	551/705 (78)	1.63 (1.22–2.19) ^b	1.55 (1.10–2.18) ^a
Urbanicity			
Rural	174/236 (74)	Ref.	—
Urban	953/1268 (75)	1.08 (0.79–1.48)	—
Region			
Northeast	202/261 (77)	Ref.	—
Midwest	296/393 (75)	0.89 (0.62–1.29)	—
South	375/499 (75)	0.88 (0.62–1.26)	—
West	254/351 (72)	0.76 (0.53–1.11)	—
Parent attitudes and beliefs			
Overall satisfaction with pharmacy services		1.17 (1.09–1.26) ^c	1.10 (1.02–1.19) ^a
Pharmacist vaccination practice beliefs		1.68 (1.45–1.95) ^c	1.42 (1.18–1.70) ^c
Care coordination and health care utilization beliefs		1.59 (1.33–1.90) ^c	1.13 (0.91–1.42)
Confidence in vaccines		1.49 (1.33–1.68) ^c	1.30 (1.15–1.48) ^c

Dashes (—) indicate the variable was not included in the multivariable model because it was not statistically significant at the bivariate level.

^a $p < 0.05$.

^b $p < 0.01$.

^c $p < 0.001$.

typically use for their children's prescription medications, and living in a state that allowed pharmacists to vaccinate adolescents with HPV vaccine was not associated with increased awareness among parents (11). By extension, this is reflected in our regression analysis, where parents who had previously vaccinated their children in alternative settings, or had greater agreement about pharmacists' competence in vaccination practice, were more likely to endorse pharmacist-provided HPV vaccination. Organizations and businesses that advocate for pharmacy practice may see an increase in support of pharmacy-located vaccinations among physicians and the general public if greater awareness was brought to vaccination-training requirements for pharmacists. Pharmacists' vaccination training is unique from other health profes-

sionals in two ways. First, the Accreditation Council for Pharmacy Education requires all schools and colleges of pharmacy to incorporate immunization training in their curricula (23). Second, pharmacists are required by law in all 50 states to have vaccination training in order to give immunizations. All U.S. states recognize the American Pharmacists Association Pharmacy-Based Immunization Certificate Training Program, which is based on national standards for immunization training set by the CDC, and includes education in immunology and vaccine development, vaccine-preventable disease, patient care considerations, hands-on assessment of intramuscular and subcutaneous injections, Basic Life Support certification, and operating an immunization program (24).

Once pharmacists' vaccination training was accounted for stakeholder endorsement, physicians and parents both stipulated care coordination as a necessary condition for their endorsement of pharmacist-provided HPV vaccination. Similar findings in other studies showed that many parents are concerned about dose reporting to their children's primary care providers when receiving vaccines in nontraditional settings (11, 22, 25). Interestingly, more physicians than parents required vaccine dose reporting and referrals for adolescents for other health services for their support. This difference is likely a reflection of physicians being keenly aware of the importance of complete, up-to-date information on their patients and of ensuring they receive recommended vaccines in a timely manner as part of comprehensive medical care. Additionally, many physicians stipulated adolescent referrals for other medical services, echoing medical organizations' concerns for preventing fragmented medical care (26). As such, pharmacies that offer vaccination services should take steps to reliably and accurately report vaccine doses and ensure that adolescents are referred back to their providers for health care services when those needs are identified. An additional step to preserve continuity of care is to adopt widespread use of state immunization information systems to standardize dose reporting, facilitate vaccination management and accountability, and help providers identify missed opportunities for vaccinations (27).

Finally, physicians demonstrated differences in attitudes toward pharmacist-provided HPV vaccination for adolescents past due that justify further investigation. Family medicine doctors ascribed more benefits and fewer concerns for pharmacist-provided HPV vaccination compared with pediatricians. This distinction also appeared in regression analysis, where family medicine doctors more often endorsed pharmacist provision than pediatricians. One explanation is that family medicine doctors routinely see adults along with children, and thus have greater interactions with pharmacists by virtue of a higher likelihood of prescribing medications to adults for acute and chronic conditions compared with children. Additionally, family medicine physicians may be more amenable to pharmacists providing HPV vaccination to adolescents as they likely interacted with adult patients who have used pharmacy-based vaccination (15). Physicians practicing in Western states were also more likely to endorse pharmacist-provided HPV vaccination compared with those practicing in Northeastern states. This may be due to relatively more progressive medical practices among physicians and the expanded scope of practice pharmacists have in Western states (10). Future research on pharmacy-located vaccination could attempt to disentangle why family medicine doctors look more favorably on pharmacist-provided HPV vaccination, and how pharmacy practice in the West has garnered wider support among PCPs.

Our study has notable strengths, including the use of two large national samples of PCPs and parents of adolescents. Our study also fills an important gap in the literature, as little is known about how to increase these two key stakeholders' support for pharmacist involvement in adolescent preventive services like HPV vaccination. Our study is limited by a cross-sectional design that prevents us from assessing the temporal relationship among variables. We also achieved a modest cooperation rate for the physician survey, which is a common

challenge for physician surveys (28) and may limit the representativeness of our surveyed physicians. In addition, the interpretations of our findings should be limited in lieu of the fact that we did not survey community pharmacists who may express additional considerations that would increase their provision of HPV vaccine, including insurance coverage of vaccination and having appropriate space to immunize (29). We also cannot presume that physician and parent support of expanded pharmacist vaccination practice will translate into actual use of these pharmacy-located services.

Conclusion

Pharmacists' vaccination authority has expanded since the 1990s, when U.S. states passed the first pharmacy practice immunization laws (30, 31). In particular, the changes to pharmacy practice immunization laws over the past two decades have tended to allow pharmacists to administer more ACIP-recommended vaccines to younger patients with less restrictive oversight (30). This expanded vaccination practice, coupled with the high accessibility of pharmacists within communities, has led to several studies pointing to higher vaccination rates for patients when pharmacists are involved with the immunization process compared with conditions where there were no pharmacists involved (32, 33). As such, federal panels' recommendations to include pharmacists in strategies to address low HPV vaccine uptake for U.S. adolescents are both timely and meaningful (5, 6). Feedback and buy-in from key stakeholders is important to help guide the foreseeable expansion of HPV vaccination in pharmacies and increase program utility to those involved in the vaccination process.

Disclosure of Potential Conflicts of Interest

N.T. Brewer is the chair of the National HPV Vaccination Roundtable at the American Cancer Society/CDC; reports receiving commercial research funding from Merck, Pfizer, and CDC; and is a consultant/advisory board member for Merck. No potential conflicts of interest were disclosed by the other authors.

Disclaimer

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Acquisition of data (provided animals, acquired and managed patients, provided facilities, etc.): P.D. Shah, W.A. Calo, M.W. Marciak
Analysis and interpretation of data (e.g., statistical analysis, biostatistics, computational analysis): P.D. Shah, W.A. Calo, N.T. Brewer
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Administrative, technical, or material support (i.e., reporting or organizing data, constructing databases): N.T. Brewer
Study supervision: N.T. Brewer

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