Immunization Coverage Levels Among 19- to 35-Month-Old Children in 4 Diverse, Medically Underserved Areas of the United States

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ABSTRACT. ***Background.*** **The National Immunization Survey demonstrates that national immunization coverage in 2002 remained near the all-time highs achieved in 2000. However, that survey cannot detect whether coverage is uniformly high within relatively small areas or populations. The measles resurgence in the early 1990s revealed that coverage was low in some areas, particularly among inner-city children from racial and ethnic minority groups. Today, identifying areas with low childhood-vaccination coverage remains important, particularly if these areas are at risk for the introduction of disease. In 1995, the Centers for Disease Control and Prevention launched a congressionally mandated demonstrated project now called the Childhood Immunization Demonstration project of Community Health Networks. This mandate specified an assessment to determine whether a network of primary care providers affiliated with university teaching hospitals could assume a public health responsibility for raising immunization levels among preschoolers in medically underserved communities. Communities with federally designated health professional shortage areas were invited to submit proposals, and 4 were selected: Detroit, MI, New York, NY, San Diego, CA, and rural Colorado.**

Objectives. **To measure immunization coverage among preschool children in the 4 selected medically underserved areas and determine predictors of coverage levels.**

Design and Setting. **Surveys in the 4 areas were based on stratified cluster probability sample designs in which clusters of dwelling units were selected and all households in selected clusters were screened for the presence of children aged 12 to 35 months. Immunization histories were obtained from parents and providers for these children. For each age-eligible child, the information collected on utilization of immunization health services included a listing of all clinics or offices ever used for the child's well-child care and/or for obtaining immunizations. Information was also collected on whether the child currently had health insurance (public and/or private) and whether the child had a medical home. A child was classified as having a medical home if the survey respondent reported a source of well care that was the same as the source of sick care and that this place was not an emergency department.**

Participants. **Children 12 to 35 months of age in Detroit, New York, San Diego, and rural Colorado.**

Outcome Measure. **Community-wide up-to-date (UTD) immunization coverage levels at 19 to 35 months of age, defined as receipt of 4 doses of diphtheria and tetanus toxoids and pertussis vaccine, 3 doses of poliovirus vaccine, 1 dose of measles, mumps, and rubella vaccine, 3 doses of *Haemophilus influenzae* type B vaccine, and 3 doses of hepatitis B vaccine (the 4:3:1:3:3 series).**

Analysis. **We examined the association between coverage level and independent variables and performed χ^2 and *t* tests to determine whether differences observed within and between groups and sites were significant.**

Results. **The overall response rate for eligible children ranged from 79.4% to 88.1%. Coverage levels for most individual vaccines were >90% in all sites except Detroit. Coverage for the 4:3:1:3:3 series was significantly higher for children in New York (84%) and San Diego (86%) than for children in Detroit (66%) and rural Colorado (75%). Demographic risk factors related to UTD immunization status varied by site. Although differences in coverage levels by ethnicity varied by site, differences were not significant. In Colorado and New York, coverage was slightly lower among Hispanic than white children (71% vs 76% and 83% vs 91%, respectively). In San Diego, coverage was lower among whites, compared with Hispanics (76% vs 85%). Coverage was also lower for African American than white children only in New York (75% vs 91%). However, in San Diego and Colorado, children receiving their vaccinations from private providers had lower coverage levels than children receiving their vaccinations from other providers (78% vs 91% and 71% vs 57%, respectively). In all 4 sites, children for whom respondents reported having an immunization card at the time of the interview were more likely to have higher series coverage levels than children for whom a parent-held card was not available. Also, children who were UTD at 3 months of age had significantly higher vaccination-series coverage levels than children who were not UTD at 3 months of age. In addition, the vaccination coverage was lower for children in Detroit whose parents reported problems accessing the health care system because lack of transportation (46%), compared with those who did not report such problems (65%); however, this difference did not reach significance ($\chi^2 = 6.0$). In Colorado, the small proportion of children in families without a phone had a lower vaccination coverage level (58%) than those in households with a phone (75%) ($\chi^2 = 6.3$). In all sites, children who were UTD at 3 months of age and had a parent-held vaccina-**

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tion card were more likely to be UTD at 19 to 35 months of age.

Conclusions. **Preschoolers in these medically underserved areas were not at uniform risk for underimmunization. Because they were designated as health professional shortage areas, the 4 sites in this study were expected to have low immunization-coverage rates. However, this was not the case. In fact, coverage in 3 of the 4 areas was quite high compared with US national figures (73%); only Detroit had a much lower UTD rate (66%). Efforts are needed to improve methods to identify areas with low immunization coverage so that resources can be directed to places where interventions are needed. Our results reveal that an area's need for childhood immunization interventions is not well predicted by a low number of providers per capita. Other criteria must be developed to predict areas or populations with low immunization coverage. Understanding more about the characteristics of children/provider pairs for children who are UTD at 3 months and more about the role of parental hand-held cards, along with finding strategies to improve immunization delivery by providers in Vaccines for Children Program facilities, suggest potentially productive avenues for increasing and sustaining high coverage levels.** ***Pediatrics*** **2004;113:e296–e302. URL: http://www.pediatrics.org/cgi/content/full/113/4/e296;** ***immunization coverage levels, medically underserved areas, preschool children.***

ABBREVIATIONS. CDC, Centers for Disease Control and Prevention; CHN, Community Health Networks; HPSA, health professional shortage areas; UTD, up to date; WIC, US Department of Agriculture Special Supplemental Nutrition Program for Women, Infants, and Children; VFC, Vaccines for Children Program; DTP, diphtheria and tetanus toxoids and pertussis vaccine; MMR, measles/mumps/rubella vaccine; Hib, *Haemophilus influenzae* type B vaccine; HepB, hepatitis B vaccine; 4:3:1:3:3 series, 4 doses of DTP, 3 doses of poliovirus vaccine, 1 dose of MMR, 3 doses of Hib, and 3 doses of HepB.

The National Immunization Survey demonstrates that vaccination of US preschoolers in 2001 remained near the all-time highs achieved in 2000. However, the results do not imply that coverage is uniformly high in all areas.[1–3] Although incidence of vaccine-preventable diseases is low, identifying any areas with low childhood-vaccination coverage (commonly referred to as "pockets of need") remains important. This is particularly true of urban areas, because such areas have the highest risk of transmission if disease is introduced.[4] The result of low coverage among inner-city children was illustrated by the measles resurgence in the early 1990s.[5,6] Of course, identifying pockets of need is a prerequisite for implementing any program designed to raise immunization coverage to assure that such a disease resurgence does not recur.

In 1995, the Centers for Disease Control and Prevention (CDC) launched a congressionally mandated demonstration project now called the Childhood Immunization Demonstration project of Community Health Networks (CHN). This mandate specified an assessment to determine whether a network of primary care providers affiliated with university teaching hospitals could assume a public health responsibility for raising immunization levels among preschoolers in medically underserved communities. Communities with federally designated health professional shortage areas (HPSAs) were invited to submit proposals, and 4 were selected: Detroit, Michigan; New York, New York; San Diego, California; and rural Colorado.

We report the results of 4 independent population-based surveys conducted by the CDC in 1997–1999 to assess baseline immunization coverage among preschool children in these 4 medically underserved areas. This is the first study to produce comparable immunization coverage estimates for several underserved communities. We also present predictors of immunization coverage levels and discuss implications for identifying pockets of need and implementing programs to raise coverage.

METHODS

Target Population

The 4 participating sites in the CHN project were designated as HPSAs[5] because each area had a critical shortage of primary health care providers. HPSAs are defined as areas with a population-to-provider ratio of ≥3500 to 1, areas adjoining these underserved areas, or areas in which residents must travel >30 minutes to the nearest provider.[7,8] Urban areas eligible to be considered in this project were census tracts with a population of at least 100 000 that included a designated HPSA and any contiguous census tracts in which a majority of residing children <2 years old were eligible for Medicaid. Eligible rural areas were defined as nonmetropolitan or rural areas that were beyond a metropolitan statistical area[6] and in which most residents were members of traditionally underserved minority populations: African Americans, Alaska Natives, American Indians, Asian Americans, Latinos/Hispanics, and Pacific Islanders.

Household Surveys

Surveys in the 4 areas were based on stratified cluster probability sample designs in which clusters of dwelling units were selected and all households in selected clusters were screened for the presence of children 12 through 35 months old.[9,10] The surveys were approved by the Institutional Review Board of the CDC in Atlanta, Georgia.

Household Interviews

Standardized interviews were conducted with primary caretakers of the age-eligible children in the sample households to obtain information on sociodemographic characteristics, utilization of immunization health services, utilization of federal programs, parental knowledge and beliefs about vaccination, and perceived barriers to accessing the immunization health care system.[11–13]

For each age-eligible child, the information collected on utilization of immunization health services included a listing of all clinics or offices ever used for the child's well-child care and/or for obtaining immunizations. Information was also collected as to whether the child currently had health insurance (public and/or private) and whether the child had a medical home. A child was classified as having a medical home if the survey respondent reported a source of well care that was the same as the source of sick care and that this place was not an emergency department.

The information collected about the utilization of federal programs encompassed aid received from the US Department of Agriculture Special Supplemental Nutrition Program for Women, Infants, and Children.

The questions asked about barriers to care included availability of transportation and vaccine costs incurred by parents. Because studies of access to immunization health services have shown that up-to-date (UTD) immunization status at 3 months is a good indicator of early access to the health care system, we also constructed this indicator for use as potential predictor variable.[3,5]

Immunization Record

If a vaccination card was available in the home, the interviewer transcribed all immunization doses and dates to a standardized

TABLE 1. Survey Participation in the Community Health Network Study by Site

Characteristics	Detroit	New York	San Diego	Colorado
Clusters	381	150	255	300
Households screened	18 442	24 406	16 934	23 240
Households with children 12–35 mo	1162	1178	1165	1324
Household response rate, %*	84.1	84.8	79.4	88.1
Provider record response, %	77.9	75.7	80.5	80.5
Children enrolled (12–35 mo)	771	847	843	1091
Children enrolled (19–35 mo)	576	597	627	776
Children with vaccination status (19–35 mo)	502	520	555	713

* Some households had >1 eligible child.

recording form. If an immunization record was not available, the interviewer completed the immunization section of the questionnaire based on the respondent's recall. In such cases, respondents did not report specific dates for the immunizations and often responded "all shots," or they reported that they did not know the child's immunization history. All respondents were asked for permission to contact the child's immunization providers. If this permission was granted, providers were sent a request for the child's immunization record and information about the practice (including whether the facility was a Vaccines for Children Program [VFC] facility). All providers were surveyed. When 1 of a child's providers supplied a complete record from birth, follow-up to collect data from other providers was discontinued.

Vaccination History

If a child's parent-held records and provider records did not agree, we credited each child with all shots listed in either record. If no provider or parent-held record was available, the child's vaccination status was classified as unknown; a report from recall was not accepted without confirmation from a provider.

Analytical and Statistical Methods

Community-wide immunization coverage levels were estimated for each area and measured as UTD for immunization at 19 to 35 months of age for comparability with the National Immunization Survey. UTD at 19 to 35 months of age was defined as receipt of 4 doses of diphtheria and tetanus toxoids and pertussis vaccine (DTP), 3 doses of poliovirus vaccine, 1 dose of measles/mumps/rubella vaccine (MMR), 3 doses of *Haemophilus influenzae* type b vaccine (Hib), and 3 doses of hepatitis B vaccine (HepB); these doses constitute the 4:3:1:3:3 series. We also measured UTD status for each antigen, ie, 4 doses of DTP; 3 of poliovirus vaccine, Hib, and HepB; and 1 of MMR. UTD at 3 months was defined as the receipt of 1 dose each of DTP, poliovirus vaccine, Hib, and HepB.

All estimates were weighted to represent the target populations in each of the selected sites. The weights account for unequal selection probabilities that occurred in the fieldwork in a few cases and also compensate for nonresponse by households and providers.

We assessed the UTD coverage level of children at each site separately. We examined the association between UTD coverage level and each factor and performed χ^2 and t tests to determine whether differences observed within and between sites were significant. The statistical analyses accounted for the clustered sample designs. To minimize the probability of a type I error, only P values of $<.01$ were considered significant. Analyses were conducted by using SUDAAN, a family of statistical procedures for analysis of data from complex sample surveys.[14]

RESULTS

Response Rates

As shown in Table 1, 150 to 381 clusters were selected randomly in the 4 study sites, a total of 16 304 to 23 706 household units were screened in the sampled clusters in each area, and responding households yielded data for 771 to 1091 children 12 to 35 months of age. The overall enrollment response rate for eligible children ranged from 79.4% to 88.1%.

Across all 4 sites, 7% of children enrolled had no provider to contact for immunization information. The remaining children had an average of 2 providers. In total, 4905 provider questionnaires were fielded, of which 78.2% were returned. Provider reports were obtained for 88.2% of children for whom a provider was contacted.

As a result of missing hand-held records and missing provider information, immunization status was classified as unknown for some enrolled children. Table 1 shows that the overall response rate for vaccination status ranged from 70.5% to 81.5% across the 4 sites.

Population characteristics that might predispose children to have low immunization coverage varied from site to site (Table 2). Most study children in Detroit were African American, and most in New York, San Diego, and rural Colorado were Hispanic. Teen motherhood was lowest in Detroit. Maternal education was notably lower in San Diego. Most study families lived in poverty, with the exception or rural Colorado. In all sites, approximately three quarters of the families with an age-eligible child had ≥2 children.

Population characteristics that enable access to health care also varied. Income was highest in Colorado. Overall, most children were insured. In Detroit, New York, and San Diego, 48% to 64% of children were privately insured, whereas in Colorado, 52% of children were insured by Medicaid or Civilian Health and Medical Program of the Uniformed Services. All study sites had an appreciable proportion of children with no insurance (7%–22%). Most of the children had been or were enrolled at the time in WIC and did not have out-of-pocket expenses for vaccinations. The vast majority of children had a medical home, and children in these communities had received immunizations from private, public, and other providers (hospital outpatient clinics and a mix of private and public providers). A majority of children in Detroit and New York had only 1 immunization provider, whereas the majority of children in Colorado and San Diego had at least 2. Overall, a large proportion of children (80%–88%) received their immunization services from providers in VFC facilities. However, 11.6% and 9.6% of children in Detroit and San Diego reported problems accessing the health care system because of transportation problems. Out-of-pocket expenses were paid for immunization services for nearly 47% of children in Colorado.

TABLE 2. Distribution of Population by Sociodemographic and Health Care Utilization Characteristics and Standard Errors (± SE) Among Children 12 to 35 Months Old by Site: CHN 2001

	Detroit % (± SE) N = 771	New York % (± SE) N = 847	San Diego % (± SE) N = 843	Rural Colorado % (± SE) N = 1091
Predisponing factors				
Ethnicity				
White	8.9 (1.6)	10.2 (1.8)	21.1 (2.3)	50.8 (2.1)
African American	78.2 (2.5)	20.3 (2.9)	6.5 (1.1)	0.3 (0.2)
Hispanic	10.8 (2.2)	67.2 (3.2)	66.6 (3.2)	47.9 (2.2)
Other	2.1 (0.6)	2.3 (0.6)	5.7 (1.2)	0.9 (0.3)
Mother's age				
<20 y	28.1 (1.9)	47.5 (2.1)	40.2 (2.1)	39.9 (1.4)
20–29 y	13.7 (1.7)	8.7 (1.0)	10.0 (1.2)	6.6 (0.7)
≥30 y	58.2 (2.1)	43.7 (1.9)	49.8 (2.3)	53.5 (1.7)
Mother's education				
<High school	28.8 (2.0)	32.9 (1.9)	44.0 (3.1)	24.1 (2.0)
High school	40.0 (2.0)	28.1 (2.0)	23.4 (2.0)	28.1 (1.3)
>High school	31.2 (1.8)	39.1 (2.3)	32.5 (2.7)	47.8 (1.9)
Poverty level				
Above	40.6 (2.3)	38.2 (3.3)	46.6 (3.2)	63.6 (1.8)
Below	59.4 (2.3)	61.8 (3.3)	53.4 (3.2)	36.4 (1.8)
No. of children <18 y				
1	20.9 (1.8)	25.2 (2.0)	22.5 (1.9)	24.2 (1.4)
2	27.2 (1.7)	35.6 (2.5)	30.9 (1.7)	37.3 (1.5)
≥3	51.9 (2.1)	39.0 (2.9)	46.6 (2.4)	38.5 (1.7)
Enabling factors				
Income				
<$15,000	60.2 (2.2)	64.7 (2.7)	55.9 (2.9)	36.3 (1.7)
$15,000–$29,999	25.1 (1.9)	18.1 (1.9)	25.5 (1.7)	36.0 (1.7)
≥$30,000	14.7 (1.7)	17.2 (2.4)	18.5 (2.6)	27.7 (1.6)
Insurance				
Private	64.3 (2.2)	61.1 (2.5)	47.9 (2.0)	30.1 (1.8)
Public	28.2 (1.9)	25.7 (2.5)	29.8 (2.8)	52.4 (1.8)
None	7.5 (1.1)	13.2 (1.2)	22.3 (2.0)	17.5 (1.2)
Medical home				
Yes	93.9 (1.1)	95.0 (0.7)	92.9 (1.0)	85.4 (1.2)
No	6.1 (1.1)	4.9 (0.7)	7.1 (1.0)	14.6 (1.2)
Facility type				
Private	23.4 (1.7)	36.9 (2.7)	27.6 (2.5)	30.0 (1.6)
Public	25.8 (1.9)	18.1 (2.3)	27.9 (3.0)	35.3 (1.7)
Other	13.9 (1.4)	7.4 (1.3)	24.6 (1.9)	26.4 (1.4)
Mixed	36.9 (2.1)	37.6 (1.3)	19.8 (2.1)	8.3 (1.0)
No. of providers				
1	66.6 (2.1)	76.5 (1.9)	47.8 (2.7)	43.8 (1.9)
≥2	33.4 (2.1)	23.5 (1.9)	52.1 (2.7)	56.2 (1.9)
VFC facility				
Yes	84.1 (1.6)	87.6 (1.7)	80.2 (2.4)	80.9 (1.8)
No	11.6 (1.4)	11.7 (1.7)	12.3 (1.9)	8.9 (1.1)
Mixed	4.3 (0.9)	0.7 (0.6)	7.6 (1.9)	10.2 (1.3)
WIC				
Yes	78.7 (1.8)	80.5 (2.4)	75.7 (2.5)	29.5 (1.6)
No	21.3 (0.8)	19.5 (2.4)	24.3 (2.5)	70.5 (1.6)
Residential moves				
0	48.9 (1.9)	64.3 (3.2)	39.6 (2.4)	47.7 (1.7)
1	24.9 (2.0)	21.7 (1.7)	28.4 (2.2)	28.5 (1.4)
≥2	26.2 (1.9)	13.9 (2.5)	32.0 (2.1)	23.8 (1.4)
Phone at home				
Yes	86.4 (1.6)	90.8 (2.2)	90.4 (1.3)	90.8 (1.2)
No	13.6 (1.6)	9.2 (2.2)	9.5 (1.3)	9.2 (1.2)
Hand-held card				
Yes	64.9 (2.6)	90.3 (1.6)	84.1 (1.9)	72.2 (1.4)
No	35.1 (2.6)	9.7 (1.6)	15.9 (1.9)	27.8 (1.4)
Transportation problems				
No	88.4 (1.2)	97.9 (0.5)	90.4 (1.4)	94.9 (0.7)
Yes	11.6 (1.2)	2.1 (0.5)	9.6 (1.4)	5.1 (0.7)
Cost of last immunization				
None	87.7 (1.3)	86.3 (1.8)	86.0 (1.8)	53.0 (1.9)
$1–$500	9.3 (1.1)	9.4 (1.2)	12.2 (1.6)	30.2 (1.6)
>$500	2.9 (0.6)	4.1 (0.8)	1.8 (0.4)	16.7 (1.1)

Vaccination Coverage Rates in the Study Sites

In New York and San Diego, all estimates of immunization coverage for DTP, poliovirus vaccine, Hib, and MMR among preschoolers were at least 90% (Table 3). For single antigens, coverage for 4 doses of DTP in Colorado fell below 90%. In Detroit,

TABLE 3. Up-to-Date Single Antigen and Combination Series 4:3:1:3:3 Coverage and Standard Error (± SE) Among Children 19 to 35 Months Old by Site: CHN 2001

Antigen	Detroit % (± SE) N = 502	New York % (± SE) N = 520	San Diego % (± SE) N = 555	Colorado % (± SE) N = 713
4 DTP/diphtheria/tetanus/acellular pertussis	72 (2.3)	90 (1.6)	91 (1.7)	83 (1.5)
3 Poliovirus vaccines	87 (1.9)	97 (1.1)	98 (0.9)	93 (1.0)
1 MMR	85 (1.7)	96 (1.0)	98 (1.0)	91 (1.0)
3 Hib	86 (1.8)	96 (1.0)	97 (1.3)	93 (1.0)
3 Hep B	84 (1.9)	95 (1.3)	94 (1.3)	87 (1.1)
UTD at 3 mo	67 (2.4)	82 (1.9)	81 (1.2)	74 (1.9)
UTD at 19–35 mo	66 (2.4)	84 (2.2)	86 (1.8)	78 (1.6)

coverage for these antigens lagged, with coverage as low as 72% for 4 doses of DTP. Of note, the lowest coverage for HepB was 84% for Detroit, well above the goal of 70% established for the year 2000.

Coverage for the 4:3:1:3:3 vaccine series (UTD at 19–35 months) was lower and varied significantly across sites ($\chi^2 = 44.51$; degrees of freedom = 3; $P < .0001$), with coverage in Detroit (66%) being lower than in San Diego (86%), New York (84%), and Colorado (75%).

Table 4 displays the percentage of children UTD at 19 to 35 months by selected factors. Although differences in coverage levels by ethnicity varied by site, differences were not significant. In Colorado and New York, coverage was slightly lower among Hispanic than white children (71% vs 76% and 83% vs 91%, respectively). In San Diego, coverage was lower among whites, compared with Hispanics (76% vs 85%). Coverage was also lower for African American than white children only in New York (75% vs 91%).

In San Diego and Colorado, vaccination coverage levels varied significantly by type of health facility. In fact, children in San Diego who received all vaccinations from a private provider had lower vaccination coverage levels than children receiving their vaccinations from the "other" category of providers (78% vs 91%; $t = -3.25$; $P < .005$); in Colorado, coverage was lower among children receiving vaccines from private providers than among children receiving vaccines from the "mixed" category of providers (71% vs 82%; $t = -3.04$; $P < .005$).

In all 4 sites, children for whom respondents reported having an immunization card at the time of the interview were more likely to have higher series coverage levels than children for whom a parent-held card was not available. Also, children who were UTD at 3 months of age had significantly higher vaccination-series coverage levels than children who were not UTD at 3 months of age. In addition, the vaccination coverage was lower for children in Detroit, whose parents reported problems accessing the health care system because lack of transportation (46%), compared with those who did not report such problems (65%); however, this difference did not reach significance ($\chi^2 = 6.0$; P = not significant). In Colorado, the small proportion of children in families without a phone had a lower vaccination coverage level (58%) than those in households with a phone (75%) ($\chi^2 = 6.3$; P = not significant).

DISCUSSION

Because they were designated as HPSAs, the 4 sites in this study were expected to have low immunization coverage rates. However, this was not the case. In fact, coverage in 3 of the 4 areas was quite high when compared with US national figures (73%)[3]; only Detroit had a much lower UTD rate at 66%. Efforts are needed to improve methods to identify areas with low immunization coverage so that resources can be directed to places at which interventions are needed.

Our results reveal that an area's need for childhood immunization interventions is not well predicted by a low number of providers per capita. HPSA status may predict areas in which acute care, prenatal care, or elder care is suboptimal, but, as others have noted, HPSA criteria cannot be assumed to predict problems of access to the health care system that translate into low immunization coverage.[15,16]

Our findings are positive with regard to the establishment of the concept and practice of a medical home for childhood health care. In our study, >95% of children had a usual source of care, and >80% of providers participated in VFC. Moreover, being in poverty was not associated with low immunization coverage, attesting to the success of renewed emphasis on immunization (particularly infrastructure issues) that began with the Childhood Immunization Initiative.[17]

UTD status at 3 months and parent-held cards were shown to be strong predictors for being UTD at 19 to 35 months of age. These factors, in combination with the variation in coverage by race/ethnicity and by VFC providers practiced in VFC facilities, suggest potentially productive avenues for research. Additional studies should identify parental and provider attitudes and practices that influence immunization. Among the questions that require additional understanding are: What are the parental characteristics and behaviors that support early and sustainable linkage with the health care system? What are the provider characteristics and behaviors that motivate parents to make early and sustainable linkages with the health care system? More needs to be learned about the transactions between patient and provider as well as the environmental factors that influence quality of care that leads to early and sustainable parent-clinician relationships.

The area-sample method with household screen-

TABLE 4. UTD Coverage Levels for the Combination Series 4:3:1:3:3 and Standard Errors (SE) by Population and Health Services Characteristics Among Children 19 to 35 Months Old by Site: CHN 2001

Characteristics	Detroit			New York			San Diego			Colorado		
	UTD (± SE)			UTD (± SE)			UTD (± SE)			UTD (± SE)		
	N	%	*P* Value	*N*	%	*P* Value	*N*	%	*P* Value	*N*	%	*P* Value
Predisposing factors												
Ethnicity			NS			NS			NS			NS
White	45	48 (8.2)		49	91 (4.1)		107	76 (4.5)		345	80 (2.4)	
African American	380	63 (2.6)		104	75 (6.0)		38	85 (5.8)		2	-	
Hispanic	52	67 (5.9)		352	83 (1.9)		371	85 (2.1)		329	76 (2.3)	
Other	10	88 (11.2)		11	91 (8.9)		36	76 (8.2)		13	-	
Mother's age			NS			NS			NS			NS
<20 y	132	68 (4.3)		247	85 (2.2)		231	86 (2.6)		295	76 (2.5)	
20–29 y	56	55 (6.4)		42	69 (7.1)		47	82 (4.9)		37	62 (6.7)	
≥30 y	299	61 (3.3)		227	81 (3.0)		274	80 (2.6)		381	73 (2.5)	
Mother's education			NS			NS			NS			NS
<High school	133	51 (5.0)		170	78 (4.6)		246	84 (2.5)		168	71 (4.3)	
High school	197	65 (3.7)		154	82 (3.2)		127	76 (4.2)		202	70 (3.2)	
>High school	157	69 (4.4)		192	86 (2.3)		179	85 (2.6)		343	77 (2.4)	
Poverty level			NS			NS			NS			NS
Above	188	62 (3.4)		168	85 (2.8)		224	80 (2.7)		436	74 (2.1)	
Below	262	63 (3.6)		280	80 (2.8)		274	83 (2.6)		236	74 (2.9)	
Enabling factors												
Income			NS						NS			
<$15,000	283	63 (3.5)		335	81 (2.7)	NS	311	84 (2.3)		250	72 (2.5)	NS
$15,000–$29,999	129	61 (4.9)		94	82 (4.8)		140	77 (4.6)		258	77 (2.5)	
≥$30,000	75	66 (6.6)		87	87 (3.2)		101	85 (3.8)		205	72 (3.2)	
Insurance			NS			NS			NS			NS
Private	304	62 (3.1)		316	82 (2.6)		269	82 (2.8)		205	72 (3.0)	
Public	147	67 (4.8)		135	87 (2.3)		159	84 (3.6)		387	75 (2.3)	
None	36	45 (9.3)		65	73 (6.3)		124	81 (3.4)		121	72 (4.1)	
Medical home			NS			NS			NS			NS
Yes	460	62 (2.6)		487	82 (2.0)		509	84 (2.0)		601	73 (1.9)	
No	25	59 (8.6)		29	81 (9.2)		43	67 (7.8)		112	79 (4.4)	
Facility type			NS			NS			<.005			<.005
Private	104	55 (4.9)		154	83 (3.2)		122	78 (4.5)		180	71 (3.5)	
Public	111	63 (5.5)		80	80 (6.0)		136	81 (3.0)		234	72 (3.2)	
Mixed	156	63 (4.0)		163	78 (3.6)		95	74 (4.6)		190	82 (2.9)	
Other	57	63 (5.6)		31	78 (8.6)		118	91 (2.6)		52	57 (7.2)	
VFC facility			NS			NS			<.01			NS
Yes	313	58 (3.0)		362	80 (2.6)		371	80 (2.3)		457	73 (2.2)	
No	40	68 (6.1)		45	88 (4.7)		58	78 (5.7)		50	62 (6.9)	
Mixed	18	87 (8.6)		3	-		38	97 (3.0)		57	81 (4.5)	
Hand-held card			<.0001			NS			<.0001			<.0001
Yes	330	72 (2.9)		474	84 (2.1)		485	88 (1.7)		518	80 (1.7)	
No	157	47 (4.1)		42	69 (7.5)		67	56 (5.8)		195	59 (3.2)	
UTD at 3 mo			<.0001			<.005			<.0001			<.0001
Yes	336	73 (2.7)		421	87 (1.6)		447	91 (1.7)		526	83 (1.7)	
No	151	41 (4.2)		95	63 (6.5)		105	50 (5.9)		187	47 (3.4)	
WIC			NS			NS			NS			NS
No	108	62 (5.2)		418	81 (2.4)		422	82 (2.3)		506	74 (2.0)	
Yes	379	63 (2.8)		98	86 (3.8)		130	83 (4.1)		207	73 (2.8)	
Phone at home			NS			NS			NS			NS
Yes	421	64 (2.6)		465	83 (2.2)		497	82 (2.1)		650	75 (1.7)	
No	65	52 (6.1)		49	72 (6.9)		53	88 (5.5)		60	58 (6.5)	
Transportation problems			NS			NS			NS			NS
No	435	65 (2.6)		506	82 (2.0)		498	82 (2.1)		677	74 (1.6)	
Yes	52	46 (7.0)		10	68 (14.6)		54	87 (5.4)		36	72 (8.2)	
Cost last immunization			NS			NS			NS			NS
>$500	279	76 (2.1)		283	64 (2.6)		411	83 (2.1)		374	82 (2.5)	
$1–$500	159	71 (3.1)		33	60 (7.1)		57	82 (5.9)		42	85 (5.1)	
None	94	78 (3.9)		4	-		6	-		15	73 (11.3)	

NS indicates not significant.

ing used here is feasible and necessary to conclusively identify pockets of underimmunization. However, better methods are needed for determining where this intensive research method may be applied most productively. We recommend that local health officials be relied on to direct research to areas that they suspect are at risk for low coverage. If local health authorities suspect low coverage in a specific population, in-depth evaluation and continued monitoring of vaccination coverage in the community can avert deterioration of coverage and accumulation of susceptible children.

A more-systematic and relatively inexpensive method to preliminarily identify pockets of need is to review immunization histories in school records. These immunization records are an indication of the children's vaccination status at 19 to 35 months of age. If these reviews show a pattern of delayed immunization among preschoolers, additional resources can be directed to verify and correct a problem in coverage among young children.[18,19] Another method to identify immunization pockets of need is immunization registries. Registries, when complete and functional, are tools that can be used for mapping coverage levels in communities on a real-time basis.

Unlike some vaccination coverage assessments that use only data verified by providers, our method of determining coverage for each child combined vaccination history from all available sources. Although most providers responded, some of them did not have any information on vaccination coverage for children without parent-held cards. We cannot exclude the possibility that inadequacies in the clinical records for the populations we studied may have biased our results among sites with the lowest provider response rates (Detroit and New York).

Although the nation as a whole attains immunization coverage levels sufficient to block disease transmission, pockets of susceptibility may act as potential reservoirs of infection.[20–22] Polio and measles no longer circulate in the United States, but disease may be imported from abroad. Transmission of imported disease in undervaccinated populations may threaten the success of disease-elimination efforts. Thus, studies such as this one are important to establish whether undervaccination is a problem in specific communities.[11,23,24]

CONCLUSIONS

Although the vaccination coverage was high for HPSA children in Colorado, New York, and San Diego, it was low in Detroit. A priority is to identify other underserved areas such as Detroit that are lagging in vaccination coverage and ensure that high coverage is attained and maintained.[25] Household surveys are too expensive and labor intensive for routine use. Therefore, proven methodologies must be reintroduced to monitor vaccination coverage among population subgroups or small geographic areas. Several methodologies are available for the review of immunization histories such as school records or the use of population-based registries for which functional registries exist. These methodologies may be a more-practical approach unless training local interviewers can be demonstrated as a feasible alternative.

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