Underinsurance and Pediatric Immunization Delivery in the United States

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KEY WORDS: immunization, financing

ABBREVIATIONS
VFC—Vaccines for Children
MSA—metropolitan statistical area
RHC—rural health center
FQHC—federally qualified health center
NIS—National Immunization Survey
DTaP—diphtheria-tetanus-acellular pertussis
PCV7—heptavalent pneumococcal conjugate vaccine
MMR—measles-mumps-rubella
Hib—Haemophilus influenzae type b
CI—confidence interval
HDC—health department clinic

The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

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abstract

BACKGROUND: Underinsured children are covered by private health insurance that does not cover the cost of vaccines, are not entitled to receive publicly purchased vaccines at no cost through the Vaccines for Children (VFC) Program unless they receive doses at a Federally Qualified Health Center (FQHC) or a Rural Health Center (RHC), may be referred by their primary care providers to health department clinics (HDCs) for vaccinations, and may have lower vaccination coverage for new and more expensive vaccines.

OBJECTIVES: To describe the estimated percentage of children in the U.S. who are underinsured, receive vaccine doses at HDCs, and are not VFC-entitled; and to evaluate the association between being underinsured, receiving vaccine doses at an HDC, and timely vaccination coverage.

METHODS: Subjects were 16 621 19–35 month-old children sampled by the National Immunization Survey in 2007.

RESULTS: Of all 19–35 month-old children, an estimated 10.5% were underinsured; and an estimated 1.4% were underinsured, received doses at an HDC, and were not VFC-entitled. Compared to fully insured children, children who were underinsured and received doses at an HDC had significantly lower vaccination coverage for the varicella (81.5% vs. 87.7%, \( p < 0.05 \)) and PCV7 (55.1% vs. 75.9%, \( p < 0.05 \)) vaccines.

CONCLUSIONS: Children who were underinsured and received doses at HDCs were found to have lower estimated timely vaccination coverage for recently recommended vaccines and more expensive varicella and PCV7 vaccines. To adequately vaccinate these children at HDCs, states require stable funding to pay for vaccines as the number of new and more expensive vaccines grows. Pediatrics 2009;124:S507–S514

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In October 1994, the Vaccines for Children (VFC) program was established to eliminate cost as a barrier to pediatric vaccination.1 Children entitled to VFC vaccines are ≤18 years of age and (1) are uninsured (not covered by any health insurance), (2) are eligible for Medicaid, (3) are American Indian or Alaska Native, or (4) are covered by private health insurance that does not cover all of the costs of all recommended vaccines and are given vaccine doses at a federally qualified health center (FQHC) or rural health center (RHC). Children who are covered by private health insurance that does not cover all of the costs of all recommended vaccines are considered underinsured.

Since 1995, the number of recommended vaccines for infants and adolescents has increased from 9 vaccines to 18 vaccines.2 Also, the 2008 private-sector cost per dose for recently recommended vaccines is higher than that for the vaccines recommended in 1995 (eg, the cost of human papillomavirus vaccine is $125 and that of measles-mumps-rubella [MMR] vaccine is $47), and the cost of the vaccines that are required for full vaccination of a child through the age of 18 in the public sector has increased from $361 to $1666 for males and $2042 for females.4 The cost of the vaccines that are required for full vaccination of a child through the age of 6 in the public sector has increased from $359 to $1231. These increases suggest that cost might be a barrier to underinsured children becoming fully vaccinated according to the recommended schedule.3

To overcome that barrier, underinsured children who are ≤18 years of age are entitled to receive VFC vaccines at no cost at FQHCs and RHCs. In 2009, there were only 4123 FQHCs and 3757 RHCs in the United States.5 FQHCs and RHCs are mandated to provide care in medically underserved geographic areas,6 and they may be located in geographic areas that are inconvenient for some parents. As a consequence, inconvenience may be an additional barrier to underinsured children becoming fully vaccinated with all recommended childhood vaccine doses.2

Although insurance policies for underinsured children may cover the costs of some vaccines, research showed that physicians are likely to refer children to health department clinics (HDCs) when they learn that the children are underinsured.7 Because underinsured children are not entitled to receive VFC vaccines at HDCs, Centers for Disease Control and Prevention Immunization Grant Program Section 3178 and state funding sources are used to purchase vaccines that are administered to underinsured children at HDCs. However, many states have reported that funding from those sources is not sufficient to provide publicly purchased vaccines to underinsured children.9 The purposes of this article are (1) to describe the estimated proportions of children who are underinsured, (2) to explore the extent to which underinsured children receive vaccine doses at HDCs, (3) to evaluate the association of being underinsured and receiving vaccine doses at an HDC with timely vaccination coverage, and (4) to describe the sociodemographic characteristics of underinsured children.

METHODS

We analyzed data obtained from the families of 16,621 children 19 to 35 months of age in the National Immunization Survey (NIS) in 2007. The NIS is a landline telephone survey of families of 19- to 35-month-old children. Data collected include sociodemographic characteristics of the sampled households. For households from which consent is obtained, a mail survey is sent to vaccination providers to obtain the provider-reported vaccination histories of sampled children.

For children belonging to birth cohorts sampled in the 2007 NIS, the recommended vaccination schedule10 specified that infants were to receive 4 doses of diphtheria-tetanus-pertussis (diphtheria-tetanus-acellular pertussis [DTaP] and/or diphtheria-tetanus toxoids-pertussis) vaccine, 3 doses of polio vaccine, 1 dose of MMR vaccine after 12 months, 3 doses of hepatitis B vaccine, 3 doses of Haemophilus influenzae type b (Hib) vaccine, 1 dose of varicella vaccine after 12 months, and 4 doses of heptavalent pneumococcal conjugate vaccine (PCV7). Because the schedule specified that children were to complete the schedule by 19 months of age, we defined timely vaccination coverage as vaccination coverage at 19 months of age.

NIS respondents were asked questions about the types of health insurance that covered their children. Data from those questions and the sociodemographic data were used to determine whether sampled children were entitled to VFC vaccines. In our study, children were considered underinsured if their parents reported that, aside from copayments and the cost of the office visit, their private health insurance did not cover all of the costs of the vaccines administered at the child’s most recent vaccination visit. Children 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. Children 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, children 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.”

To compare subgroups of children with respect to measures of poverty, we compared median annual family incomes. Also, we compared estimated proportions of children living below 133% of the federal poverty level, because this is the income level at which state Medicaid programs are mandated by the federal government to provide Medicaid services.

In all of our analyses, we used the survey library in the R 2.8.0 statistical software package (R Development Core Team, Software available at: www.r-project.org/), which allowed the sampling weights, NIS sampling design, and clustering of children within households to be taken into account. In 2007, the Council of American Survey Research Organizations (CASRO)11 response rate for the telephone portion of the NIS was 64.9%; among 19- to 35-month-old children in households that completed the NIS telephone interview, 68.6% had sufficiently detailed vaccination history returned from the mail survey sent to vaccination providers. Separate statistical adjustments were made to the NIS sampling weights to account for noncoverage of households with no telephones,12 nonresponse to the NIS telephone interview,13 nonresponse to the NIS mail survey sent to providers,12 and other effects that could bias estimates from the NIS. Zell et al14 and Smith et al13,15,16 provided detailed descriptions of the design, statistical methods, and limitations of the NIS.

RESULTS

Estimated Percentages of Children Entitled to Receive VFC Vaccines

In 2007, 46.8% (95% confidence interval [CI]: ± 1.4%) of children who were 19 to 35 months of age were VFC-entitled (Table 1). Among all 19- to 35-month-old children who were VFC-entitled in 2007, 1.7% ± 0.5% were underinsured and received doses at a FQHC/RHC.

Estimated Percentages of Underinsured Children

In 2007, 10.5% ± 0.7% of all 19- to 35-month-old children were underinsured. The proportions of underinsured children varied from state to state, from ~3.8% in New York and Massachusetts to 25.0% in Nebraska (Fig 1). Among children who were privately insured, 20.9% ± 1.3% were underinsured.

Among children in the 2006 annual birth cohort of ~4.2 million children, ~440 000 ± 29 000 were underinsured. The numbers of underinsured children varied from state to state, from <1000 children in Vermont to ~50 000 children in California (Fig 2). In 2007, the estimated proportion of 19- to 35-month-old children who were underinsured and received vaccine doses at an HDC was 1.4% ± 0.2% (Table 1), corresponding to an estimated 82 000 ± 12 000 children.

Locations Where Children Who Were Underinsured and Never Vaccinated at a FQHC/RHC Received Vaccines

Among all 19- to 35-month-old children who were underinsured in 2007 and never vaccinated at a FQHC/RHC, 82.6% ± 3.1% received doses at a private clinic, 13.8% ± 2.0% received doses at an HDC, and 16.7% ± 3.3% received doses at hospital, military, or other clinics, such as clinics served by the Special Supplemental Nutrition Program for Women, Infants, and Children of the US Department of Agriculture. Among underinsured children who received doses at an HDC, 52.4% ± 8.0% were given all of their vaccine doses at an HDC.

Compared with fully insured children, children who were underinsured and never vaccinated at a FQHC/RHC were significantly less likely to be given vaccines at a private clinic (82.6% vs 86.8%; P < .05) and significantly more likely to be vaccinated at an HDC (13.8% vs 4.0%; P < .05). Compared with children who were VFC-entitled, children who were underinsured and never vaccinated at a FQHC/RHC were significantly more likely to be given vaccines at a private clinic (82.6% vs 64.3%; P < .05) but were as likely to be given vaccines at an HDC (13.8% vs 14.8%; P > .05).

Compared with fully insured children, children who were underinsured and never vaccinated at a FQHC/RHC were
significantly more likely to receive DTaP, polio, MMR, hepatitis B, Hib, and varicella vaccines and PCV7 at HDCs (Table 2). Also, children who were underinsured and never vaccinated at a FQHC/RHC were as likely to receive doses of each of those 7 vaccines at an HDC as were children who were VFC-entitled (Table 2).

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

For the DTaP, polio, MMR, hepatitis B, and Hib vaccines, children who were underinsured and received vaccine doses at an HDC had rates of timely vaccination coverage at 19 months that were not significantly different from those of fully insured children or children who were underinsured and did not receive doses at an HDC (Table 3). For the more-recently recommended varicella vaccine and PCV7, however, children who were underinsured and received vaccine doses at...
TABLE 2 Estimated Percentages of 19- to 35-Month-Old Children Who Received Vaccine Doses at a HDC, According to Vaccine Type and Insurance Category, in the 2007 NIS

<table>
<thead>
<tr>
<th>Insurance Category</th>
<th>Sample Size, N</th>
<th>Proportion of Children Receiving Vaccine Doses at HDC, Estimate ± 95% CI, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>DTaP</td>
</tr>
<tr>
<td>Not VFC-entitled</td>
<td>9883</td>
<td></td>
</tr>
<tr>
<td>Fully insured</td>
<td>7973</td>
<td>3.8 ± 0.6a</td>
</tr>
<tr>
<td>Underinsured</td>
<td>2267</td>
<td>13.5 ± 2.0p</td>
</tr>
<tr>
<td>VFC-entitled</td>
<td>6228</td>
<td>14.0 ± 1.6</td>
</tr>
<tr>
<td>Other insurance typec</td>
<td>500</td>
<td>10.6 ± 3.1</td>
</tr>
</tbody>
</table>

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 managed by the state separately from the state Medicaid program, military Tricare insurance, or other insurance.

TABLE 3 Estimated Rate of Vaccination Coverage by 19 Months of Age, According to Insurance Category, in the 2007 NIS

<table>
<thead>
<tr>
<th>Insurance Category</th>
<th>Sample Size, N</th>
<th>Vaccination Coverage at 19 mo, Estimate ± 95% CI, %</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>DTaP</td>
</tr>
<tr>
<td>Not VFC-entitled</td>
<td>9883</td>
<td></td>
</tr>
<tr>
<td>Fully insured</td>
<td>7973</td>
<td>76.6 ± 1.6</td>
</tr>
<tr>
<td>Underinsured and no doses at HDC</td>
<td>1920</td>
<td>72.2 ± 3.9</td>
</tr>
<tr>
<td>Underinsured and doses at HDC</td>
<td>347</td>
<td>71.8 ± 6.7a</td>
</tr>
<tr>
<td>VFC-entitled</td>
<td>6228</td>
<td>65.7 ± 2.0</td>
</tr>
<tr>
<td>Other insurance typec</td>
<td>500</td>
<td>66.8 ± 7.7</td>
</tr>
</tbody>
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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 managed by the state separately from the state Medicaid program, military Tricare insurance, or other insurance.

an HDC had rates of timely vaccination coverage at 19 months that were significantly lower than those of fully insured children and significantly lower than those of children who were underinsured and did not receive doses at an HDC (Table 3). Compared with VFC-entitled children, the estimated rate of vaccination coverage at 19 months for PCV7 was significantly lower among children who were underinsured and received doses at an HDC (Table 3).

Sociodemographic Characteristics of Underinsured Children

Compared with VFC-entitled children, children who were underinsured and received doses at an HDC lived in households that were significantly less likely to have an annual income below 133% of the federal poverty level, to have ≥4 children ≤18 years of age, or to be located in a rural non–metropolitan statistical area (non-MSA); were significantly more likely to be white rather than Hispanic or black; were significantly more likely to receive doses from a vaccination provider who ordered vaccines from the state VFC program; and were significantly more likely to have a mother who was married, was a college graduate, was ≥30 years of age, or preferred to speak English during the NIS telephone interview (Table 4). Compared with children who were fully insured, children who were underinsured and received doses at an HDC lived in households that were as unlikely to have an annual income below 133% of the federal poverty level, were significantly more likely to have ≥4 children ≤18 years of age, and were significantly more likely to be located in a rural non-MSA; were significantly more likely to receive vaccine doses from a provider who ordered vaccines from the state VFC program; and were significantly less likely to have a mother who was a college graduate or ≥30 years of age (Table 4). Compared with children who were underinsured and did not receive doses at an HDC, children who were underinsured and received doses at an HDC were significantly more likely to live in a rural non-MSA; were significantly more likely to receive vaccine doses from a provider who ordered vaccines from the state VFC program; and were significantly more likely to have a mother who was a college graduate (Table 4).

DISCUSSION

Summary of Findings

Our data showed that, among children who were 19 to 35 months of age in 2007, 46.8% ± 1.4% were entitled to VFC vaccines. Among all 19- to 35-month-old children, 10.5% ± 0.7% were underinsured. Among all privately insured 19- to 35-month-old children, 20.9% ± 1.3% were underinsured. Among all 19- to 35-month-old children who were underinsured and never vaccinated at a FQHC/RHC, 13.8% ± 2.0% received doses at an HDC.
Approximately 7 of 10 VFC-entitled children lived in households with an annual income <133% of the federal poverty level, compared with <1 of 11 children who were privately insured. Compared with children who were fully insured, children who were underinsured and received doses from an HDC lived in geographic locations that were significantly more likely to be rural non-MSA, lived in households that were significantly more likely to have more children, and were significantly less likely to have a mother who was a college graduate or >30 years of age.

Children who were underinsured and never vaccinated at a FQHC/RHC were given doses at an HDC at higher rates for all vaccines, compared with children who were fully insured. Children who were underinsured and received vaccine doses at an HDC were as likely to be up to date at 19 months of age for DTaP, polio, MMR, hepatitis B, and Hib vaccines as were children who were fully insured. However, their estimated rates of coverage at 19 months for the varicella vaccine and PCV7 were signifi-
icantly lower than those for fully insured children. The estimated rate of coverage at 19 months for PCV7 was significantly lower among children who were underinsured and received doses at an HDC, compared with VFC-entitled children.

Literature reports identified underinsurance as the most significant gap in the financing of childhood vaccines and hypothesized that children who are underinsured may be at risk for not being fully vaccinated with newer vaccines because of their greater costs. Data from our study support that hypothesis. Underinsured children may be covered by insurance policies that have high deductibles and/or copayments, or their insurance policies may not provide coverage for all primary or preventive care. When either is the case, the out-of-pocket costs to complete the recommended vaccination series may be so great as to be a barrier to vaccination, and parents may decide to delay or to forgo this and other essential primary care for their children. As additional, more-expensive vaccines are recommended, it may be anticipated that vaccination providers may increase the practice of referring underinsured children to HDCs to reduce vaccination costs to parents.

HDCs have been the traditional safety-net providers for childhood immunizations. However, underinsured children are not entitled to receive VFC vaccines at HDCs, and identifying alternative public-sector financing for their vaccines at HDCs is a challenge. Many states have reported that limitations in both federal Section 317 funding and state financing are barriers to providing vaccines to underinsured children and that they are not able to provide state-purchased vaccines for underinsured children at either public or private clinics. The National Vaccine Advisory Committee has identified underinsurance as an important financing gap and has expressed support for expanding the VFC program to include underinsured children vaccinated at HDCs, as well as increasing Section 317 funding. Because <2% of all 19- to 35-month-old children are underinsured and vaccinated at HDCs, filling the underinsurance gap identified by the National Vaccine Advisory Committee may be financially possible.

Limitations

In the NIS, statistical adjustments are made to the survey weights to account for noncoverage of households with no telephones, nonresponse to the NIS telephone interview, nonresponse to the NIS mail survey sent to providers, and other effects that might bias estimates from the NIS. In 2007, ~10.1% of children lived in households that either did not have a landline telephone or had only cellular telephone service. However, because the difference in vaccination coverage rates between children living in households covered by the NIS and children living in households not covered by the NIS is expected to be small, we anticipate that the bias in our estimates also would be small. Other limitations include measuring underinsurance status according to parents’ reports at their child’s last immunization. Underinsurance status could vary between the administration of a child’s first vaccine dose and the most-recent dose discussed in the NIS interview; therefore, we might have underestimated the proportion of children who were underinsured. However, the question asked in the NIS to evaluate underinsurance status 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 have been imperfect and might have overestimated the proportion of children who were underinsured.

CONCLUSIONS

As new, more-expensive vaccines are recommended, the proportion of underinsured children may increase and the cost to vaccinate children may increase. Current referral rates from private providers to HDCs may increase if parents of underinsured children cannot afford to pay out-of-pocket costs for vaccines. It is important to solve the childhood vaccine-financing dilemma so that HDCs can continue to serve as immunization safety-net providers for underinsured children, who may become more financially vulnerable as new, more-expensive vaccines are recommended. Otherwise, a substantial fraction of children, especially children in rural areas, may not be able to receive the benefits of vaccination.

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