

RESPONSE RATES IN A SURVEY THAT COLLECTS CHILDHOOD VACCINATION INFORMATION FROM HOUSEHOLDS AND PROVIDERS

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1. Introduction

One of the Healthy People 2000 objectives is to have at least 90% of 2-year-old children fully vaccinated with the recommended schedule of vaccines. The National Immunization Survey (NIS) was initiated in April 1994 by the Centers for Disease Control and Prevention (CDC) to monitor vaccination coverage levels on an ongoing basis (Ezzati-Rice *et al.*, 1995). The target population is noninstitutionalized children 19 to 35 months of age. The NIS covers 78 Immunization Action Plan (IAP) areas, which comprise the 50 states, the District of Columbia, and 27 other urban areas. The quarterly random-digit-dialing (RDD) samples for the 78 IAP areas are independent; any four consecutive quarters of data can be combined to produce annualized estimates of vaccination coverage for an IAP area.

The NIS includes a provider record-check survey to adjust for response bias in the household respondent's report of the child's vaccination status (Zell *et al.*, 1995). Household respondents' reports of vaccinations often contain errors (Battaglia *et al.*, 1997). Examples of reporting error include memory recall errors and the use of records that fail to show all the vaccinations that the child received (Battaglia *et al.*, 1996). Although the interviewers urge the respondent to refer to the child's immunization record or "shot card" if one is available, only about 50% of respondents use a shot card. Even when available, the shot card may not show all the vaccinations that the child has received. Without a shot card, the complexity of the recommended vaccination schedule in the first two years of life makes it difficult for a respondent to recall the child's vaccination history accurately. Thus the household respondents' reports of vaccination status are subject to potentially large errors. A combination of parental reports and information from health care providers' records gives a more-accurate estimate of the vaccination coverage levels than either source alone (Zell *et al.*, 1995). The data from the providers are used to produce adjusted estimates of vaccination coverage, with the aim of removing the response bias in the household reports (Centers for Disease Control and Prevention, 1996). Thus we have studied

provider response rates --- the percentage of children with a response from at least one vaccination provider --- both overall and in relation to the demographic characteristics of the household. Section 2 describes the process of collecting the data from the providers, and the stages at which nonresponse may occur. Section 3 presents the results of analyzing the data on attrition. Section 4 then examines the relationship of complete provider response (i.e., a response is received from all providers for a child) to household characteristics. For various demographic subdomains, Section 5 discusses the potential bias associated with using only the data for children with provider response to form estimates of vaccination coverage. Finally, Section 6 assembles our conclusions.

2. Methodology of the NIS Provider Record-Check Survey

Our analysis uses data from two quarters, Q3/96 and Q4/96. Data collection for the provider record-check survey begins during the telephone interview with the parent or legal guardian of an eligible child. Following questionnaire sections collecting the household's report of vaccines and demographic information, the provider section begins with a short introduction that describes the need for data from vaccination providers, reminds the respondent of the assurances of confidentiality, and explains that the respondent's verbal permission is necessary for the CDC to contact the providers and request vaccination histories. Respondents are then asked for their consent and for the names and addresses of all vaccination providers for each eligible child in the household.

Information collected in the provider section is used to prepare a packet of materials that is mailed to each of the vaccination providers named by the household respondent. The packet contains a cover letter describing the purpose of the NIS and listing the child's name, gender, and birth date and the parent's name; a form, signed by the interviewer, documenting the verbal consent from the parent; an individualized questionnaire requesting the child's vaccination history and information describing the characteristics of the provider; copies of articles based on NIS data; and a postage-paid return envelope. The materials include an 800 number that the provider can call with any questions. If convenient, providers may send copies of shot records rather than transcribe the vaccination histories onto the NIS form. Providers are also encouraged

to respond by facsimile machine. In order to call attention to the survey, the initial mailing relies on an express mail service.

This initial mailing is followed two weeks later by a postcard reminder, sent to all respondents. Five weeks after the initial mailing, nonresponding providers are mailed a second packet, using the U.S. Postal Service's Priority Mail service. Seven weeks after the initial mailing, nonrespondents are telephoned as a final reminder.

The proportion of children with provider data available depends on several factors. Household respondents (in particular, the child's legal guardian) must be willing to give consent for the study to contact vaccination providers. If the household respondent is not the child's parent or legal guardian (or if this relationship is uncertain), the provider is not contacted. The survey staff must have accurate provider address information, either from the household respondent or from post-interview locating activities. And finally, providers named by the household respondents must be willing to participate in the study by returning the vaccination record information for the sampled child.

3. Nonresponse in the NIS Provider Record-Check Survey

Table 1 shows attrition from the sample of eligible children identified in Q3/96 and Q4/96. Response from at least one provider was obtained for more than two-thirds (68.3%) of all eligible children identified during screening interviews.

Two points are worth noting about the numbers of cases used for vaccination coverage estimates. First, children without provider data are included in the estimation process if they contain sufficient vaccination data from the telephone interview. Even though most of the attrition from the provider record-check survey occurs during the telephone interview, most of these children are included in the final data files. Of the 18,141 eligible children identified, telephone interviews were completed for 16,354 (90.1%). Second; not all of the 12,391 children with response from at least one provider are used in the estimation process. For some of these children, data from multiple providers are necessary to construct a complete shot history. Following data collection, each child's vaccination data from both households and providers are carefully reviewed for completeness. Data for 16,354 children are used in the estimation process; of these, 10,532 (64.4%) have valid provider data for estimation purposes.

Table 2 (based on the 16,354 children used in the estimation process) shows the differences in proportions of children with any provider response in categories of various sociodemographic variables. For each variable, one category serves as the base, and its proportion of children with at least one provider response is displayed; for the other categories, the third column of the table shows the difference from the base proportion. Although many

differences are less than five percentage points, some differences are worth noting. Children of never-married mothers are less likely than children of married mothers to have any provider responses. As might be expected, children with multiple providers are more likely to have at least some provider data, especially children with three or more providers. Table 2 indicates that availability of provider data is also associated with shot card use by the respondent during the interview. The largest difference in Table 2 occurs in the mobility variable, between children who were born outside the U.S. and children who have never moved. Survey procedures do not call for contacting providers in other countries; and, of the foreign-born children who are missing provider data, 47.3% have providers that cannot be located in the United States or are located in other countries. Up-to-date status in Table 2 refers to children who, according to the household respondent, have received the number of shots recommended by the CDC for each of four antigens (4 or more DTP, 3 or more Polio, 1 or more MMR, and 3 or more Hib; this combination is referred to as 4:3: 1:3 up-to-date). Children who have unknown up-to-date status are less likely to have provider data.

Using marital status of mother as an example, we illustrate in Table 3 that categories of attrition can vary considerably by subdomain. For children with a never-married mother, 25.7% of attrition occurs from the respondent not being the parent or legal guardian of the child. For children with currently married mothers, this category accounts for only 2.6% of attrition.

4. Household Characteristics Related to Complete Provider Response in the NIS

The analysis presented in this section excludes children who were born outside the U.S. ($n = 144$) leaving a sample of 16,210 children for whom completed telephone interviews were obtained in 43 and 44 of 1996; 60.9% of these children have complete provider response (i.e., all providers identified by the household responded to the provider record-check survey). The propensity for children to have complete provider response was treated as the dependent variable. The demographic variables from the household survey are all categorical. Therefore, we used chi-squared automatic interaction detection (CHAID) (Kass, 1980) to divide the NIS sample into mutually exclusive and exhaustive subsets that best predict having complete provider response. The CHAID analysis identified a total of 72 subsets. Our main conclusions from the CHAID analysis are that one is more likely to obtain complete provider response for: 1) children with only one vaccination provider; 2) children for whom a shot card was used during the household interview; 3) children who were reported as being 4:3: 1:3 up-to-date by the household

respondent; 4) children who are the first born; and 5) children who have not moved since birth.

5. Examination of Bias in the NIS Estimates of Vaccination Coverage for Subdomains

One of the key NIS measures of vaccination coverage is the 4:3: I:3 (4 or more DTP, 3 or more Polio, 1 or more MMR, and 3 or more Hib) up-to-date status of the child. Table 4 shows "provider-adjusted" estimates of 4:3:1:3 vaccination coverage for Q3 and Q4 of 1996. The provider-adjusted estimates are formed by first stratifying all the children in the household telephone survey according to whether the household reports the child as 4:3: 1:3 up-to-date and whether the report is based on a shot card (Centers for Disease Control and Prevention, 1996). This yields four strata. A fifth stratum consists of children for whom the household respondent does not know whether the child is 4:3: 1:3 up-to-date. For each of the five strata, the provider data are used to calculate the proportion of children who are 4:3: 1:3 up-to-date. These provider-up-to-date proportions are then combined according to the weighted distribution of children across the five strata to give the provider-adjusted estimate of 4:3 : 1: 3 vaccination coverage.

An alternative approach to forming estimates of vaccination coverage is simply to use the children with provider data, and ignore information on the weighted distribution of children across the five strata. Table 4 indicates that almost all of the provider-adjusted estimates are only slightly lower than the estimates of vaccination coverage from provider data alone. These results offer some evidence that the subdomain estimates may not be subject to nonresponse bias. The NIS is currently developing alternative procedures for forming estimates of vaccination coverage. The alternative estimates of vaccination coverage will then be compared with the provider-adjusted estimates.

6. Conclusions

The NIS provider record-check survey was able to obtain a response from at least one provider for 68.3% of all children identified in the sample. Attrition at several points in the data collection process leads to the remaining 3 1.7% of the children not having any provider response. Because 96.6% of survey forms mailed to providers are filled in and sent back, we are currently examining the NIS *household* survey procedures for ways to reduce further the number of children with no provider response. The CHAID analysis demonstrated that the number of vaccination providers for the child, use of a shot card during the household interview, the household report of the 4:3: 1:3 up-to-date status of the child, age of the mother, whether the child is the first born, and mobility of the family since the birth of the child are important determinants of whether complete provider

response is obtained. With a mean of 1.35 providers per child in the NIS, obtaining responses from all of a child's providers is an important step in constructing a complete picture of all vaccinations received by the child.

References

- Battaglia, M., Shapiro, G., and Zell, E. R. (1996), "Substantial Response Bias May Remain When Records Are Used in a Telephone Survey," 1996 *Proceedings of the Section on Survey Research Methodology*, American Statistical Association, pp. 452-455.
- Battaglia, M., Ezzati-Rice, T. M., and Zell, E. R. (1997), "Respondent Characteristics Associated with Misreporting of Vaccinations in a Telephone Survey," paper presented at 1997 American Association for Public Opinion Research Meetings, Norfolk, VA.
- Centers for Disease Control and Prevention (1996), "Sample Design and Procedures To Produce Estimates of Vaccination Coverage in the National Immunization Survey," Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, National Immunization Program, April 18, 1996.
- Ezzati-Rice, T. M., Zell, E. R., Battaglia, M., Ching, P., and Wright, R. (1995), "The Design of the State and Local Area Immunization Coverage and Health Survey," 1995 *Proceedings of the Section on Survey Research Methods*, American Statistical Association, pp. 668-672.
- Kass, G. (1980), "An Exploratory Technique for Investigating Large Quantities of Categorical Data," *Applied Statistics*, 29, pp. 119- 127.
- Zell, E. R., Ezzati-Rice, T. M., Hoaglin, D. C., and Massey, J. T. (1995), "Adjusting for Response Bias on Vaccination Status in a Telephone Survey," 1995 *Proceedings of the Section on Survey Research Methods*, American Statistical Association, pp. 684-689.

Table 1: Attrition from the Sample of Identified Eligible Children, NIS, Q3/96 and Q4/96

Category	Number of Children	Percent of Total Eligible Children
Total Eligible Children	18141	100.0%
Breakoff before Consent Item	2792	15.4%
Respondent Refusal to Consent	503	2.8%
Incomplete Parent or Child Information	1056	5.8%
Respondent Not Parent or Legal Guardian	380	2.1%
Provider Not Located	334	1.8%
Provider Nonresponse	685	3.8%
Response from One or More Providers	12391	68.3%

Table 2: Proportion of children with Responses from One or More Providers by Sociodemographic Variables, NIS, Q3/96 and Q4/96

Variable/Category	Proportion with One or More Provider Responses	Difference
Age of Child 19-25 Months (Base) 26-35 Months	.760	-.004
Birth Order First Born (Base) Born after First Born	.746	.020
Mother's Marital Status Married (Base) Divorced, Widowed Never Married	.774	-.046 -.062
Mother's Age More than 35 years (Base) 26-35 years Less than 26 years	.764	.005 -.032
Education of Mother More than 12 Years (Base) 12 Years Less than 12 Years	.769	-.036 -.018
Number of Providers Reported in Interview One provider (Base) Two providers Three or more providers Undetermined number	.750	.050 .077 -.143
Shot Card Use Yes (Base) No	.800	-.091

Mobility since Birth Did Not Move (Base) Moved, Same State Moved, Different State Foreign-Born	.771	-.019 -.058 -.285
Country of Residence MSA County (Base) NonMSA County	.747	.053
Up-to-Date on 4:3; 1:3 Yes (Base) No Unknown	.784	-.030 -.088

Table 3: Attrition from the Sample of Identified Eligible Children by Marital Status of Mother, NIS, Q3196 and Q4196

Attrition Category	Mother's Marital Status		
	Married	Divorced, Separated, Widowed	Never Married
Breakoff before Consent Item	.291	.214	.163
Respondent Refusal to Consent	.141	.090	.102
Incomplete Parent or Child Information	.286	.224	.228
Respondent Not Parent or Legal Guardian	.026	.187	.257
Provider Not Located	.087	.090	.073
Provider Nonresponse	.168	.195	.177

Table 4: 4:3: 1:3 (4 or more DTP, 3 or more Polio, 1 or more MMR, and 3 or more Hib) Vaccination Coverage Estimates by Subdomain, NIS, 4319 and 44196

Subdomain	Provider-Adjusted 4:3:1: Estimate ("h")	4:3:1: Estimate from Provider Data Alone ("l")
Age of Child:		
19-25 months	74.2	74.4
26-35 months	79.2	79.4
Marital Status of Mother:		
Widowed, Divorced, or Separated	68.0	68.3
Never married	73.9	73.9
Married	79.2	79.3
Education of Mother:		
Less than 12 years	72.0	72.0
12 years	74.4	74.6
More than 12 years	81.5	81.8
First-Born Status:		
Not first born	73.1	73.4
First born	82.6	82.7
Number of Providers:		
1	79.4	79.4
2	73.4	72.2
3+	75.7	72.4
Shot Card Use:		
No	75.0	75.1
Yes	78.8	79.0
Mobility since Birth:		
Moved - different state	74.1	74.1
Moved - same state	71.9	72.4
Did not move	79.8	80.1
County of Residence:		
MSA county	77.0	77.2
NonMSA county	77.6	78.0