

Underinsurance and Adolescent Immunization Delivery in the United States

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KEY WORDS

immunization, financing

ABBREVIATIONS

HDC—health department clinic

VFC—Vaccines for Children

ACIP—Advisory Committee on Immunization Practices

Td—tetanus-diphtheria toxoids

Tdap—tetanus toxoids-reduced diphtheria toxoids-acellular pertussis

MCV4—tetraivalent meningococcal conjugate vaccine

HPV4—quadrivalent human papillomavirus vaccine

RHC—rural health center

FQHC—federally qualified health center

CI—confidence interval

NIS—National Immunization Survey

MSA—metropolitan statistical area

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abstract

OBJECTIVE: The goal was to explore the association of being underinsured and receiving doses at a health department clinic (HDC) with not receiving all recommended adolescent vaccine doses.

METHODS: A total of 5657 adolescents, 13 to 17 years of age, were sampled in the National Immunization Survey-Teen in 2006–2007.

RESULTS: A total of 63.9% of all adolescents were covered by private health insurance. Among privately insured adolescents, ~31.3% were underinsured. Compared with fully insured adolescents, underinsured adolescents were more likely to receive doses at an HDC for tetanus-diphtheria toxoids/tetanus toxoids-reduced diphtheria toxoids-acellular pertussis vaccine (25.1% vs 6.2%; $P < .05$), tetraivalent meningococcal conjugate vaccine (11.5% vs 2.5%; $P < .05$), and quadrivalent human papillomavirus vaccine (16.2% vs 3.4%; $P < .05$). Also, compared with fully insured adolescents, underinsured adolescents who received doses at an HDC had lower estimated rates of vaccination coverage for tetanus-diphtheria toxoids/tetanus toxoids-reduced diphtheria toxoids-acellular pertussis vaccine (58.5% vs 70.9%; $P < .05$), tetraivalent meningococcal conjugate vaccine (10.8% vs 25.8%; $P < .05$), and quadrivalent human papillomavirus vaccine (7.8% vs 14.3%; $P < .05$).

CONCLUSION: Underinsured adolescents who receive doses at an HDC have lower rates of vaccination coverage than do fully insured adolescents. *Pediatrics* 2009;124:S515–S521

In 1994, when the Vaccines for Children (VFC) program was established,¹ only 1 vaccine was recommended by the Advisory Committee on Immunization Practices (ACIP) for routine vaccination for 11- to 18-year-old adolescents.² At that time, 1 dose of the tetanus-diphtheria toxoids (Td) vaccine cost approximately \$1.41 (in 2008 dollars). Between 2005 and 2007, the ACIP recommended that routine administration of Td be replaced by administration of 1 dose of the tetanus toxoids-reduced diphtheria toxoids-acellular pertussis (Tdap) vaccine³ and augmented its recommendations to include 1 dose of the tetravalent meningococcal conjugate vaccine (MCV4)⁴ and 3 doses of the quadrivalent human papillomavirus vaccine (HPV4) for females.⁵ In 2008 dollars, the private-sector cost per dose for recently recommended vaccines is greater than that for vaccines that were recommended in 1994 (eg, the cost of HPV4 is \$125.29 and that of Td vaccine is \$1.41). Because of these new recommendations, the 2008 cost to fully vaccinate a child through the age of 18 years in the private sector with all recommended child and adolescent vaccines has risen from \$361 to \$1666 for males and to \$2042 for females. The 2008 cost to fully vaccinate an adolescent in the private sector with all recommended adolescent vaccines has increased from \$1.41 to \$435 for males and \$811 for females.⁶ Among adolescents who are covered by private health insurance that does not cover all of the costs of vaccines, this increased cost may be a barrier to full vaccination according to ACIP recommendations.

Adolescents who are covered by private insurance that does not cover all of the costs of recommended vaccines are referred to as being “underinsured” in this article. Underinsured children who are ≤ 18 years of age are entitled to receive VFC vaccines at no

cost at federally qualified health centers (FQHCs) and rural health centers (RHCs). However, FQHCs and RHCs are mandated to provide care in medically underserved geographic areas and may be located in geographic areas that may be inconvenient for some parents to access.⁷ To avoid the out-of-pocket costs of paying their private provider to administer the newly recommended vaccines and to avoid the inconvenience of travel to a FQHC or RHC, some parents take their adolescents to a health department clinic (HDC) to be vaccinated. By seeking vaccinations outside their medical home, those adolescents experience a break in the continuity of their medical care and may be at risk of not receiving all recommended vaccinations. The purposes of this article are (1) to provide estimates of the proportions of 13- to 17-year-old adolescents in the United States who are underinsured, (2) to explore the extent to which underinsured adolescents receive vaccination doses at HDCs, and (3) to evaluate the extent to which underinsured adolescents have received all recommended adolescent vaccination doses.

METHODS

National Immunization Survey-Teen

We analyzed data obtained from 5657 adolescents, 13 to 17 years of age, sampled in the National Immunization Survey (NIS)-Teen in 2006–2007. Data are collected in the NIS-Teen in 2 phases, that is, a telephone survey of households with landline telephones that have adolescents 13 to 17 years of age and a subsequent survey mailed to sampled adolescents’ vaccination providers. Approximately 82% of the respondents in the telephone portion of the NIS-Teen were the sampled adolescent’s mother, 15% were the adolescent’s father, and 3% were another family member. In the telephone portion of the NIS-Teen, respondents were

asked to provide information about the adolescent, the mother of the adolescent, and the socioeconomic characteristics of the adolescent’s household. At the end of the telephone interview, consent to contact the sampled adolescent’s vaccination providers was requested. If consent was granted, then a questionnaire was mailed to the adolescent’s providers. Provider-reported vaccination histories were used to determine vaccination status in our study. The design and statistical methods of the NIS-Teen⁸ are similar to those of the NIS.⁹ In 2006 and 2007, the Council of American Survey Research Organizations (CASRO)¹⁰ response rates for the telephone portion of the NIS-Teen were 56.5% and 55.9%, respectively. Among households that completed the NIS-Teen telephone interview, the proportions of adolescents who had sufficiently detailed vaccination history returned from the mail survey sent to vaccination providers were 52.7% in 2006 and 53.8% in 2007. In all of our analyses, we used the survey library¹¹ in the R 2.8.0 statistical software package (R Development Core Team, Software available at: www.r-project.org/), which allowed the NIS-Teen sampling weights, the NIS-Teen sampling design, and the independence of sampling from year to year to be taken into account in our statistical analyses. The NIS-Teen was approved by the Centers for Disease Control and Prevention institutional review board.

Determination of Vaccination Status of Adolescents Sampled in the NIS-Teen

Adolescents were considered to be up to date according to ACIP recommendations¹² for the Td/Tdap vaccines and MCV4 if their provider-reported vaccination histories indicated that they were given ≥ 1 dose of either Td or Tdap vaccine and ≥ 1 dose of MCV4. Adolescent females were considered

to be up to date according to ACIP recommendations for HPV4 if their provider-reported vaccination histories indicated that they were given ≥ 3 doses of that vaccine.

Insurance Category Definitions

Respondents to the telephone portion of the NIS-Teen were asked about the types of health insurance that covered their adolescent. In our study, adolescents were considered uninsured if the NIS-Teen respondents reported that the adolescents were not covered by any type of health insurance. Adolescents were considered underinsured in our study if they were reported as being covered by private health insurance that, aside from copayments and the cost of the office visit, did not cover all of the costs of the vaccines administered at the adolescent's most recent visit to the vaccination provider. Adolescents were considered VFC-entitled if at the time of the NIS-Teen telephone interview they (1) were American Indian/Alaska Native, (2) were uninsured, (3) were covered by Medicaid, or (4) were underinsured and were given vaccine doses at a FQHC or RHC.

Adolescents who were covered by private insurance that covered all of the costs of the vaccines administered at their most recent vaccination and who were not VFC-entitled were considered fully insured. Adolescents who were underinsured, received vaccine doses at an HDC, and were not VFC-entitled are referred to as "underinsured and received doses at an HDC." Finally, adolescents who were underinsured, did not receive vaccine doses at an HDC, and were not VFC-entitled are referred to as "underinsured and did not receive doses at an HDC."

RESULTS

Estimated Proportions of VFC-Entitled Adolescents

Among adolescents in the United States who were 13 to 17 years of age

TABLE 1 Estimated Distribution of 13- to 17-Year-Old Adolescents According to Insurance Category in the 2006–2007 NIS-Teen

Insurance Category	No. of Respondents	Proportion in Insurance Category, Estimate \pm 95% CI, %
Private, never VFC-entitled	3954	63.3 \pm 1.6
Not underinsured	1221	43.9 \pm 1.4
Underinsured	2733	19.4 \pm 1.2
Did not receive doses at HDC	842	13.1 \pm 1.1
Received doses at HDC	379	6.3 \pm 0.7
Ever VFC-entitled	1478	32.0 \pm 1.7
Medicaid	1027	23.3 \pm 1.6
Uninsured	329	6.6 \pm 1.0
American Indian/Alaska Native	121	2.5 \pm 0.5
Underinsured and given doses at FQHC or RHC	47	0.6 \pm 0.2
Non-VFC, other insurance type	225	4.7 \pm 0.8

TABLE 2 Estimated Percentages of 13- to 17-Year-Old Adolescents Who Received ≥ 1 Dose of Selected Vaccine at a HDC, According to Insurance Category, in the 2006–2007 NIS-Teen

Insurance Category	Proportion of Adolescents Receiving ≥ 1 Dose at HDC, Estimate \pm 95% CI, %		
	Td/Tdap Vaccine	MCV4	HPV4
Not VFC-entitled			
Fully insured	6.2 \pm 1.8 ^a	2.5 \pm 1.2 ^a	3.4 \pm 2.7 ^a
Underinsured	25.1 \pm 4.3 ^b	11.5 \pm 5.2 ^b	16.2 \pm 11.1 ^b
VFC-entitled	21.2 \pm 4.7	11.4 \pm 5.5	18.5 \pm 9.0
Other insurance type ^c	15.3 \pm 11.1	11.2 \pm 13.5	4.1 \pm 8.1 ^a

^a Significantly less than the reference category at the .05 level of statistical significance.

^b Reference category.

^c Separate Medicaid State Children's Health Insurance Program insurance, military Tricare insurance, or other insurance.

in 2006 and 2007, 32.0% (95% confidence interval [CI]: $\pm 1.7\%$) were VFC-entitled, 0.6% \pm 0.2% were underinsured and received doses at a FQHC or RHC, 23.3% \pm 1.6% were covered by Medicaid, 6.6% \pm 1.0% were uninsured, and 2.5% \pm 0.5% were American Indian/Alaska Native (Table 1).

Estimated Proportions of Underinsured Adolescents

Among all adolescents who were 13 to 17 years of age in 2006 and 2007, 20.0% \pm 1.2% were underinsured; the estimated percentage of those who were underinsured and never vaccinated at a FQHC/RHC was 19.4% \pm 1.2% (Table 1). The percentage of 13- to 17-year-old adolescents who were underinsured and received vaccine doses at an HDC was 6.3% \pm 0.7%. Among all 13- to 17-year-old adolescents who were privately insured, 31.3% \pm 1.7% were underinsured. An estimated 4.3 \pm 0.3 million adolescents

who were 13 to 17 years of age in 2006 and 2007 were underinsured.

Administration of Vaccines to Underinsured Adolescents at HDCs

Compared with fully insured adolescents, adolescents who were underinsured and never vaccinated at a FQHC/RHC were significantly more likely to receive Td/Tdap vaccines, MCV4, and HPV4 at HDCs (Table 2). The estimated proportions of adolescents who received vaccine doses at an HDC were not significantly different between VFC-entitled adolescents and adolescents who were underinsured and never vaccinated at a FQHC/RHC for any of those 3 vaccines.

Association of Being Underinsured and Receiving Vaccine Doses at an HDC With Vaccination Coverage

Adolescents who were underinsured and received vaccine doses at an HDC

TABLE 3 Estimated Vaccination Coverage for Selected Vaccines Among 13- to 17-Year-Old Adolescents, According to Insurance Category, in the 2006–2007 NIS-Teen

Insurance Category	No. of Respondents	Vaccination Coverage Rate, Estimate \pm 95% CI, %		
		≥ 1 Dose of Td/TdaP Vaccine	≥ 1 Dose of MCV4	≥ 3 Doses of HPV4
Fully insured	2500	70.9 \pm 2.2 ^a	25.8 \pm 1.9 ^a	14.3 \pm 2.6 ^a
Underinsured and did not receive doses at HDC	783	66.6 \pm 4.4 ^a	26.4 \pm 3.7 ^a	15.8 \pm 4.5 ^a
Underinsured and received doses at HDC	330	58.8 \pm 5.9 ^b	10.8 \pm 4.1 ^b	7.8 \pm 4.7 ^b
VFC-entitled	1886	61.5 \pm 3.7	19.6 \pm 2.7 ^a	12.4 \pm 2.9
Other insurance type ^c	177	68.4 \pm 7.3 ^a	24.0 \pm 7.9 ^a	12.7 \pm 7.7

^a Significantly different from the reference category at the .05 level of statistical significance.

^b Reference category.

^c Separate Medicaid State Children's Health Insurance Program insurance, military Tricare insurance, or other insurance.

had vaccination coverage rates lower than those of fully insured adolescents for Td/TdaP vaccine (58.8% vs 70.9%; $P < .05$), MCV4 (10.8% vs 25.8%; $P < .05$), and HPV4 (7.8% vs 14.3%; $P < .05$) (Table 3). Also, the estimated vaccination coverage rates for each of those vaccines among adolescents who were underinsured and received doses at an HDC were significantly lower than the estimated coverage rates among adolescents who did not receive vaccine doses at an HDC. There were no significant differences in vaccination coverage rates between VFC-entitled adolescents and adolescents who were underinsured and received vaccine doses at an HDC.

Sociodemographic Characteristics of Underinsured Adolescents

Compared with VFC-entitled adolescents, adolescents who were underinsured, received doses at an HDC, and were not VFC-entitled lived in households that were significantly less likely to be below 133% of the federal poverty level (10.9% vs 40.5%; $P < .05$), were significantly less likely to live in a metropolitan statistical area (MSA) central city, and were significantly more likely to live in a rural non-MSA (Table 4). Also, compared with VFC-entitled adolescents, adolescents who were underinsured and received doses at an HDC were significantly less likely to be Hispanic or non-Hispanic black and

were significantly more likely to be non-Hispanic white (Table 4). Finally, compared with mothers of VFC-entitled adolescents, the mothers of adolescents who were underinsured and received doses at an HDC were significantly more likely to be married and not widowed/divorced/separated or never married, were significantly more likely to be a college graduate, were significantly more likely to be ≥ 45 years of age, and were significantly more likely to prefer to speak English during the NIS-Teen telephone interview than Spanish (Table 4).

Compared with adolescents who were fully insured, adolescents who were underinsured and received doses at an HDC lived in households that were no more likely to be in poverty, were significantly more likely to be located in a rural non-MSA, and were significantly less likely to be located in a non-central city MSA. Also, compared with adolescents who were fully insured, adolescents who were underinsured and received doses at an HDC were significantly less likely to have a mother with a college degree (Table 4).

DISCUSSION

Synthesis of Results With Other Relevant Findings

Earlier this decade, premiums for private health insurance increased dramatically from year to year.¹³ Also,

many employers shifted the cost of health insurance to their employees by increasing deductibles, increasing patient cost-sharing, and restricting the scope of benefits that required high out-of-pocket costs for health care services.^{14–16} Our results show that, in 2006 and 2007, ~ 1 of 5 adolescents 13 to 17 years of age was underinsured. Among all 13- to 17-year-old adolescents who were privately insured, nearly 1 of 3 was underinsured.

The increased cost of recently recommended vaccines may be a barrier for underinsured adolescents becoming fully vaccinated in their medical home by their private vaccination provider. Parents of those adolescents may seek vaccinations for their teens at facilities where vaccinations are less expensive or free. Inconsistent use of a medical home for primary care represents a break in the continuity of medical care, which has been found to be associated with lower estimated vaccination coverage rates.¹⁷ Our results are concordant with those findings and show that underinsured adolescents who are given vaccinations at HDCs have lower estimated vaccination coverage rates than do fully insured adolescents who receive all doses in their medical home with their private provider.

Although underinsured adolescents are entitled to receive VFC vaccines at no cost at FQHCs and RHCs, those facilities are mandated to provide care in medically underserved geographic areas and may be located in geographic areas that are inconvenient for some parents.⁸ This inconvenience may be an additional barrier that prevents underinsured adolescents from accessing the benefits to which they are entitled through the VFC program. To avoid out-of-pocket costs for recommended vaccines at their adolescent's medical home, some parents have taken their adolescent to an HDC to be vaccinated.

TABLE 4 Distribution of Selected Socioeconomic Characteristics, According to Insurance Category, in the 2006–2007 NIS-Teen

Socioeconomic Characteristics	Proportion, Estimate ± 95% CI, %				
	Not VFC-Entitled				VFC-Entitled
	Privately and Fully Insured	Privately Insured and Underinsured With No Doses at HDC	Privately Insured and Underinsured With Doses at HDC	Other Insurance Type ^a	
Characteristics of household					
Annual income < 133% of FPL	6.7 ± 1.3	5.5 ± 1.9 ^a	10.9 ± 4.8 ^b	61.9 ± 3.3 ^a	40.5 ± 9.3 ^a
No. of children ≤ 18 y of age in household					
1	31.3 ± 2.1	33.2 ± 3.8	28.8 ± 5.0 ^b	30.6 ± 7.5	26.1 ± 2.7
2	38.6 ± 2.4	39.7 ± 4.3	39.8 ± 6.2 ^b	31.9 ± 7.8	30.8 ± 3.0 ^a
≥ 3	30.1 ± 2.4	27.0 ± 4.2	31.4 ± 6.3 ^b	37.4 ± 8.8	43.1 ± 3.3 ^a
Location of household in MSA					
MSA, central city	33.8 ± 2.3 ^a	39.2 ± 4.3 ^a	26.7 ± 5.6 ^b	33.9 ± 8.2	44.8 ± 3.3 ^a
MSA, not central city	54.6 ± 2.4 ^a	50.5 ± 4.3 ^a	38.6 ± 6.2 ^b	51.9 ± 8.6 ^a	33.1 ± 3.1
Rural, not MSA	11.6 ± 1.4 ^a	10.4 ± 2.3 ^a	34.7 ± 5.8 ^b	14.3 ± 4.4 ^a	22.1 ± 2.4 ^a
Characteristic of adolescent					
Race/ethnicity					
Hispanic	10.3 ± 1.5	9.4 ± 2.8	8.9 ± 4.2 ^b	39.9 ± 9.0 ^a	28.5 ± 3.0 ^a
White non-Hispanic, single race	76.3 ± 2.3 ^a	81.5 ± 3.8	83.6 ± 5.2 ^b	38.5 ± 7.7 ^a	40.2 ± 3.1 ^a
Black non-Hispanic, single race	9.6 ± 1.7	5.4 ± 2.7	6.5 ± 3.4 ^b	15.8 ± 6.1 ^a	24.2 ± 3.1 ^a
Other non-Hispanic, single race	2.7 ± 0.9 ^a	2.7 ± 1.4 ^a	0.4 ± 0.6 ^b	5.8 ± 4.1 ^a	2.5 ± 1.1 ^a
Other non-Hispanic, multirace	1.1 ± 0.6	0.9 ± 0.9	0.7 ± 0.8 ^b	0.0 ± 0.0	4.5 ± 1.3 ^a
Age, y					
13	19.9 ± 2.0	18.6 ± 3.5	15.7 ± 5.2 ^b	15.7 ± 6.2	20.4 ± 2.6
14	19.9 ± 2.0	23.2 ± 3.8	23.3 ± 5.3 ^b	19.0 ± 6.6	18.9 ± 2.6
15	20.7 ± 2.0	19.5 ± 3.3	18.7 ± 4.7 ^b	24.6 ± 7.4	23.1 ± 2.8
16	20.7 ± 2.0	16.9 ± 3.1	21.8 ± 5.0 ^b	19.6 ± 6.4	20.3 ± 2.6
17	18.7 ± 1.9	21.7 ± 3.6	20.5 ± 5.0 ^b	21.2 ± 7.7	17.3 ± 2.5
Characteristic of mother					
Marital status					
Married	82.2 ± 2.0	80.1 ± 3.9	83.5 ± 4.8 ^b	61.1 ± 8.5 ^a	50.3 ± 3.3 ^a
Divorced/separated/never married	15.7 ± 1.9	17.2 ± 3.7	13.1 ± 4.4 ^b	33.6 ± 8.2 ^a	46.7 ± 3.3 ^a
Education, y					
< 12	5.3 ± 1.2	7.5 ± 2.9	8.7 ± 3.9 ^b	27.7 ± 8.3 ^a	31.1 ± 3.1 ^a
12	26.7 ± 2.3	24.4 ± 4.0	26.2 ± 5.7 ^b	31.0 ± 7.9	33.4 ± 3.1 ^a
> 12, not college graduate	33.9 ± 2.3 ^a	29.4 ± 3.9 ^a	41.6 ± 6.3 ^b	28.4 ± 7.5 ^a	28.1 ± 2.9 ^a
College graduate	34.1 ± 2.2 ^a	38.7 ± 4.0 ^a	23.5 ± 4.6 ^b	12.9 ± 5.3 ^a	7.4 ± 1.3 ^a
Age, y					
≤ 34	5.0 ± 1.2	4.8 ± 2.1	5.9 ± 3.2 ^b	19.2 ± 7.1 ^a	19.7 ± 2.8 ^a
35–44	48.7 ± 2.5	41.4 ± 4.3 ^a	50.1 ± 6.3 ^b	45.4 ± 8.6	51.5 ± 3.3
≥ 45	46.3 ± 2.4	53.8 ± 4.3 ^a	44.0 ± 6.3 ^b	35.4 ± 8.2	28.8 ± 2.9 ^a
Preferred language					
English	97.2 ± 0.9	95.4 ± 2.1	96.7 ± 2.8 ^b	69.1 ± 8.8 ^a	79.1 ± 2.8 ^a
Spanish	2.3 ± 0.8	2.9 ± 1.5	3.3 ± 2.8 ^b	30.2 ± 8.8 ^a	18.5 ± 2.7 ^a
Other	0.5 ± 0.4 ^a	1.7 ± 1.5 ^a	0.0 ± 0.0 ^b	0.7 ± 0.9	2.4 ± 1.1 ^a

FPL indicates federal poverty level.

^a Significantly different from the reference category at the .05 level of statistical significance.^b Reference category.

Our findings showed that underinsured adolescents who were not VFC-entitled were significantly more likely to be given vaccine doses at HDCs than were fully insured adolescents and were as likely to be given vaccine doses at HDCs as were adolescents who were VFC-entitled.

To pay for vaccinations for underinsured adolescents, states may use

their own sources of funding to purchase vaccines that are administered to underinsured children at HDCs, including funds provided through the Centers for Disease Control and Prevention immunization Section 317 grant program.¹⁸ However, funding from Congress to support the Section 317 grant program has not changed appreciably since 1994, when only 1

adolescent vaccine was recommended.¹⁹ When state and Section 317 funding is insufficient to cover the cost of vaccines for administering publicly purchased vaccines to underinsured patients at HDCs, some states have adopted a policy of not administering newly recommended vaccines to underinsured children,^{20,21} which further restricts underinsured adolescents'

access to recommended vaccines. Furthermore, parents of underinsured adolescents who are given all vaccines in their medical home, to avoid fragmentation of primary care services, may incur large out-of-pocket costs to cover recommended vaccines.

Strengths and Weaknesses

Our work has several strengths. First, data from our study were drawn from a large sample of 13- to 17-year-old adolescents, by using methods that have been used each year in the past 14 years by the NIS.⁸ Also, estimates of vaccination coverage from the NIS-Teen are based on provider-reported vaccination histories, which are known to be more accurate than parent reports from memory.²² These features allowed us to obtain reliable estimates of vaccination coverage.

The findings in this report are subject to potential limitations. Because the NIS-Teen is a survey of households with landline telephones, results are weighted to be representative of all 13- to 17-year-old adolescents in the United States. Separate statistical adjustments have been made to the survey weights to account for noncoverage of households without landline telephone service,²³ nonresponse to the NIS-Teen telephone interview,⁸ nonresponse to the NIS-Teen mail survey sent to providers,⁸ and other effects that could bias estimates from the NIS-Teen.⁹ When the data that were used in our work were collected, the proportion of adolescents who lived in a household without landline telephone service was ~10%.²⁴ Bias in complex-sample surveys such as the NIS-Teen is equal to the product of the proportion of the target population not covered by the survey and the difference in vaccination coverage rates between the proportion of the target population that is covered by the survey and the proportion that is not covered by the

survey.^{25,26} Because the proportion of adolescents living in households with no landline telephone service is moderate and the difference in vaccination coverage rates between covered and noncovered proportions of the target population is expected to be no greater than moderate (<10%), the maximal bias in national estimates obtained from our analysis that can be attributed to noncoverage of non-telephone-containing and cellular telephone-only households is expected to be small.²⁷

Finally, underinsured status in our study was determined from parents' reports that, aside from copayments and the cost of the office visit, their private insurance did not cover all of the costs of vaccines for their adolescent's last vaccination. Parents who answered this question incorrectly would have been misclassified in our analysis, and the statistical significance of differences in our analyses would have been underestimated. Also, because the question to determine underinsurance status in the NIS-Teen pertained only to the last visit for vaccinations, our estimate of the proportion of children who were underinsured may be too low. However, the question to evaluate underinsurance status in the NIS did not ask parents to exclude the vaccination administration fee from their determination of whether their private insurance paid for all of the costs of vaccines. Insofar as parents might not have been fully aware of what their out-of-pocket costs paid for, our ascertainment of underinsurance status might be imperfect.

CONCLUSIONS

Other vaccine financing issues have the potential to jeopardize further underinsured adolescents' access to recommended vaccines. Specifically, the increased cost of newly recommended vaccines results in an additional bar-

rier to vaccinating adolescents, because of the expense that private practices must bear to purchase, to store, to maintain, and to insure vaccines.²⁸ Allowable reimbursement rates for administering vaccines to Medicaid-entitled children and adolescents have not changed since 1994 and have not kept pace with the actual costs of administering vaccine doses.²¹ In a recent survey of primary care physicians, significant proportions said that reimbursement for vaccine purchase and reimbursement for vaccine administration were inadequate. Eleven percent said that their practice had seriously considered whether to stop providing all vaccines to privately insured children in the previous year.²⁹

In response to factors that jeopardize access to routinely recommended vaccines without financial barriers, the National Vaccine Advisory Committee made a variety of recommendations,²¹ including (1) extending the VFC program to include access to VFC vaccines for underinsured children and adolescents who receive immunizations at HDCs, (2) expanding VFC to cover vaccine administration reimbursement for all VFC-entitled children and adolescents, (3) encouraging providers to participate in the VFC program, (4) updating the maximal allowable Medicaid administration reimbursement amounts, and (5) reviewing the American Medical Association billing methods used by private providers, to ensure that the methods accurately reflect private providers' nonvaccine costs. If these VFC-related recommendations were implemented, than underinsured adolescents would have access to VFC vaccines at 5000 more HDCs. However, underinsured teens would not be able to receive VFC vaccines at private provider offices, which potentially would disrupt the continuity of primary care at the patients' medical home if they were referred to

an HDC for vaccination. Careful monitoring of referral rates to HDCs and

careful monitoring of coverage will be essential to determine whether under-

insured children are protected from vaccine-preventable diseases.

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