RESPONDENT CHARACTERISTICS ASSOCIATED WITH MISREPORTING OF VACCINATIONS IN A TELEPHONE SURVEY

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KEYWORDS: National Immunization Survey, Provider Record Check Study

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. In order to measure progress toward achieving this goal, the National Immunization Survey (NIS) was initiated in April 1994 to monitor vaccination levels on an ongoing basis. The target population is the noninstitutionalized population of 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 urban areas. The NIS has been designed to provide estimates of vaccination levels for the 78 individual IAP areas and for the U.S. as a whole through the use of a random-digit-dialing (RDD) telephone survey methodology (Ezzati-Rice et al., 1995). By using the same data collection and estimation methodology in each IAP area, the NIS aims to produce estimates of vaccination levels that are comparable among IAP areas (Battaglia et al., 1995). The quarterly samples for the 78 IAP areas are independent, so that any four consecutive quarters of data can be combined to produce annualized estimates of vaccination levels. The NIS measures the following individual vaccinations and vaccination series:

DTP (diphtheria and tetanus toxoids and pertussis vaccine)
Polio (oral poliovirus vaccine)
MCV (measles-containing vaccine)
MMR (measles-mumps-rubella vaccine)
Hib (*Haemophilus influenzae* type b)
Hepatitis B
Varicella (starting July 1996)
4:3:1 (4+ DTP, 3+ Polio, and 1+ MMR)
4:3:1:3 (4+ DTP, 3+ Polio, 1+ MMR, and 3+ Hib)
3:3:1 (3+ DTP, 3+ Polio, and 1+ MMR).

The NIS includes a provider record-check study to assess and adjust for response bias in the household respondent's report of the child's vaccination level (Zell et al., 1995). Such biases arise, in part, because parents tend to underestimate the number of doses received for multiple-dose vaccines and to overestimate coverage for single-dose vaccines (Goldstein et al., 1993; Valadez and Weld, 1992). In addition, results from the National Immunization Provider Record Check Study (NIPRCS), conducted by CDC in conjunction with the 1994 National Health Interview Survey (NHIS), indicate that household respondents' reports of vaccinations often contain errors, and that 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 (Ezzati-Rice et al., 1996). Examples of reporting error include memory recall errors and the use of a shot card that fails to show all the vaccinations that the child received. Although the interviewers urge the respondent to refer to the child's vaccination record or "shot card" if one is available (and are prepared to schedule a call-back to facilitate use of a shot card), slightly more than 50% of respondents refer to 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 (Battaglia et al., 1996).

2. RDD and Provider Record-Check Results for 1995

During calendar year 1995 a total of 31,997 child level telephone interviews were completed as part of the NIS random-digit-dialing survey. The product of the residential number resolution rate, the screener response rate, and the interview response yields an overall CASRO-like response rate of 86%. About 4% of households screened in the NIS contain a child in the 19 to 35 month eligible age range, although the initial expectation based on the National Health Interview Survey, was that about 5% of telephone household in the U.S. would qualify for the NIS. Massey (1995) proposed a new method for computing response rates for RDD screening surveys. Secondary information from the National Health Interview Survey and other external sources is used to estimate the actual number of eligible households in the NIS sample. Dividing this estimate into the number of interviews completed with eligible households yields a direct estimate of the response rate. Following this approach, which has been described as a method for incorporating undercoverage into the response rate (Shapiro et al., 1996), the NIS response rate for 1995 was 70%.

During the RDD telephone interview, the respondent is asked to identify the name and address of the child's vaccination providers and to give verbal consent for those providers to be contacted. The NIS provider record check survey is conducted by mail with telephone follow-up (Battaglia et al., 1997). For 1995 valid provider data was obtained for 49% (15,595) of the children. Improvements in the provider record check methodology have raised this to 69% for the first quarter of 1997. The vaccination information from the provider record check survey is used as the gold standard, because it has been shown to be much more accurate than the household reports of vaccination received (Zell et al., 1995).

The household report on the 4:3:1:3 up-to-date (UTD) status of the child can be used to classify all children in the RDD sample into 5 categories:

1. Shot card, 4:3:1:3 UTD
2. Shot card, Not 4:3:1:3 UTD
3. Recall, 4:3:1:3 UTD
4. Recall, Not 4:3:1:3 UTD
5. Don't Know (D.K.) whether 4:3:1:3 UTD.

Table 1 shows the percentage of children in each of the above five categories who are 4:3:1:3 up-to-date based on the provider information, and indicates that substantial response bias exists in the household report of the 4:3:1:3 vaccination status. For 1995 the use of the household information alone yields a weighted national 4:3:1:3 vaccination estimate of 55.4%. We can combine household data and provider data to obtain provider-adjusted estimates of vaccination levels for each IAP area (Zell et al., 1995, Battaglia, 1997). As shown in Table 1, within each of the five categories, the provider data is used to estimate the proportion of children who are 4:3:1:3 up-to-date. The provider adjusted 4:3:1:3 vaccination estimate equals the weighted average of the category-specific 4:3:1:3 up-to-date proportions. The provider-adjusted estimate for 1995 is 74.6%. The gross difference rate (i.e., the percentage of erroneous household reports) is 36.4%, while the net difference rate (i.e., the nonoffsetting part of the gross difference rate) is -20.2%. The net bias equals -19.2%.

3. Factors Associated with Household Reporting Errors

The 1995 NIS sample consists of 13,581 children with a nonmissing household report on 4:3:1:3 up-to-date status who also have useable provider data. These children were used to assess demographic and socioeconomic factors associated with agreement between the household and provider 4:3:1:3 up-to-date status of the child. A dichotomous dependent variable was formed by coding children with agreement between the household and provider to 1, and children with disagreement between the household and provider to 0. Because the provider data is treated as the gold standard, disagreement indicates a household reporting error. Table 1 lists the predictor variables included in the final main effects logistic regression model which was estimated using SUDAAN in order to take the weights and the sample design into account. Initially, separate models were run for children who were and were not 4:3:1:3 up-to-date according to their providers. Variables that were significant at the 0.10 level in either model were included in the final main effects model which is shown in Table 3. The final main effects model indicates that children with a Hispanic or nonHispanic Black mother are more likely to have a household reporting error than children with a nonHispanic White mother. Children for whom a shot card was not used during the telephone interview are more likely to have a household reporting error. Children who moved from a different state are less likely to have a household reporting error than children who have not moved. Children with a mother who has less than 12 years of education are also more likely to have a household reporting error than children with a mother who has more than 12 years of education. Finally, children who are not 4:3:1:3 up-to-date according to their providers are less likely to have a household reporting error.

4. Summary

Substantial response bias exits in the household reports of vaccination status of children age 19-35 months. For 4:3:1:3 up-to-date, the net bias is -19.2%. The use of provider vaccination information in conjunction with the household report leads to much more accurate estimates of vaccination coverage for the 78 IAP areas. Demographic and socioeconomic variables associated with household reporting error were examined.

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Table 1: Comparison of Household and Provider Report of 4:3:1:3 Up-to-Date Status of Child

Household Report Category	Percentage 4:3:1:3 Up-to-Date According to Households	Percentage 4:3:1:3 Up-to-Date According to Providers
Shot Card, 4:3:1:3 up-to-date	100%	90%
Shot Card, Not 4:3:1:3 up-to-date	0%	62%
Recall, 4:3:1:3 up-to-date	100%	75%
Recall, Not 4:3:1:3 up-to-date	0%	66%
D.K. 4:3:1:3 Status of Child	D.K.	70%

Table 2: Predictor Variables Considered for Inclusion in Logistic Regression Models

AGE OF CHILD 1 = 19-25 months 2 = 26-35 months
MARITAL STATUS OF MOTHER 1 = Divorced, separated, widowed, deceased 2 = Never married 3 = Married, unknown
RACE/ETHNICITY OF MOTHER 1 = Hispanic 2 = Black, nonHispanic 3 = Native American & other races, nonHispanic 4 = Asian, nonHispanic 5 = White, nonHispanic
POVERTY STATUS 1 = At or above poverty level 2 = Below poverty level 3 = Unknown
EDUCATION OF MOTHER 1 = Less than 12 years 2 = 12 years 3 = More than 12 years
SHOT CARD USE 1 = Shot card not used 2 = Shot card used
MOBILITY SINCE BIRTH OF CHILD 1 = Moved - same state 2 = Moved - different state 3 = Did not move, unknown
MSA VERSUS NONMSA COUNTY OF RESIDENCE 1 = MSA 2 = NonMSA

(Last category is used as the reference group in the logistic regression models).

Table 3: Logistic Regression Model for Predicting Reporting Errors in 4:3:1:3 Up-to-Date Status of Child
Dependent Variable:
Household and Provider(s) Agree = 1 [both UTD or both not UTD].
Household and Provider(s) Disagree = 0 [not UTD and UTD, or UTD and not UTD].

Predictor	Coefficient	P-value
Intercept	1.00	0.000
Child is age 19-25 months	-0.06	0.253
Mother is Hispanic	-0.20	0.043
Mother is Black, nonHispanic	-0.24	0.006
Mother is American Indian, nonHispanic	0.34	0.148
Mother is Asian, nonHispanic	-0.10	0.588
Education of mother < 12 years	-0.16	0.096
Education of mother = 12 years	-0.01	0.878
Shot Card not used	-0.67	0.000
Moved within same state	0.02	0.807
Moved from different state	0.23	0.034
Live in an MSA county	-0.09	0.184
Child is not 4:3:1:3 up-to-date according to their provider(s)	0.13	0.063