Vaccines for Children Program, United States, 1997

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ABSTRACT. *Objectives.* **1) To determine the proportion of preschool children receiving immunizations from providers enrolled in the Vaccines for Children (VFC) program; 2) to assess whether their immunization providers serve as their medical home for primary care; and 3) to examine the relationship between various provider characteristics and immunization status.**

Design. **Two-phase national survey consisting of parent interviews verified by provider record check.**

Setting. **A total of 78 survey areas (50 states, the District of Columbia, and 27 urban areas).**

Patients or Other Participants. **Noninstitutionalized children from 19 to 35 months of age in 1997.**

Interventions. **None.**

Outcome Measures. **VFC penetration rate (the percentage of children who received all or some vaccines from a VFC-enrolled provider); the frequency with which children received all or some vaccines within a medical home; the number of parent-reported immunization providers; and 4:3:1:3 up-to-date status at 19 to 35 months of age.**

Results. **Of 28 298 children interviewed for whom consent to contact providers was obtained, complete provider data were available for 21 522 (76%). Of these children, ~75% received all or some immunizations from a VFC-enrolled provider, 73% received all or some immunizations within a medical home, and 75% had one immunization provider. Children received all or some immunizations from a VFC-enrolled provider more frequently when vaccinated by pediatricians versus family physicians or in public facilities versus private practice. After controlling for poverty, immunization coverage varied only slightly with receipt of vaccines from a VFC-enrolled provider, receipt of vaccines within a medical home, and the number of parent-reported providers. Among children vaccinated within a medical home, those vaccinated solely by pediatricians were 1.63 times as likely to be 4:3:1:3 up-to-date than were those vaccinated solely by family physicians after removing the effects of poverty.**

Recommendations. **Greater numbers of children are likely to benefit from an even higher participation rate among immunization providers in the VFC program, particularly among family physicians and private physicians. The public–private collaboration developed by the VFC program should be capitalized on so that public sector resources can help pediatricians and family physicians practice according to the *Standards for Pediatric Immunization Practices*. *Pediatrics* 1999;104(2). URL: http://www.pediatrics.org/cgi/content/full/104/2/e15; *childhood, vaccination, immunization, medical home, Vaccines for Children Program.***

ABBREVIATIONS. VFC, Vaccines for Children Program; NIS, National Immunization Survey; UTD, up-to-date.

In the past decade, increasing emphasis has been placed on the importance of receiving all aspects of pediatric care within the context of a medical home. In 1992, the American Academy of Pediatrics published a policy statement asserting that infants, children, and adolescents should have a medical home in which "accessible, continuous, comprehensive, family centered, coordinated, and compassionate" care is delivered by well trained physicians capable of managing or facilitating all aspects of pediatric care and developing a meaningful relationship with the child and family.[1] Immunization of children is the most cost-effective and one of the few cost-saving[2] clinical preventive services, and it is a major component of comprehensive care. The preamble of the *Standards for Pediatric Immunization Practices* states that "ideally, immunizations should be given as part of comprehensive child health care . . . if all America's children are to benefit from the best primary disease prevention our health care system has to offer."[3]

In 1990, approximately half of the children in the United States were vaccinated in health department-operated clinics that generally did not serve as the child's medical home for primary care.[4] The greatest barrier to vaccinating in the medical home has been cost to parents and providers. Initiated in 1994, the Vaccines For Children (VFC) program was designed to reduce this barrier, which previously had led many physicians to refer children to health department immunization clinics. VFC represents a major vaccine finance reform, one key recommendation to raise immunization coverage levels.[4–6]

The VFC program is a state-operated federal entitlement program that supplies private and public providers with federally purchased vaccine according to the recommended schedule of Centers for Disease Control and Prevention Advisory Committee on Immunization Practices (ACIP). The majority of states began to enroll private providers in VFC during 1994–1995, and by the beginning of 1997, all

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but two states had implemented VFC in the private sector. Through the VFC program, federally purchased vaccine is made available for four groups of vulnerable children, including those who are Medicaid-enrolled, uninsured, or American Indian/Alaska Native. Underinsured children (ie, children with insurance that does not cover immunizations) also are eligible to receive VFC vaccine, but only if served by a federally qualified health center or a rural health clinic. Recent data indicate that ~18.7 million children are enrolled in Medicaid (1995),[7] 10.5 million are uninsured (1996),[8] and 1 million are classified as American Indian/Alaska Native (1996).[9] Unfortunately, reliable estimates of underinsured children are difficult to obtain.

In addition to federally purchased vaccine, the VFC program also provides an important health system benefit by creating a financially meaningful collaboration between public health and the private sector. By enrolling in the VFC program, private providers become an integral part of the nation's immunization program, working together with the public sector to ensure vaccination of all children. Benefits to the provider include the availability of federally purchased vaccine at no cost, educational opportunities, and the ability to provide immunization services to patients in the office without the need for referral.

Other legislative efforts have helped to encourage the receipt of immunizations within a medical home. By requiring insurance to cover the cost of vaccines, for example, state-specific first dollar coverage laws, passed in at least six states since the early 1990s (S. Kaufman, personal communication, December 21, 1998), ensure that vaccination in the medical home is affordable for families. Also, the Children's Health Insurance Program (CHIP), which was implemented initially just after the data collection for the current study, was created by the Balanced Budget Amendment of 1997. This program requires that immunization with all Advisory Committee on Immunization Practices-recommended vaccines be a covered benefit for enrolled children. Therefore, previously uninsured children who enroll in Children's Health Insurance Program will be covered by a health insurance policy without cost-sharing requirements for any recommended routine childhood immunizations.

Although these policies, programs, and laws have all supported the receipt of immunizations within a medical home, there is little information about what proportion of children receive immunizations within medical homes or the degree of penetration of the VFC program among providers of preschool children. The National Immunization Survey (NIS) collects immunization information about ~34 000 preschool children in the United States each year and provides an opportunity to obtain information on VFC and medical home status. The survey seeks provider verification of immunizations received for each child interviewed and measures characteristics of preschool immunization providers.

The primary objectives of this study were to determine 1) the proportion of preschool children vaccinated by VFC-enrolled providers and 2) whether their immunization providers served as a medical home for primary care. We also determined provider specialty type, number of providers per child, and type of facility in which the provider practiced. Finally, we assessed the association between provider characteristics and the immunization status of the children in the survey. The source of data was the 1997 NIS, conducted between 2 and 3 years after the start of the VFC program, at which time ~95% of the US birth cohort lived in states that had implemented VFC in the private sector.[10]

METHODS

Setting and Subjects

Subjects included noninstitutionalized children, 19 to 35 months of age, whose telephone numbers were selected at random from each of 78 survey areas: the 50 states, the District of Columbia, and 27 selected urban areas. Approximatly 440 telephone interviews were completed for children from each survey area.

Design

The NIS was first implemented in 1994 to provide state and national estimates of vaccine coverage levels for children 19 to 35 months of age; it continues on a quarterly basis.[11] The survey consists of two phases. During the first phase, a screening questionnaire is used to identify age-eligible children using a list-assisted random-digit-dial technique.[12,13] Once all eligible children are identified, demographic information and vaccination history, including a listing of each vaccine received, and the names and addresses of all immunization providers (ie, individual providers or clinic/practice sites), is obtained from the parent. If more than 1 child in the household is age-eligible, information is collected on each age-eligible child. The second phase consists of a provider record check in which all reported health care providers are contacted in writing to verify the child's vaccination history. Immunization providers are also asked to indicate whether they are enrolled in the VFC program, whether their practice is the child's medical home (self-identified), their specialty type, and the type of facility in which they practice (eg, private practice, public health department, community health center, or military clinic). Because the respondent may be a staff member other than the provider, this person's name and telephone number are also requested.

Measures and Definitions

To determine socioeconomic status, families of children interviewed were asked questions to estimate annual income. The questions, modeled after those used in the National Health Interview Survey, used a cascading approach to narrow reported family income into 1 of 10 categories. Based on the answers to these questions and the number of adults and children in the household, children were classified as residing in families at or above or below the federal poverty level (eg, $16 276 for a family of 4 including 2 children in 1997).[14]

Children were classified as receiving all or some, none, or an uncertain proportion of their vaccines from a VFC-enrolled provider based on responses from the provider record check phase of the study. If, for example, at least one of the child's immunization providers reported being enrolled in the VFC program, the child was classified as receiving all or some vaccines from a VFC-enrolled provider. Furthermore, the VFC penetration rate was defined as the percentage of children who received all or some of their vaccines from a VFC-enrolled provider. If all the child's responding immunization providers indicated that they were not enrolled in the VFC program, the child was classified as receiving none of his vaccines from a VFC-enrolled provider. Finally, if all the responding immunization providers chose the option unknown, the child was classified as receiving an uncertain proportion of his vaccines from a VFC-enrolled provider. The proportion of vaccines received from a provider whose practice served as the child's medical home was determined in a manner similar to that used to classify the proportion of vaccines received from a VFC-enrolled provider. In addition, those providers who reported serv-

ing as the child's medical home were asked to indicate their specialty (pediatrics, family medicine, general practice, or other). To account for children who had more than one medical home provider, specialty type of medical home provider was classified as pediatrics only, family medicine only, or other combinations.

A child for whom verifying information was received from all reported providers was considered to have complete provider data. To be considered up to date (4:3:1:3 UTD), a child would have to have received ≥4 doses of diphtheria, tetanus, pertussis (DTP or DTaP), ≥3 doses of polio vaccine (oral poliovirus vaccine or inactivated poliovirus vaccine), ≥1 doses of measles-containing vaccine, and ≥3 doses of *Haemophilus influenza* vaccine (Hib) before the interview.

Statistical Analysis

Data were weighted to adjust for unequal selection probabilities across the 78 survey area, to account for household nonresponse and to mirror natality (ie, vital statistics) data. In addition, to account for lower immunization coverage rates among the 12% of children in households without telephones, a method developed by Battaglia et al[15] that draws on several sources of data to make adjustments was used. The analysis was limited to 21 522 children with complete provider data. Multivariate logistic regression was used to determine the relationships between 4:3:1:3 UTD status and three explanatory variables (vaccinations received from a VFC-enrolled provider, vaccinations received within a medical home, and provider number), individually and collectively, after controlling for the effect of poverty. For these regression analyses, all subjects were included.

RESULTS

Sample

During 1997, 32 742 telephone interviews (representing 32 433 households) with age-eligible children born between February 1994 and May 1996 were conducted, and verbal consent to contact identified providers was obtained for 28 298 children (86%). Of children whose parents gave consent to contact providers, complete provider data were collected for 21 522 (76%). Table 1 describes the study subjects as well as those children excluded from the analysis because of insufficient provider data. In general, children included in this analysis were more likely to be white, to live at or above the poverty level, and to have higher parent-reported immunization coverage levels than were children with missing or incomplete provider records.

Immunizations From a VFC-Enrolled Provider

Of the children, 74% received all or some of their immunizations from a VFC-enrolled provider. Among these children, 26% were below the poverty level. Children with at least one VFC-enrolled provider were more likely to be below the poverty level than children with no VFC-enrolled providers (26% vs 9%, respectively; (Table 2). Among children receiving vaccines in a medical home, the VFC penetration rate (ie, the percentage of children receiving all or some vaccines from a VFC-enrolled provider) varied according to provider specialty type (Table 3). There was no significant relationship between immunization coverage rates and the proportion of vaccines received from a VFC-enrolled provider (Table 2).

Immunizations Within a Medical Home

Of the children, 74% received all or some of their immunizations from a provider considered to be the child's medical home for primary care. Among these children, 70% were vaccinated solely by pediatricians, 12% solely by family physicians, and 18% by a combination of provider types. Immunization coverage rates were higher for children receiving all or some vaccines within a medical home than for those children who did not receive any vaccines in a medical home (79% vs 76%, respectively). Children vaccinated solely by pediatricians had higher 4:3:1:3 UTD status than did those vaccinated solely by family physicians (80% vs 71%, respectively). Table 2 illustrates the relationship between a child's socioeconomic and 4:3:1:3 UTD status and the proportion of vaccines received within a medical home, as well as the specialty type of the immunization provider.

Parent-Reported Number of Providers

Of the children surveyed, 75% reported having 1 immunization provider, 22% reported having 2 immunization providers, and 3% reported having 3 or more immunization providers. Children with 2 providers were somewhat less likely to be 4:3:1:3 UTD than were those reporting 1 provider, whereas children with 3 or more providers were not significantly different in terms of immunization coverage than were those with 1 provider. Children who had 2 or more parent-reported providers were more likely to be living below the poverty level than were children with only 1 parent-reported provider. Table 2 illustrates the relationship between a child's socioeconomic and 4:3:1:3 UTD status and the number of parent-reported immunization providers.

TABLE 1. Characteristics of Children With Complete Provider Data Versus Children With Incomplete or Missing Provider Data, 1997 NIS

	Complete Provider Data (N = 21 522)	Incomplete/Missing Provider Data (N = 11 220)
Mean age (mo)	26.9	27.1
Race/ethnicity (%)		
White, non-Hispanic	63	53
Black, non-Hispanic	14	18
Other, non-Hispanic	5	6
Hispanic*	18	22
Below poverty level (%)†	24	27
Parent-reported 4:3:1:3 UTD status (%)	52	46

* Includes Hispanic persons of any race.
† Based on the US Census Bureau poverty thresholds for 1997. Percentage calculated after excluding children with missing income data.

TABLE 2. Weighted Analysis of Poverty and UTD (4:3:1:3 UTD) Status of Children by Selected Provider-related Characteristics (N = 21 522)

Provider-related Characteristic	Percentage of Children	Percentage of Children Below Poverty Level*	Percentage of Children 4:3:1:3 UTD
VFC-enrollment of provider			
Proportion of vaccines received from a VFC-enrolled provider			
All/some†	74	26	78
None	9	9‡	80
Uncertain	17	20‡	75‡
Provider as medical home			
Proportion of vaccines received within a medical home			
All/some†	73	22	79
None	15	27‡	76‡
Uncertain	12	30‡	69‡
Provider specialty type (n = 15 797)			
Pediatrics only†	70	20	80
Family medicine only	12	23	71‡
Other combinations	18	31‡	82
Number of providers			
Total number of parent-reported providers			
1†	75	23	78
2	22	26‡	75‡
3 or more	3	29	80

* Percentage below poverty level calculated after excluding children with missing income data.
† Reference group for significance tests.
‡ Difference from reference group is significant at .05 level (two-tailed).

TABLE 3. Weighted VFC Penetration Rate (Percentage of Children Receiving All/Some Vaccines From a VFC-Enrolled Provider) by Provider Specialty and Facility Type

	VFC Penetration Rate (%)
Provider specialty (n = 15 797)	
Pediatrics only	75
Family medicine only	68
Other combinations	89
Facility type (n = 21 522)	
Private practice only	72
Public health department clinics only	93
Hospital-based clinics or academic centers only	80
Community or migrant health centers only	85
Military/other facilities only	66
A combination of facility types	96

Facility Type

The majority of children (58%) received all their vaccines at private practices. Substantially fewer children received all their vaccines at public health department clinics (14%), hospital-based clinics or academic centers (6%), and community and migrant health centers (3%). Table 3 illustrates the relationship between the type of facility at which a child was immunized and the VFC penetration rate. Provider participation in the VFC program was higher among children with public facility providers than among those with private facility providers.

Controlling for the Effect of Poverty

On an individual basis, receiving all or some immunizations within a medical home and having a single parent-reported immunization provider were both associated with an increased likelihood of being 4:3:1:3 UTD (OR: 1.14 [1.04, 1.25]; P = .004 and 1.10 [1.02, 1.18]; P = .01, respectively). In a model containing these two significant explanatory variables, each was associated independently with 4:3:1:3 UTD status: receiving all or some immunizations within a medical home (OR: 1.15 [1.05, 1.26]; P = .003) and having 1 single parent-reported immunization provider (OR: 1.11 [1.03, 1.19]; P = .006). Among the subset of children receiving all or some immunizations within a medical home (n = 15 797), after controlling for poverty, children vaccinated solely by pediatricians were 1.63 times more likely to be 4:3:1:3 UTD than were children vaccinated solely by family physicians ([1.46, 1.82]; P = .0001).

DISCUSSION

We have shown that at least three fourths of preschool children in the United States received immunizations from a provider enrolled in the VFC program at a time when the program was less than 3 years old. The majority of children received immunizations within a medical home for primary care, reported only 1 immunization provider, and were vaccinated in private sector facilities. Pediatricians vaccinated the vast majority of preschool children who received vaccines within a medical home.

Immunization coverage varied only slightly with the receipt of vaccines from a VFC-enrolled provider, the receipt of vaccines within a medical home, and the number of parent-reported providers. However, a large and clinically meaningful difference in coverage was found between children vaccinated solely by pediatricians and those vaccinated solely by family physicians, the former group being better vaccinated.

The high penetration of the VFC program among immunization providers has implications for the delivery of vaccines to vulnerable children. The VFC program is an active agent of change for immunization delivery in the United States rather than just a passive vaccine purchase program. It fosters a large scale public–private collaboration that gives health departments unprecedented access to private providers. Specifically, VFC recouples immunizations

with primary care for the benefit of the children it serves, thereby reducing the burden on health department clinics of direct service delivery,[16–18] enabling them to pursue the core function of assurance of immunization services.[19] Health departments now are able to devote resources to helping private providers to adopt the *Standards for Pediatric Immunization Practices*. For example, states are collaborating with provider organizations to improve vaccine storage and handling procedures, to operate reminder/recall systems, and to conduct immunization coverage assessments.[20,21]

The present study included a substantial number of vulnerable children, with one quarter of those surveyed residing in families below the poverty level. A previously published analysis of the 1997 NIS data found that children living in families below the poverty level had 4:3:1:3 immunization coverage levels as much as 7% lower than did children living in families above the poverty level, regardless of race or ethnic group.[22] This finding is consistent with those from other studies that have found poverty to be a risk factor for underimmunization.[23–26]

We highlight four study findings. First, the high proportion of children who received vaccines from a VFC-participating provider and the fact that receipt of all or some vaccines from a VFC-enrolled provider was more common among impoverished children suggest that the VFC program has reached a large number of children in a very short time, particularly those children it was created to serve. Private provider enrollment began in most states during 1994–1995, with the last state scheduled to enroll private providers in early 1999. As these dates indicate, VFC is still a very new program. However, it has been difficult to assess private provider participation on a national or state level, because the overall number of immunization providers never has been determined accurately. Although ~44 000 providers are enrolled currently in VFC, we do not know how many could be enrolled (Centers for Disease Control and Prevention, unpublished data). However, the child-based analysis in this study allows us to understand provider enrollment at the child level, because it applies to the vaccination of preschool children by VFC-enrolled providers. Closely related to the progress made in provider enrollment, Zimmerman et al[16] have shown high levels of provider satisfaction and have demonstrated that providers who participate in the program report fewer actual concerns about paperwork, audits, and reimbursement than anticipated by those who have not yet enrolled.

The relationships between VFC-enrollment status and provider specialty as well as facility type suggest that targeted interventions are needed to improve further the frequency with which preschool children are vaccinated by VFC-participating providers. For example, because children cared for solely by pediatricians are more likely to encounter VFC-enrolled providers than are children cared for solely by family physicians, it may be most fruitful to focus VFC education and recruitment efforts toward family physicians. Similarly, private provider enrollment in VFC seems to be lower than in public clinic settings, suggesting a need to direct attention toward this former group.

Second, the majority of children surveyed received immunizations within a medical home for primary care. In addition to being protected from vaccine-preventable diseases, such children are most likely to receive the other benefits of comprehensive care such as developmental and other preventive screening, anticipatory guidance, acute care, follow-up care, and chronic illness care that a medical home provides. Studies have shown an association between underimmunization and failure to receive other preventive services,[27,28] and interventions designed to promote vaccination within the medical home have been shown to improve both vaccination coverage and receipt of other preventive services.[29–31] Coupling immunizations with other services that make up comprehensive care improves the conduct of clinical preventive services and optimizes a child's opportunity to thrive. It is noteworthy and problematic that children who received none of their immunizations within a medical home also were more likely to be living below the poverty level, a finding that represents an important disadvantage for children whose likelihood for optimal health status already may be compromised because of scarce family resources. The fact that these vulnerable children continue to receive immunizations outside the context of primary care underscores the need for continued expansion of provider enrollment in the VFC program.

Third, among children vaccinated within a medical home, pediatricians administer the majority of immunizations. This finding suggests that, in general, targeting education and office-based interventions toward practicing pediatricians is likely to impact the greatest number of preschool children. However, the data suggest that family physicians, although they vaccinate far fewer preschool children than do pediatricians, could benefit from specific interventions related to raising immunization coverage levels. The finding that children vaccinated solely by family physicians are less likely to be 4:3:1:3 UTD than are children vaccinated solely by pediatricians is not surprising given the increasingly complex immunization schedule and the fact that children often represent only a small proportion of a family medicine practice.[32]

In addition to the benefits of comprehensive care that medical homes provide for children, research has shown that parents prefer the coordination of services that medical homes offer.[33,34] Given the preventive health benefits and parental preference associated with the receipt of childhood immunizations within the context of primary care and the fact that there has been substantial growth in the number of practicing pediatricians in the past 20 years (more than eight times the growth seen in the child population over the same time period[35]), it is both beneficial and feasible to aim for all preschool children to receive immunizations within a medical home.

Finally, the fact that the majority of children are vaccinated by 1 immunization provider is encouraging because this minimizes the record scattering that

occurs with multiple providers. Nonetheless, one quarter of children surveyed reported receiving vaccinations from 2 or more providers, and this group of children is at risk for the adverse consequences of record scattering. Although underimmunization is one logical and important consequence of record scattering, overimmunization, in which children receive unnecessary immunizations (and are exposed to unnecessary risks), is also a possible outcome, because information on immunization status is unknown at the time of the child's encounter with an immunization provider.[36,37] Another adverse consequence of record scattering is that it complicates practice-based coverage assessments,[38] an intervention strategy shown to improve immunization levels.[5] Although hand-held immunization cards have not been shown to reduce the problems created by record-scattering,[39,40] state or local immunization registries may provide a viable solution by consolidating scattered records in a central location.[41]

This study has several limitations. The first limitation is one of scope. The study did not provide an opportunity to assess the impact of the VFC program on immunization coverage levels among vulnerable children. Rather than an outcome evaluation, our analysis of program penetration represents a process evaluation of the status of VFC.

Second, a substantial number of children whose parents gave consent to contact providers (24%) were excluded from the analysis because of insufficient provider data. As indicated in Table 1, children in the study sample differ from excluded children in terms of race or ethnicity, socioeconomic status, and parent-reported 4:3:1:3 UTD status. Because a previously published analysis of these same data demonstrated generally higher coverage levels among white Americans and those living at or above the poverty level,[22] the study sample, by including more white children and those living at or above the poverty level, is somewhat likely to overestimate immunization coverage levels. The impact of the difference in parent-reported 4:3:1:3 UTD status between the two groups is unknown, although data from another national survey demonstrate that similarly determined parent-reported coverage levels tend to underestimate true coverage levels by ~5%.[11]

A third limitation involves children for whom the medical home status and provider VFC-enrollment were classified as unknown. The reasons that these two distinct pieces of data are missing are likely to be different. The missing medical home data may arise from the lack of a clear, commonly held definition for the term medical home as well as the difficulty in determining, from the provider's perspective, which children consider a particular practice to be a medical home. Determining VFC-enrollment may vary in difficulty from state to state with greastest difficulty in universal purchase states that supply vaccine to all private providers in addition to VFC vaccine.

Recommendations

First, although participation in the VFC program is high, more children are likely to benefit from an even higher participation rate among immunization providers, particularly among family physicians and private physicians. Additional gains in provider participation will facilitate a more complete recoupling of immunizations with primary care, which will improve not only immunization coverage but also receipt of other clinical preventive services. Second, the public–private collaboration developed by the VFC program should be capitalized on so that public sector resources can help pediatricians and family physicians practice according to the *Standards for Pediatric Immunization Practices*. Key standards include conducting practice-based immunization coverage assessments and implementing reminder/recall systems. VFC program site visits provide opportunities to assist pediatricians and family physicians in using these standards. Third, this relatively new program can benefit from additional evaluation, so that it continues to adapt to the immunization needs of children in the United States.

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