SUPPLEMENT ARTICLE

The Association of Health Insurance and Continuous Primary Care in the Medical Home on Vaccination Coverage for 19- to 35-Month-Old Children

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ABSTRACT

OBJECTIVE. Our goal was to examine the association of continuous care in the medical home and health insurance on up-to-date vaccination coverage by using data from the National Survey of Children's Health and the National Immunization Survey.

METHODS. Interviews were conducted with 5400 parents of 19- to 35-month-old children to collect data on demographics and medically-verified vaccinations. Health insurance coverage was categorized as always, intermittently, or uninsured for the previous 12 months. Insurance types were private, public, or uninsured. Having a personal doctor or nurse and receiving preventive health care in either the past 12 or 24 months constituted continuous primary care in the medical home. Children were up-to-date if they received all vaccinations by 19 to 35 months of age (≥ 4 doses of diphtheria and tetanus toxoids and pertussis vaccine, ≥ 3 doses of poliovirus vaccine, ≥ 1 dose of any measles-containing vaccine, ≥ 3 doses of *Haemophilus influenzae* type b vaccine, and ≥ 3 doses of hepatitis B vaccine).

RESULTS. Bivariate analyses revealed children who were always insured had significantly higher vaccination coverage (83%) than those with lapses or uninsured during the past 12 months (75% and 71%, respectively). Those with continuous primary care in the medical home had significantly higher coverage than those who did not (83% vs 75%, respectively). In multivariate analysis, the same pattern of association was observed for insurance status and medical home, but the only statistically significant association was for children of never-married mothers who had significantly lower coverage (74%) compared with children of married mothers (84%).

CONCLUSIONS. Among children with the same insurance status and continuity of care in the medical home, children of single mothers were less likely to be up-to-date than children of married mothers. Interventions assisting single mothers to obtain preventive care for their children should be a priority.

ISSUES AFFECTING PEDIATRIC access to health care have been studied extensively, and one concept that has been a priority for researchers is that of the medical home. In 1992, the American Academy of Pediatrics issued its first policy statement, which provided a definition of the medical home: "that medical care of infants, children and adolescents should be accessible, continuous, comprehensive, family-centered, coordinated and compassionate. It should be delivered or directed by well-trained physicians who are able to manage or facilitate essentially all aspects of medical care. The physician should be known to the child and family and should be able to develop a partnership of mutual responsibility and trust with them." The medical home should provide preventive services, such as well-child care and immunization delivery, and these services should be provided over an extended period of time to enhance continuity of care.[1] However, costs related to obtaining ongoing primary care, as well as vaccinations in the medical home, have posed a barrier for children who are uninsured or underinsured.[2]

In 1994, the Vaccines for Children (VFC) program was instituted to assist children in remaining in their medical home for vaccinations.[3] VFC reduced the cost of obtaining childhood vaccinations by providing publicly purchased vaccines at no charge to enrolled health care providers. Before VFC implementation, private providers would often refer parents who could not afford vaccines to health departments, thus fragmenting medical care.[4] The effect of VFC has been to minimize that practice, the outcome being a greater percentage of children obtaining vaccinations in their medical home[3,5–7] and a resultant rise in vaccination rates over the years since its implementation.

Several studies have examined the association between having regular preventive care visits and vaccination coverage for young children.[8–10] However, only a few have created a definition of the medical home to examine how this factor influences vaccination coverage.[8,11,12] The association between type of health insurance and continuity of insurance coverage with vaccination coverage have also been evaluated.[13–17] However, most of the studies examining health insurance coverage have looked at how the presence or absence of insurance affected vaccination coverage but were not able to take into account the effect of insurance lapses on vaccination rates.

We used a nationally representative sample to examine how up-to-date (UTD) vaccination coverage for 19- to 35-month-old children was associated with continuous primary care in a medical home, type of health insurance, and lapses in health insurance coverage. As additional childhood vaccines are added to the schedule, understanding the impact of these factors on vaccine delivery becomes more important.

METHODS

The National Survey of Children's Health (NSCH) was a module of the State and Local Area Integrated Telephone Survey, which is a broad-based, ongoing surveillance system that uses the sampling frame of the National Immunization Survey (NIS), conducted jointly by the Centers for Disease Control and Prevention's (CDC's) National Center for Health Statistics and the National Immunization Program. The survey design is described briefly in the article by Kogan and Newacheck[18]; more in-depth information can be found elsewhere.[19] The NIS is a random-digit dialed telephone survey conducted annually by the CDC to obtain national, state, and selected urban-area estimates of vaccination coverage for US children aged 19 to 35 months at the time of the interview.[20] It includes household- and child-specific information from the most knowledgeable respondent concerning the child's vaccination history followed by a mail survey to vaccination providers to verify vaccination information. Human subjects review was not required for this study.

NSCH-NIS Linkage

The NSCH questionnaire was designed to follow a completed NIS interview in households with an NIS-eligible child or the NIS screener in households without an NIS-eligible child. The NSCH responses were weighted to estimate the US population of children, age-adjusted for nonresponse and unequal probability of selection. Of the 102 353 NSCH children in the study, 6976 were 19 to 35 months of age. Of these, 420 NSCH records were unable to be linked to NIS records, leaving 6556 subjects who had completed interviews from both NSCH and NIS surveys. Ninety-seven percent of these records were linked across surveys via a unique household identifier; the remaining 3% were linked by a combination of household identifier and demographic characteristics or assigned randomly within the household when it was impossible to determine which twin or triplet was the child who had been selected randomly for the NSCH sample. Of the 6556 linked observations, adequate provider-verified vaccination data were obtained during the NIS data collection for 5400 children, 19 to 35 months of age, and all analyses were based on these 5400 children. We further adjusted the weights for these 5400 children to account for provider nonresponse and incomplete response to vaccine record requests.

Variables and Definitions

Both surveys provided variables for the analyses. Variables from the NSCH included: type of health insurance at the time of the interview (private, public, or uninsured), health insurance coverage for 12 months before interview date (always, intermittently, or never insured), highest educational level of anyone in the household, identification of a personal doctor or nurse who

knows the child well and is familiar with the child's health history, and receiving preventive health care from the child's personal doctor or nurse in either the past 12 or 24 months before the interview date. Continuous care in the medical home was based on whether the respondent stated (*a*) they had a personal doctor or nurse for their child who knows the child well and was familiar with the child's health history, and (*b*) the child had received preventive health care in either the past 12 or 24 months from the same personal doctor or nurse. Variables from the NIS included provider-verified vaccination data, race/ethnicity of child, poverty status, history of participation in the Special Supplemental Nutrition Program for Women, Infants and Children (WIC), birth order, maternal age, educational level, and marital status. An additional variable was created that combined health insurance coverage for the past 12 months and current insurance type into 4 levels: always insured, private health insurance; always insured, public health insurance; intermittently insured, either type of insurance; and never insured. This new variable was created to allow for the inclusion of these 2 variables in the modeling, because a cross-tabulation of insurance type and insurance coverage would result in empty cells.

A child was UTD for vaccination coverage if they had received ≥4 doses of diphtheria and tetanus toxoids and pertussis vaccine, ≥3 doses of poliovirus vaccine, ≥1 dose of any measles-containing vaccine, ≥3 doses of *Haemophilus influenzae* type b vaccine, and ≥3 doses of hepatitis B vaccine by the time of the household interview.

Statistical Analyses

χ^2 analyses were performed to test for associations between the sociodemographic and health care variables and vaccination coverage. Logistic regression analyses tested for the association of continuous care in the medical home and health insurance coverage by insurance type with UTD vaccination status while controlling for covariates. Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) are reported. In addition, predictive marginals were used to calculate adjusted vaccination coverage estimates and are reported with respective 95% CIs expressed as half-widths. A 2-sided significance level of 0.05 was adopted for all statistical tests. All analyses were conducted by using SAS 8.02 (SAS Institute, Inc, Cary, NC) and SAS-callable SUDAAN 9.01 (Research Triangle Institute, Research Triangle Park, NC).[21]

RESULTS

Survey Respondents

Table 1 describes the sociodemographic characteristics of the 5400 respondents. Approximately 66% of children had private insurance, with the majority (87%) always insured for the 12 months before the interview date. Mothers of almost half of the children (46%) and the highest-educated household member of nearly three fourths of the children (73%) had more than a high school education. Eighty-five percent reported having a personal doctor or nurse who was familiar with their child's health history. Of those children who had a personal doctor or nurse, 85% received preventive health care in either the past 12 or 24 months before the interview, with 88% receiving care in the 12 months. Eighty percent of the children were categorized as receiving continuous primary care in the medical home. The majority of children lived in households with income at or above the federal poverty level (77%). Almost half of the children's mothers (42%) had ever participated in WIC, and 19% were receiving WIC benefits at the time of the interview. The majority (77%) of mothers were married, with 17% classified as never married at the time of the child's birth.

Vaccination Coverage

Table 2 describes the results of the associations between the sociodemographic variables and UTD status. Eighty-three percent (4456) of the children were UTD with the 4:3:1:3:3 vaccination series (≥4 doses of diphtheria and tetanus toxoids and pertussis vaccine, ≥3 doses of poliovirus vaccine, ≥1 dose of any measles-containing vaccine, ≥3 doses of *Haemophilus influenzae* type b vaccine, and ≥3 doses of hepatitis B vaccine). Vaccination coverage for children with private insurance was 84%, which was significantly higher compared with coverage of 79% among children with public insurance and 71% for the uninsured. Coverage for children who had lapses in health insurance was also significantly lower compared with coverage for children who were always insured (75% vs 83%, respectively). Children who did not have continuous primary care in the medical home had significantly lower vaccination coverage (75%) compared with those who had had coverage (83%). Children who did not have a personal doctor or nurse, did not receive preventive health care in either the past 12 or 24 months, were of Hispanic or black race/ethnicity, ever received WIC benefits, were born to a mother <30 years old, or whose mother was not married at the time of the child's birth had significantly lower vaccination coverage when compared with the referent group for that particular characteristic.

Multivariate Logistic Regression

Multivariate logistic regression analyses using backward elimination were conducted to determine the likelihood of UTD immunization coverage with continuous primary care in the medical home and health insurance coverage by insurance type while controlling for significant covariates that included race/ethnicity of the child, WIC status, and mother's age and marital status and the

TABLE 1 Characteristics of Study Sample: NCSH, 2003 (*N* = 5400)

Variable Description	Sample *n*, Unweighted	%, Weighted
Current health insurance type[a]		
Private	3498	65.5
Public	1471	27.6
Uninsured	370	6.9
Health insurance coverage for past 12 mo		
Always insured	4612	86.6
Intermittently insured	559	10.5
Never insured	153	2.9
Highest level education attained by anyone in household		
Less than high school	343	6.4
High school graduate (12 y)	1072	19.9
More than high school	3985	73.2
Identified ≥1 persons as child's personal doctor or nurse		
Yes	4564	84.7
No	826	15.3
Continuous primary care in medical home[b]		
Yes	4317	80.1
No	1073	19.9
Preventive health care in either the past 12 or 24 mo		
Yes	4317	85.3
No	743	14.7
Race/ethnicity of child		
Hispanic	860	15.9
White, non-Hispanic	3649	67.7
Black, non-Hispanic	398	7.4
Other, non-Hispanic	487	9.0
Poverty status		
≥1.0, above poverty level	4159	77.0
<1.0, below poverty level	804	14.9
Unknown	437	8.1
WIC status		
Currently receive	1258	23.3
Ever received	1024	19.1
Never received	3074	57.6
Mother's education		
<12 y	573	10.6
12 y	1301	24.1
>12, not college graduate	1067	19.8
College graduate	2459	45.5
Mother's marital status		
Widowed, divorced, separated, or deceased	341	6.3
Never married	916	17.0
Married	4142	76.7
Mother's age, y		
≤19	125	2.3
20–29	2377	44.0
≥30	2898	53.7
First-born child		
No	2222	41.1
Yes	3178	58.9
Health insurance coverage past 12 mo by current insurance type		
Always insured, private insurance	3339	62.7
Always insured, public insurance	1273	23.9
Intermittently insured, either public or private insurance	559	10.5
Not insured	153	2.9

[a] Private health insurance referred to any type of health insurance, including health maintenance organizations, other than public programs. Public health insurance was defined as either Medicaid or a State Children's Health Insurance Program. Insurance type was measured only at the time of the interview.

[b] A child was determined to have received continuous care in the medical home if the respondent stated that he or she had an identified personal doctor or nurse for the child who knew the child well and was familiar with the child's health history and the child had received preventive health in either the past 12 or 24 months before the interview from the personal doctor or nurse.

Date source: Centers for Disease Control and Prevention, National Center for Health Statistics, State and Local Area Integrated Telephone Survey, NSCH, 2003.

TABLE 2 Vaccination Coverage by Sociodemographic and Health Care Characteristics and OR of Being UTD With 4:3:1:3:3 Vaccination Coverage: NSCH 2003 (*N* = 5400)

Variable Description	% UTD[a] (± 95% CI), Unadjusted[b]	OR (95% CI)
Current health insurance type[c]		
Private	83.6 (2.2)	Reference
Public	78.8 (4.0)	0.73 (0.55–0.97)[d]
Uninsured	71.1 (8.4)	0.48 (0.31–0.75)[d]
Insurance coverage for past 12 mo		
Always insured	82.5 (2.1)	Reference
Intermittently insured	74.5 (5.8)	0.62 (0.44–0.87)[d]
Never insured	71.2 (13.1)	0.52 (0.27–1.01)
Highest level education for anyone in household		
Less than high school	78.9 (7.2)	0.81 (0.52–1.28)
High school graduate, 12 y	78.9 (4.6)	0.82 (0.60–1.12)
More than high school	82.1 (2.2)	Reference
Identified ≥1 persons as child's personal doctor or nurse		
Yes	82.7 (2.1)	Reference
No	73.6 (5.2)	0.59 (0.43–0.79)[d]
Preventive health care in either the past 12 or 24 mo		
Yes	82.8 (2.2)	Reference
No	75.3 (4.4)	0.63 (0.47–0.84)[d]
Continuous primary care in medical home		
Yes	82.8 (2.2)	Reference
No	75.3 (4.4)	0.63 (0.47–0.84)[d]
Race/ethnicity of child		
Hispanic	77.3 (5.2)	0.66 (0.47–0.91)[d]
White, non-Hispanic	83.9 (1.9)	Reference
Black, non-Hispanic	74.0 (8.1)	0.55 (0.35–0.85)[d]
Other, non-Hispanic	81.4 (6.6)	0.84 (0.53–1.33)
Poverty status		
≥1.0, above poverty level	82.0 (2.3)	Reference
<1.0, below poverty level	79.3 (4.3)	0.84 (0.62–1.14)
Unknown	76.2 (7.2)	0.70 (0.46–1.08)
WIC status		
Currently receive	80.1 (4.5)	0.78 (0.56–1.09)
Ever received	75.6 (4.3)	0.61 (0.45–0.81)[d]
Never received	83.7 (2.3)	Reference
Mother's education		
<12 y	78.2 (5.9)	0.70 (0.47–1.04)
12 y	79.4 (4.1)	0.75 (0.54–1.04)
>12 y, not college graduate	79.8 (4.1)	0.77 (0.55–1.07)
College graduate	83.7 (2.8)	Reference
Mother's marital status		
Widowed, divorced, separated, or divorced	72.4 (11.8)	0.50 (0.27–0.92)[d]
Never married	72.7 (5.1)	0.51 (0.38–0.69)[d]
Married	83.9 (1.9)	Reference
Mother's age		
≤19 y	66.2 (15.42)	0.41 (0.20–0.85)[d]
20–29 y	78.8 (2.9)	0.75 (0.58–0.97)[d]
≥30 y	83.2 (2.7)	Reference
First-born child		
Yes	80.2 (2.9)	0.88 (0.69–1.13)
No	82.1 (2.4)	Reference
Health insurance coverage past 12 mo by current insurance type		
Always insured, private insurance	84.4 (2.2)	Reference
Always insured, public insurance	78.8 (4.4)	0.68 (0.50–0.93)[d]
Intermittently insured, either private or public insurance	74.5 (5.8)	0.54 (0.38–0.76)[d]
Not insured	71.2 (13.1)	0.45 (0.23–0.88)[d]

[a] Children were considered UTD when they had received the 4:3:1:3:3 vaccines by the time of the interview.

[b] Insurance type was measured only at the time of the interview.

[c] Percentage UTD and OR in comparison with the reference group is weighted.

[d] Significant ORs (*P* < .5).

Data source: Centers for Disease Control and Prevention, National Center for Health Statistics, State and Local Area Integrated Telephone Survey, NSCH, 2003

interaction term continuous care in the medical home by insurance coverage and type (Table 3). Only covariates were eligible for elimination. The only variable found to be statistically significant in the final model was marital status of the mother; vaccination coverage for children born to never-married mothers (74%; 95% CI: ±6.0) was significantly lower compared with coverage for children born to married mothers (84%; 95% CI: ±2.0).

DISCUSSION

Our study, using a nationally representative sample, found the majority of children had continuous primary care in the medical home, were always insured during the 12 months before the survey interview, and had private insurance. Not unexpectedly, children who did not have continuous primary care, had lapses in health insurance, or did not have private insurance were significantly less likely to be UTD in bivariate analyses. Multivariate analysis revealed that children of never-married mothers had significantly lower vaccination coverage than did children of married mothers. Neither continuous primary care in the medical home nor insurance coverage or insurance type were found to be associated with UTD vaccination status when controlling for mother's marital status.

Previous research on health insurance coverage indicates that children who experience gaps are less likely to have regular contact with a health care provider.[22–24] Mayer et al[25] examined insurance coverage gaps and vaccination status of young children and found children who had experienced any gaps were less likely to be UTD. A study of NIS data by Smith et al[26] found that 19- to 24-month-old children who had lapses in insurance coverage were significantly less likely to be UTD com-

pared with children who had no breaks. One reason our finding of no association with insurance coverage and vaccination status differs from the Smith study may be that the our data were from a more recent NIS sample (2003–2004) than the Smith study (2001–2002). National 4:3:1:3:3 vaccination coverage increased from 75% in 2002% to 81% in 2004. Children in our sample with public insurance had 79% UTD coverage compared with 70% in the Smith study, and children in our sample who experienced gaps in coverage also had higher UTD coverage (75% vs 65%). These higher vaccination coverage levels may reflect differences in the distribution of, or perhaps influence of, traditional risk factors for undervaccination observed in previous studies.

The literature on the association of medical home and vaccination coverage is somewhat difficult to evaluate because the description of medical home varies across studies. Irigoyen et al[8] found in a study of 641 inner-city children that children who remained with their initial source of medical care the longest were more likely to stay current on immunizations. Smith et al[12] examined UTD coverage for 19- to 35-month-old VFC-eligible children who had a medical home, which was defined as having a doctor, nurse, or physician's assistant who provided routine ongoing care. They found VFC-eligible children were less likely to have a medical home compared with children who were not VFC-eligible; however, VFC-eligible children who had a medical home were significantly more likely to be UTD. Conversely, Ortega et al[11] found that having a medical home was not significantly associated with vaccination coverage; however, this study was conducted before VFC was instituted, which reduced referrals to the health department for vaccinations. Also, the Ortega and Irigoyen studies

TABLE 3	Adjusted 4:3:1:3:3 Vaccination Coverage, NSCH, 2003		
Variable Description		Vaccination Coverage, Adjusted, % (± 95% CI)	OR, Adjusted (95% CI)
Continuous primary care in the medical home			
Yes		82 (2.0)	Reference
No		78 (3.9)	0.79 (0.58–1.07)
Marital status of mother			
Widowed, divorced, separated, or deceased		74 (11.8)	0.62 (0.34–1.12)
Never married		74 (5.9)	0.63 (0.44–0.90)[a]
Married		84 (2.0)	Reference
Insurance coverage for past 12 mo and current insurance type			
Always insured, private insurance		83 (2.0)	Reference
Always insured, public insurance		82 (3.9)	0.94 (0.65–1.35)
Intermittently insured, either private or public insurance		76 (5.9)	0.69 (0.43–1.13)
Not insured		74 (11.8)	0.38 (0.14–1.01)

The variables included are those that remained after backward elimination. The following variables were eliminated from the model: WIC status, mother's age, and the interaction term continuous care in the medical home × insurance coverage by type. Adjusted vaccination coverage estimates were obtained by using the predicted marginals from the final logistic regression model.
[a] $P < .001$.
Data source: Centers for Disease Control and Prevention, National Center for Health Statistics, State and Local Area Integrated Telephone Survey, NSCH, 2003.

used registry data, which may have incompletely measured vaccination status.

Our finding of an association of lower UTD coverage for children of never-married mothers was previously demonstrated.[27,28] Single mothers are less likely to have adequate resources for health care, thus decreasing the likelihood of having a medical home and obtaining vaccinations for their child. As a result, controlling for marital status may be expected to reduce the association of continuous care in the medical home, insurance coverage, and type on UTD status.

A major strength of our study is that we were able to analyze the most recently available data from a nationally representative sample of children with verified vaccination data. Another strength is that we had data on health insurance coverage at the time of the interview and for the 12 months before the interview. This allowed UTD coverage to be assessed for those children who were always or never insured, as well as those who experienced lapses in coverage for the previous year.

A limitation of our study is that the cross-sectional design prevents exploring temporal associations between predictor variables and UTD vaccination status. Although we used a less comprehensive definition of medical home recently used in a study of children with special health care needs,[29] we believe we captured the essential elements necessary in defining a medical home, ie, identification of a personal doctor or nurse who knows the child well and is familiar with the child's health history and seeking preventive care services over an extended period of time from the same provider. This is essentially similar to the definition used in the Smith study.[12] We did not have information on the number or distribution of preventive care visits the child made to their provider; however, with UTD coverage at such high levels, we believe that an adequate number of visits were made to fulfill the criteria for continuous care in the medical home. Finally, insurance coverage could only be assessed for the 12 months before the interview. Most vaccinations would have been given much earlier, and we did not have insurance information available from birth. We were also limited to the type of insurance in force at the time of the interview, which may have changed previously.

CONCLUSIONS

Given previous research and our bivariate findings of the association of continuous care in the medical home, insurance coverage, and type on UTD coverage, we believe that the optimal health care setting for a child is the medical home where all needed preventive care is provided. Also, it is reasonable to expect that when parents do not have adequate health insurance, or if they lose insurance coverage, their ability to keep a child in their medical home for health care is affected. Public health interventions that can educate parents, especially un-married mothers, about government programs such as Medicaid, VFC, and state child health insurance that can assist them in getting preventive care services such as well-child visits and vaccinations for their child should be a public health priority.

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The Association of Health Insurance and Continuous Primary Care in the Medical Home on Vaccination Coverage for 19- to 35-Month-Old Children

Norma J. Allred, Karen G. Wooten and Yuan Kong

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