

Barriers to Adolescent Immunization: A Survey of Family Physicians and Pediatricians

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Background: Although early childhood vaccination rates have increased, many adolescents are not up to date on recommended vaccinations. We assessed attitudes and practices of family physicians and pediatricians regarding adolescent vaccination to identify provider-level barriers that may contribute to low immunization rates.

Methods: A 94-item self-report questionnaire was mailed to 400 physicians contracted with a managed care organization. Physicians were queried about demographic characteristics, source of vaccine recommendations, adolescent immunization practices, barriers to immunizing adolescents, and use of reminder/recall systems.

Results: Response rate was 59%. Most respondents reported routinely recommending vaccines for tetanus and diphtheria toxoids (98%), Hepatitis B (90%), and measles, mumps, and rubella (84%), whereas 60% routinely recommended varicella vaccine. Physicians reported that they were more likely to assess immunization status, administer indicated immunizations, and schedule return immunization visits to younger adolescents (11 to 13 years old) than to older adolescents (14 to 18 and 19 to 21 years old).

Conclusion: Most respondents reported recommending the appropriate vaccinations during preventive health visits; however, older adolescents were least likely to be targeted for immunization assessment and administration of all recommended vaccines. (J Am Board Fam Pract 2005;18:13–9.)

Adolescent immunization rates remain low despite the success of infant and childhood vaccination programs. Although routine adolescent immunizations have been recommended since 1996, an estimated 35 million adolescents (ie, persons 11 to 21 years of age, as defined by the American Medical Association and the American Academy of Pediatrics) lack one or more recommended vaccinations, placing them at risk for developing vaccine-preventable disease.^{1–3} Factors contributing to low immunization rates include missed opportunities, lack

of population-based immunization registries that include adolescents, low public and peer awareness about immunization coverage in this age group, misperceptions about vaccine safety, and lack of knowledge about the importance of immunizations.^{1–4} In addition, adolescents are one of the most difficult groups to reach for vaccination and other preventive services, in part because growing numbers lack a primary care provider and adolescents, in general, have fewer contacts with physicians.^{1,5–6}

Overcoming barriers at the provider level is crucial to increasing adolescent immunization rates. Previous studies have shown that lack of a provider recommendation is often cited as a reason for not receiving an immunization and that provider attitude and recommendation are strong predictors of vaccination of high-risk patients and indeed may be the most important determinants of immunization status.^{7–9}

The Centers for Disease Control and Prevention (CDC) recommend that all previously unvaccinated adolescents receive tetanus and diphtheria (Td) toxoids, varicella vaccine (if no history of natural disease), hepatitis B, and measles, mumps, and

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rubella (MMR) vaccine. In addition, influenza, hepatitis A, and pneumococcal vaccine are recommended for immunocompromised adolescents or those who are at high risk.³

This study was designed to assess physician attitudes and practices regarding adolescent vaccination within a managed care organization (MCO) setting and to describe and identify barriers at the provider level that may contribute to low immunization rates.

Methods

Study Population

In May 1999, we obtained a computerized list of all general physicians, family physicians, and pediatricians actively contracted with a national MCO; the list included name, address, phone number, gender, specialty, date of birth, and year of medical school graduation. At the time the survey was conducted, the MCO had 4.9 million members in 28 states and the District of Columbia and contracted with approximately 34,000 physicians. Eligibility criteria included a stated specialty in pediatrics, family practice, or general practice and record of a complete mailing address, including street, city, state, and zip code. Based on a minimum expected response rate of 40%, a sample of 400 physicians was randomly selected to receive a questionnaire. This sample size was chosen to provide a power of 80% to detect a difference of 20% between specialties with an α of 0.05. Questionnaires were sent to physicians in 28 states and the District of Columbia. Physicians did not receive an incentive for participating in the survey.

Questionnaire

A 94-item self-administered questionnaire was developed, piloted, revised and mailed to each physician in May 1999 by a health care research center affiliated with the MCO. Nonresponders were sent follow-up mailings in June 1999. Respondents returned the questionnaire to the research center via a self-addressed envelope mailed with the survey.

The questionnaire included demographic questions, source of physician's vaccine recommendations, questions regarding adolescent immunization practices, barriers to immunizing adolescents, the degree of importance placed on ensuring that adolescents were up to date (UTD) on immunizations, and tracking or reminder/recall systems used

by the provider office. Physicians who did not provide care to adolescent patients were asked to indicate this on the survey and complete only the demographic portion of the survey. Most questions were fixed response; several open-ended questions were included and later converted to multioutcome responses.

Each questionnaire included the name of the physician and a study identification number. Individual identifying information was omitted after receipt of the questionnaire; thus, questionnaires remained confidential, although not anonymous, at all times.

The study design for this project was approved by the Institutional Review Board of The Prudential Center for Health Care Research. (When this research was conducted, the Emory Center on Health Outcomes and Quality was known as The Prudential Center for Health Care Research, which became the USQA Center for Health Care Research; in 2001, it was transferred to Emory University to form the Emory Center on Health Outcomes and Quality.)

Analysis

Continuous data were collapsed into categories and categorical data were dichotomized before analysis. Simple associations were tested using a χ^2 test of association and corresponding p values are reported. A p value of .05 was used as the level of statistical significance. All analysis was conducted in SAS (version 8.02; SAS Institute Inc, Cary, NC).

Results

Attributes of Respondents

Forty of the 400 physicians who were mailed a questionnaire were ineligible: one physician no longer worked at the practice, 12 indicated that they did not provide care to adolescents, and 27 questionnaires were undeliverable. Two surveys were received from general physicians but were removed from the analysis because of the small number of responses from that specialty. Of the remaining 358 physicians, 210 questionnaires were returned for a response rate of 59%.

Respondents and nonrespondents did not differ significantly with respect to age, gender, or year of medical school graduation but did differ in specialty. Pediatricians [97 of 145 (67%)] were more likely to return the questionnaire than were family

Table 1. Demographic Characteristics of Survey Respondents and Nonrespondents*

Attribute	Respondents [No. (%)]	Nonrespondents [No. (%)]
Specialty [†]		
Family practice	113 (54)	100 (68)
Pediatrics	97 (46)	48 (32)
Year of medical school graduation		
1940 to 1959	8 (5)	4 (4)
1960 to 1979	71 (46)	44 (39)
After 1980	76 (49)	64 (57)
Gender		
Male	123 (64)	102 (72)
Female	69 (36)	39 (28)

* Nonrespondent data based on administrative data; respondent based on administrative data plus survey response (99% correspondence).

[†] $P < .05$ for differences between respondents and non-respondents.

physicians [113 of 206 (55%)] ($P < .05$). Demographic characteristics of survey respondents and nonrespondents are shown in Table 1.

Source of Vaccine Recommendations

Respondents were asked to select all their sources of vaccine recommendations from a checklist. Pediatricians were more likely than family physicians to indicate the American Academy of Pediatrics (99% vs 48%, $P < .05$) and the Advisory Committee on Immunization Practices (55% vs 23%, $P < .05$) as their source of vaccine recommendations, whereas more family physicians than pediatricians indicated the American Academy of Family Physicians as their source of recommendations (81% vs 7%, $P < .05$) (Table 2).

Vaccines Routinely Recommended for Adolescents

Of the 210 respondents, 98% reported that they routinely recommended Td toxoids, 90% routinely recommended hepatitis B vaccine, 84% routinely recommended MMR vaccine, and 60% routinely recommended varicella vaccine (Table 2). Pediatricians were more likely than family physicians to report recommending hepatitis B (99% vs 82%, $P < .05$) and varicella (80% vs 42%, $P < .05$) vaccines; there were no differences by specialty in recommendation rates for Td and MMR.

One hundred and thirteen (54%) respondents indicated that they routinely recommended all 4 vaccines of interest (ie, Td, MMR, hepatitis B, and varicella), whereas 64 (30%) routinely recom-

mended 3 vaccines, 23 (11%) routinely recommended 2 vaccines, 9 (4%) routinely recommended only one of the vaccines, and 1 (<0.05%) respondent did not routinely recommend any of the vaccines. More pediatricians than family physicians (72% vs 38%) reported that they routinely recommended all 4 vaccines.

Immunization Activities Included in Preventive Health Visits

When asked what immunization activities (ie, assess immunization status, administer needed immunizations, and schedule return immunization visit) were typically included in preventive health visits for adolescents aged 11 to 13, 14 to 18, and 19 to 21 years, results varied by age group (Table 2). Respondents reported that they conducted more immunization assessments during preventive health visits for adolescents aged 11 to 13 (94%) and 14 to 18 years (91%) compared with adolescents aged 19 to 21 years (74%). Likewise, more respondents reported administering needed immunizations to adolescents aged 11 to 13 years (96%) and 14 to 18 years (95%) than to adolescents 19 to 21 years of age (77%). However, more family physicians than pediatricians reported that they administered needed immunizations for adolescents aged 19 to 21 years (84% vs 69%, $P < .05$). Only 60% of respondents indicated that they scheduled return immunization visits for adolescents aged 19 to 21 years, compared with adolescents aged 11 to 13 years (78%) and 14 to 18 years (74%).

Proportion of Adolescents UTP on Vaccine-Preventable Disease

Pediatricians were more likely than family physicians to report that $\geq 75\%$ of their adolescent patients were up to date on Td toxoids, hepatitis B vaccine, and varicella vaccine, whereas there were no differences between the specialties with respect to receipt of MMR (Table 2). In addition, 14% of respondents reported that 75% or more of their adolescent patients were UTD on all 4 vaccine-preventable diseases of interest, 21% indicated the same for 3 diseases, 30% for 2 diseases, and 13% for 1 disease; 21% reported that $\geq 75\%$ of their adolescent patients were not UTD on any of the diseases of interest.

Table 2. Immunization Activities and Practices

	PED* [n = 97 (%)]	FP* [n = 113 (%)]	Total [n = 210 (%)]
Source of vaccine recommendations			
American Academy of Pediatrics	96 (99)	54 (48)	150 (71)
American Academy of Family Practitioners [†]	7 (7)	92 (81)	99 (47)
Advisory Committee on Immunization Practices [†]	53 (55)	26 (23)	79 (38)
Vaccines routinely recommended for adolescents			
Tetanus/diphtheria	97 (100)	108 (96)	205 (98)
Measles, mumps, rubella	86 (87)	90 (80)	176 (84)
Hepatitis B [†]	96 (99)	93 (82)	189 (90)
Varicella [†]	78 (80)	48 (42)	126 (60)
Immunization activities conducted at preventive health visits			
Immunization activity by age			
Assess immunization status			
11 to 13 years	95 (98)	103 (91)	198 (94)
14 to 18 years	93 (96)	98 (87)	191 (91)
19 to 21 years	72 (74)	84 (74)	156 (74)
Administer needed immunizations			
11 to 13 years	96 (99)	105 (93)	201 (96)
14 to 18 years	94 (97)	105 (93)	200 (95)
19 to 21 years*	67 (69)	95 (84)	162 (77)
Schedule return immunization visits			
11 to 13 years	82 (85)	81 (72)	163 (78)
14 to 18 years	79 (81)	77 (68)	156 (74)
19 to 21 years	54 (56)	72 (64)	126 (60)
Self-report that ≥75% adolescent patients up-to-date on vaccinations			
Tetanus/diphtheria [†]	73 (75)	68 (62)	141 (69)
Measles, mumps, rubella	72 (79)	73 (65)	145 (69)
Hepatitis B [†]	33 (34)	21 (19)	54 (26)
Varicella [†]	41 (42)	21 (19)	62 (31)
Use of recall/reminder systems	27 (28)	19 (17)	47 (22)

* PED, pediatrician; FP, family physician.

[†] $P < .05$ for differences between family physicians and pediatricians.

Use of Reminder and Recall System

Only 18% of family physicians and 28% of pediatricians reported that their practice used a tracking or reminder/recall system to identify and contact adolescents who were due or overdue for immunizations (Table 2). There were no differences in vaccine recommendations between respondents who used a reminder/recall system and those who did not, except with respect to hepatitis B recommendation. Of the 47 respondents who reported that they used a reminder/recall system, 100% routinely recommended hepatitis B vaccine, compared with 140 (88%) of 160 who reported that they did not use a recall/reminder system ($P < .05$).

Importance Placed on Ensuring That Adolescents Are UTD on Immunizations

Between 77% and 98% of respondents (depending on physician specialty and vaccine) indicated that it was “very important” to ensure that adolescents were UTD on Td, MMR, and Hepatitis B, whereas a smaller percentage (53% to 85%) indicated the

same for varicella vaccine (Table 3). Pediatricians were more likely than family physicians to rate being UTD on hepatitis B (95% vs 77%, $P < .05$) and varicella (85% vs 53%, $P < .05$) as “very important.”

Barriers to Vaccinating Adolescents

Both pediatricians and family physicians selected “adolescents rarely make preventive health visits” (45% to 74% depending on physician specialty and adolescent age), “adolescents not aware of need for immunizations” (45% to 67%), and “adolescents and/or parents underestimate the risk of vaccine-preventable disease” (43% to 57%) as the primary barriers to adolescent immunization (Table 4). Very few respondents (3% to 9%) found “obtaining consent per state law” to be a barrier. In addition, only 9% to 12% of respondents indicated that adolescent and/or parental refusal of vaccinations was a barrier to immunization.

For all adolescent age groups, more family physicians than pediatricians (59% to 63% vs 32% to

Table 3. Degree of Importance Placed on Ensuring Adolescents Are Up to Date, by Specialty*

	Not Very Important [No. (%)]	Important [No. (%)]	Very Important [No. (%)]
Tetanus/diphtheria			
PEDS [†]	2 (2)	0 (0)	94 (98)
FP [†]	3 (3)	5 (5)	102 (93)
Overall	5 (2)	5 (2)	196 (95)
Measles, mumps, rubella			
PEDS	1 (1)	1 (1)	95 (98)
FP	2 (2)	3 (3)	105 (95)
Overall	3 (1)	4 (2)	200 (97)
Hepatitis B [‡]			
PEDS	1 (1)	4 (4)	92 (95)
FP	7 (6)	18 (16)	85 (77)
Overall	8 (4)	22 (11)	177 (86)
Varicella [‡]			
PEDS	5 (5)	9 (9)	81 (85)
FP	19 (17)	32 (29)	59 (54)
Overall	24 (12)	41 (20)	140 (68)

* Overall, N = 210; pediatricians, n = 97; family physicians, n = 113.

[†] PED, pediatrician; FP, family physician.

[‡] $P < .05$ for differences between family physicians and pediatricians.

43%, $P < .05$) reported “difficult to obtain verification of previous immunization” as a barrier. For adolescents aged 11 to 13 years, more family physicians indicated “adolescents not aware of need for immunizations” (62% vs 45%, $P < .05$) as a barrier than did pediatricians. In addition, more family physicians reported “adolescents rarely make preventive health visits” (74% vs 63%, $P < .05$) and “difficult to determine who needs vaccine” (21% vs 11%, $P < .05$) as barriers for adolescents aged 19 to 21; however, more pediatricians than family physicians found “adolescents seek care from other facilities” to be a barrier for adolescents aged 19 to 21 (41% vs 26%, $P < .05$).

With the exception of the barriers “difficult to determine adolescents at risk,” “adolescents/parents refuse vaccination,” and “obtaining consent per state law,” more respondents reported that they experienced barriers for adolescents aged 19 to 21 years compared with adolescents aged 11 to 13 and 14 to 18 years ($P < .05$). When we stratified by the number of barriers experienced, more family physicians reported experiencing 7 or more barriers for adolescents 19 to 21 than did pediatricians (54% vs 46%, $P < .05$). There were no differences by specialty in the number of barriers for adolescents aged 11 to 13 or 14 to 18 years.

Discussion

The survey results suggest that most physicians recommend the appropriate vaccinations to their adolescent patients and typically include immunization activities in preventive health visits. Both pediatricians and family physicians report that they experience barriers to adolescent immunization, particularly as adolescents aged. Family physicians reported experiencing more barriers for older adolescents compared with pediatricians; however, it is likely that more adolescents aged 19 to 21 seek care from primary care physicians than from pediatricians.

Respondents, in particular family physicians, consistently placed less importance on varicella vaccine compared with hepatitis B, MMR, and Td. For example, only 68% of respondents overall reported that it was “very important” to ensure that adolescents were UTD on protection against varicella, whereas 86% to 97% reported the same regarding hepatitis B, MMR, and Td. In addition, most respondents (84% to 98%) reported that they routinely recommended hepatitis B, MMR, and Td, whereas fewer (60%) reported routinely recommending varicella vaccine, even though only 31% of respondents felt that most (ie, $\geq 75\%$) of their adolescent patients were UTD on their protection against varicella compared with 69% who reported the same for MMR and Td. This disparity may stem from the fact that varicella vaccine is relatively new—less than 3 years had elapsed between our survey and the CDC’s recommendation to administer varicella vaccine to adolescents without a history of natural disease, and the vaccine had only been licensed and available for use in the United States for an additional 15 months.^{10,11} Adherence to varicella vaccine recommendations faces several additional challenges: there is a lack of direct medical cost savings, previous surveys have found that some physicians are concerned about waning immunity after vaccination and may prefer natural disease over vaccination, and varicella is generally a benign illness, with rare complications. In addition, previous studies indicate that physicians are concerned that varicella may shift from being a childhood disease to primarily an adult disease, where the complications are greater.^{10,12–16}

To the best of our knowledge, only one previous survey has been conducted assessing physician practices with regard to adolescent immuniza-

Table 4. Barriers to Immunizing Adolescents*

	Age 11 to 13 [No. (%)]	Age 14 to 18 [No. (%)]	Age 19 to 21 [No. (%)]
Adolescents rarely make preventive health visits			
PEDS [†]	44 (45)	68 (69)	61 (63) [‡]
FP [†]	63 (56)	79 (70)	84 (74)
Overall	107 (51)	147 (70)	145 (69)
Adolescents not aware of need for immunizations			
PEDS	44 (45) [‡]	62 (64)	59 (61)
FP	70 (62)	74 (65)	76 (67)
Overall	114 (54)	136 (65)	135 (64)
Adolescents/parents underestimate risk of disease			
PEDS	42 (43)	55 (57)	44 (45)
FP	58 (51)	61 (54)	60 (53)
Overall	100 (48)	116 (55)	104 (50)
Difficult to obtain verification of previous immunization			
PEDS	31 (32) [‡]	42 (43) [‡]	35 (36) [‡]
FP	67 (59)	69 (61)	71 (63)
Overall	98 (47)	111 (53)	106 (50)
Non-compliance with multiple dose vaccines			
PEDS	40 (42)	48 (49)	44 (45)
FP	42 (37)	44 (39)	45 (40)
Overall	82 (39)	92 (44)	89 (42)
Adolescents seek care from other facilities			
PEDS	23 (24)	32 (33)	40 (41) [‡]
FP	21 (19)	23 (20)	29 (26)
Overall	44 (21)	55 (26)	69 (33)
Adolescents/parents overestimate risk of side-effects			
PEDS	18 (19)	14 (14)	11 (11) [‡]
FP	29 (26)	26 (23)	24 (21)
Overall	47 (22)	40 (19)	35 (17)
Difficult to determine who needs vaccine			
PEDS	10 (10)	16 (16)	11 (11) [‡]
FP	22 (19)	22 (19)	24 (21)
Overall	32 (15)	38 (18)	35 (17)
Difficult to determine adolescents "at risk"			
PEDS	10 (10)	15 (15)	15 (15)
FP	14 (12)	16 (14)	14 (12)
Overall	24 (11)	31 (15)	29 (14)
Adolescents/parents refuse vaccination			
PEDS	10 (10)	10 (10)	11 (11)
FP	13 (12)	10 (9)	12 (11)
Overall	23 (11)	20 (10)	23 (11)
Obtaining consent as per state law			
PEDS	3 (3)	6 (6)	5 (5)
FP	9 (8)	10 (9)	8 (7)
Overall	12 (6)	16 (8)	13 (6)

* Overall, N = 210; pediatricians, n = 97; family physicians, n = 113.

[†] PED, pediatrician; FP, family physician.

[‡] P < .05 for differences between family physicians and pediatricians.

tion.¹⁷ Our survey sample was randomly selected and national in scope, surveying physicians in 28 states and the District of Columbia. In addition, both pediatricians and family physicians were included. Despite the strengths of the study, there were at least 3 limitations. First, we did not verify through chart review whether self-reported practice reflected actual practice; thus, the true level of care was not independently verified. Second, our study sample was small (n = 358). Last, although the response rate was nearly 60%, and respondents

and nonrespondents were demographically similar, it is possible that they differed in their immunization practices.

This study provides a basic framework for understanding physicians' attitudes and practices with regard to adolescent immunization, as well as identifying barriers encountered at the provider level. Improvement is needed in knowledge about varicella vaccine use, use of reminder/recall systems, and overcoming barriers to immunizing older adolescents, particularly among family physicians.

Education and intervention efforts should be tailored to address specific barriers faced by practitioners and to define the most effective strategies to overcoming these barriers. Further research is warranted to identify practical ways to enhance immunization of all adolescents.

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References

1. Yusuf H, Averhoff F, Smith N, Brink E. Adolescent immunization: rationale, recommendations, and implementation strategies. *Pediatr Ann* 1998;27:436–44.
2. Averhoff FM, Williams WW, Hadler SC. Immunization of adolescents. *Am Fam Physician* 1997;55:159–67.
3. Immunization of adolescents. Recommendations of the Advisory Committee on Immunization Practices, the American Academy of Pediatrics, the American Academy of Family Physicians, and the American Medical Association. *MMWR Recomm Rep* 1996;45(RR-13):1–16.
4. Lannon C, Brack V, Stuart J, et al. What mothers say about why poor children fall behind on immunizations: a summary of focus groups in North Carolina. *Arch Pediatr Adolesc Med* 1995;149:1070–5.
5. Averhoff FM, Brink E, Pollard B, Resha K, Bryan G, Vaillancourt MV. Adolescent immunization: focus on implementation. *J Sch Health* 1997;67:304–8.
6. Vernon ME, Bryan G, Hunt P, Allensworth D, Bradley B. Immunization services for adolescents within comprehensive school health programs. *J Sch Health* 1997;67:252–5.
7. Nichol KL, Mac Donald R, Hauge M. Factors associated with influenza and pneumococcal vaccination behavior among high-risk adults. *J Gen Intern Med* 1996;11:673–7.
8. Taylor JA, Darden PM, Slora E, Hasemeier CM, Asmussen L, Wasserman R. The influence of provider behavior, parental characteristics, and a public policy initiative on the immunization status of children followed by private pediatricians: a study from pediatric research in office settings. *Pediatrics* 1997;99:209–15.
9. Adult immunization: knowledge, attitudes, and practices—DeKalb and Fulton Counties, Georgia, 1988. *MMWR Morb Mortal Wkly Rep* 1988;37:657–61.
10. Prevention of varicella: recommendations of the Advisory Committee on Immunization Practices (ACIP). Centers for Disease Control and Prevention. *MMWR Recomm Rep* 1996;45(RR-11):1–36.
11. Licensure of varicella virus vaccine, live. *MMWR Morb Mortal Wkly Rep* 1995;44:264.
12. Ehresmann KR, Mills WA, Loewenson PR, Moore K. Attitudes and practices regarding varicella vaccination among physicians in Minnesota: implications for public health and provider education. *Am J Public Health* 2000;90:1917–20.
13. American Academy of Pediatrics, Division of Child Health Research. Periodic Survey of Fellows #35—Adults immunity still a concern. Most fellows offer varicella vaccine; rates vary by location, payment system [monograph on the Internet]. Elk Grove Village (IL): American Academy of Pediatrics; 1998 [cited 2004 Dec 13]. Available from: <http://www.aap.org/research/periodicsurvey/ps36b.htm>
14. Schaffer SJ, Bruno S. Varicella immunization practices and the factors that influence them. *Arch Pediatr Adolesc Med* 1999;153:357–62.
15. Newman RD, Taylor JA. Reactions of pediatricians to the recommendation for universal varicella vaccination. *Arch Pediatr Adolesc Med* 1998;152:792–6.
16. MacFarlane LL, Sanders ML, Carek PJ. Concerns regarding universal varicella immunization. Time will tell. *Arch Fam Med* 1997;6:537–41.
17. Schaffer SJ, Humiston SG, Shone LP, Averhoff F, Szilagyi PG. Adolescent immunization practices: a national survey of US physicians. *Arch Pediatr Adolesc Med* 2001;155:566–71.