

## REDUCING ATTRITION IN A RANDOM-DIGIT-DIALING-BASED PROVIDER RECORD CHECK STUDY

Michael P. Battaglia, Kate Ballard-LeFauve, Linda Piccinino, Mary Cay Murray, Abt Associates Inc.;  
Robert A. Wright, Meena Khare, National Center for Health Statistics

Michael P. Battaglia, Abt Associates Inc., 55 Wheeler St., Cambridge, MA 02138

**Key Words:** CASRO response rate, Vaccination history nonresponse, National Immunization Survey

### I. Background

In 1992 the Childhood Immunization Initiative (CII) (CDC, 1993) was established to 1) improve the delivery of vaccines to children; 2) reduce the cost of vaccines for parents; 3) enhance awareness, partnerships, and community participation; 4) improve vaccinations and their use; and 5) monitor vaccination coverage and occurrences of disease. Subsequently Healthy People 2000 and 2010 objectives established the goal of having at least 90% of 2-year-old children fully vaccinated with the Advisory Committee on Immunization Practices recommended schedule of vaccines. To fulfill the CII mandate of monitoring vaccination coverage and marking progress toward achieving the Healthy People 2000 and 2010 goals, the National Immunization Survey (NIS) has been implemented by the National Immunization Program and the National Center for Health Statistics, Centers for Disease Control and Prevention (CDC), and its contractor, Abt Associates Inc.

In the NIS, the target population is children between the ages of 19 and 35 months living in the United States at the time of the interview. Official coverage estimates reported from the NIS provide rates of being up-to-date with respect to the recommended numbers of doses of all recommended vaccines (CDC, 2001). These vaccines and their recommended numbers of doses are: diphtheria and tetanus toxoids and pertussis vaccine (DTP), 4 doses; poliovirus vaccine (polio), 3 doses; measles-containing vaccine (MCV), 1 dose; *Haemophilus influenzae* type b vaccine (Hib), 3 doses; hepatitis B (Hep B), 3 doses; and varicella zoster vaccine, 1 dose. In addition to these vaccines, interest focuses on coverage rates for vaccine series, including the 4:3:1:3:3 series (4 DTP, 3 polio, 1 MCV, 3 Hib, and 3 Hep B). Annualized (four consecutive quarters) vaccination coverage estimates are published on a semi-annual basis. The time lag between the end of a reporting period and publication of official estimates is approximately 6 months, resulting in timely reporting from a federally sponsored nationally representative survey oriented toward a public health issue.

Beginning with the second quarter of 1994, the NIS has conducted quarterly surveys in 78 Immunization

Action Plan (IAP) areas, consisting of the 50 states, the District of Columbia, and 27 other large urban areas. This design has made it possible to produce annualized estimates of vaccination coverage levels within each of the 78 IAP areas with an acceptable degree of precision (a target coefficient of variation of no more than 5%). Further, by using the same data collection methodology and survey instruments in all IAP areas, the NIS produces vaccination coverage levels that are comparable across IAP areas and over time.

The NIS uses two phases of data collection to obtain vaccination information for a large national probability sample of young children: a random-digit-dialing (RDD) computer assisted telephone interview (CATI) survey designed to identify households with children between 19 and 35 months of age, followed by the NIS Provider Record Check (PRC) survey, which obtains provider-reported vaccination histories for these children. The household survey collects demographic information and the parental report of vaccines received by the child. Use of vaccination records (shot card) by respondents is encouraged. Data obtained from the PRC are used to count the number of doses that children received for each of the recommended vaccines. These counts are used to determine whether the children are up-to-date. These data, along with sampling weights and NIS survey design information, are used to obtain estimated vaccination coverage rates.

This paper provides information on the response rates achieved in the RDD survey. Attrition statistics for the PRC survey are presented and the methods employed to reduce attrition at each step in the data collection process are discussed.

### II. Random-Digit-Dialing Survey

The NIS RDD sampling phase uses independent quarterly samples of telephone numbers in each of the 78 IAP areas. With an average sample size of 442.7 completed child interviews per IAP area, the total number of completed interviews for children between 19 and 35 months of age in the four-quarter period Q4/1999-Q3/2000 was 34,534. The main goals of the RDD sampling phase are: 1) to select a probability sample of telephone numbers for each IAP area, 2) to ensure that the target number of interviews is achieved in each IAP area, 3) to minimize in a cost-effective manner the number of age-eligible children excluded

from the sampling frame, and 4) to maintain an up-to-date sampling frame of telephone numbers.

To accomplish these goals, the NIS uses the list-assisted method of random-digit dialing (Lepkowski, 1988). This method selects a random sample of telephone numbers from banks of 100 consecutive telephone numbers (e.g., 617-495-0000 to 617-495-0099) that contain one or more directory-listed residential telephone numbers. The sampling frame of telephone numbers is updated each quarter in order to include new telephone exchanges and area codes. Although the number of cellular telephone subscribers in the U.S. has increased rapidly according to Federal Communications Commission data (by 2,121% from 1990 to 2000), most households continue to maintain land-line telephone service. Also, most cellular telephone users pay for incoming calls, making it unlikely that they would be willing to pay for the survey administration time. Therefore, cellular telephone exchanges are currently excluded from the NIS sampling frame.

The target sample size of completed telephone interviews in each IAP area is designed to achieve an approximately equal number of children with adequate provider-reported vaccination histories in all 78 IAP areas. In this paper the phrase “children with adequate provider data” refers to children for whom sufficient vaccination history information is obtained from their providers to determine whether they are up-to-date with respect to the recommended vaccination schedule.

The design and implementation of the NIS sample rely on four key design tools. First, an automated procedure is used to eliminate a portion of the nonworking and business telephone numbers in the sample before the interviewers dial them (Battaglia et al., 1995). Second, statistical models are used to predict the number of sample telephone numbers needed in each IAP area for a given quarter of interviewing (Buckley et al., 1998). Third, the sample for an IAP area is divided into random subsamples called replicates. By administering the sample release on a replicate-by-replicate basis, it is possible to spread the interviews for each IAP area evenly across the entire calendar quarter. Fourth, the sample telephone numbers are matched with an extensive national database of directory-listed residential telephone numbers in order to obtain usable mailing addresses for approximately 58% of the sample telephone numbers. To promote participation in the NIS, an advance letter is sent to these addresses approximately 2 weeks prior to the RDD interview.

### III. Provider Record Check Survey

At the end of the NIS RDD interview, consent to contact the children’s vaccination providers is requested from the parent/guardian. When verbal consent is

obtained, children’s vaccination providers are mailed an immunization history questionnaire (IHQ). Vaccination providers who are mailed the IHQ are asked to record the sampled child’s vaccination history on the IHQ. The data from these IHQs are entered, cleaned, edited, and merged to produce a child-level record.

The IHQ is designed to be simple and brief, to minimize burden on the providers and to encourage participation in the survey. It consists of two pages. Page 1 includes space for a label that contains identifying information about the child (child’s name and birth date and the full name of the parent). Page 1 also includes a grid for recording dates of vaccinations. The recommended childhood vaccines listed in the NIS questionnaire form columns of the grid, and an additional column is available for recording other vaccines. Page 2 of the questionnaire contains a series of questions about the facility and vaccination provider (for example, whether the facility is public or private, and the clinical specialty of the provider).

The IHQ is sent by mail to vaccination providers with instructions to mail or fax the questionnaire back upon completion. If a response is not received after two weeks, a reminder postcard is sent to the provider. Then, if necessary, another questionnaire packet is mailed two weeks later, and finally a telephone call is made to the provider to remind and encourage them to complete the form and either mail or fax the information back. In some instances, provider-reported vaccination histories are accepted over the phone. The goal in the data collection process is to give reminders to providers and to make reporting as easy as possible by offering multiple reporting mechanisms and allowing sufficient time.

### IV. Summary of RDD Results

The NIS calculates numerous key indicators for the RDD sample. Ezzati-Rice et al. (2000) discuss methods for calculating response rates in RDD surveys that screen for an eligible target population. One commonly used response rate in RDD surveys in the Council of American Survey Research Organizations (CASRO) response rate (Frankel, 1983). It consists of three components:

$$\frac{\text{Resolved \#s}}{\text{Total Sample}} * \frac{\text{Screened Households}}{\text{Known Households}} * \frac{\text{Completed Interviews}}{\text{Eligible Households}}$$

The three ratios being multiplied together in the above equation are the resolution rate, the screening completion rate, and the interview completion rate, respectively. Resolved numbers are those telephone numbers identified as nonworking, business or residential numbers (i.e., known households). Screened households are those that complete the age eligibility screening interview. Total Sample represents the entire

sample drawn for the four quarters, and the total number of resolved numbers includes telephone numbers resolved as nonworking or business numbers by the automated sample screening procedures.

For the four-quarter period Q4/1999-Q3/2000 2,678,848 telephone numbers were sampled. The resolution rate for the entire sample was 88.3%. The screener completion rate was 96.2% and the interview completion rate was 93.4%. This resulted in an overall CASRO response rate of 79.3%, which is among the highest response rates achieved in national RDD surveys today (Massey et al., 1997). As noted earlier the NIS is conducted in 78 IAP areas. Figure 1 shows the CASRO response rates for the 78 IAP areas using a boxplot. The inter-quartile range is from 77.2% to 82.0%. The maximum response rate is 85.8%, and the minimum is 71.6%, which in itself would be considered a good response rate in a typical RDD survey.

#### V. Provider Record Check Attrition Statistics

The PRC survey has built-in provisions for assessing data to determine where children are lost through attrition at several stages in the interview and provider data collection process. The goal of this assessment is to evaluate where in the data collection process attrition occurs and to identify steps that can be taken to reduce the loss at each stage.

Data for this assessment are combined from several sources to illustrate the losses through attrition in the interview and production phases of the process. Table 1 shows data derived from production reports (called ProTrack files) as well as analysis file data. Key indicator data for the NIS at the national level are shown for the four-quarter period Q4/1999-Q3/2000. Data for a particular quarter reflect data for that quarter as of the time point of the closeout of the subsequent quarter; i.e., data for Q1/2000 are current as of the close of Q2/2000 and include any data from the ProTrack system that were received and entered after the original closeout of Q1/2000. This is done so that a complete set of data is presented for a quarter that accounts for late (post-closeout of a quarter) returns of immunization history questionnaires (IHQs) by providers.

The key indicators list in the first column of Table 1 highlights items relevant to assessing attrition. For the four-quarter period Q4/1999-Q3/2000, 34,534 children in the relevant NIS age-range of 19-35 months had completed the NIS interview. Approximately eighty-four percent of these children had consent that was in a form that was "useable" to contact their vaccination providers. This means that 5,435 cases (approximately 16% of the total age-eligible children) were lost prior to the consent process, refused consent, or gave consent that was incorrect or incomplete (did not have the child's name or was not from a parent or guardian). Among provider-child pairs that were

identified by households that had given consent in a useable form, IHQs were mailed to 93% of the providers represented in these pairs. The seven percent loss is due to providers that could not be located; i.e., address information was unavailable, inaccurate or incomplete, even after checks were performed using database and web searches and other locating tools. Each provider is mailed a packet with an IHQ; therefore, a mailed IHQ corresponds to a provider-child pair. In Table 1, more than three-fourths (78%) of questionnaires mailed to providers were returned with enough information on the child's immunizations to be used for vaccination estimates. Another 11% were returned indicating that the provider did not have an immunization record for the child; 2% were returned with a request for a written consent from the parents, and 0.1% of the providers returned a questionnaire with an indication that they were refusing. The remaining forms were either not returned, or were returned with problems that made them unusable. For the four-quarter time period Q4/99-Q3/00, 429 children with provider data (less than 2% of children with completed interviews with any returned immunization information) had data from providers that was not considered adequate for estimation purposes. The resulting 23,188 of age-eligible children that did have adequate immunization data from providers represents 68% of the total of eligible children with completed NIS interviews.

Figure 2 displays a boxplot for the 78 IAP areas with the percentage of children with adequate provider data for the four-quarter period Q3/1999-Q2/2000. The median percentage is 68.4% and the interquartile range is from 63.2% to 71.3%. The highest percentage is 78.8% and the lowest percentage is 54.5%.

#### VI. Procedures to Reduce Attrition

At each step in the data collection process for the PRC survey, procedures are used to increase the number of children with adequate provider data. The main steps include:

##### Obtaining Consent

The first step in the PRC survey data collection process occurs during the last section of household interview. This is where the name of the subject child's providers, the child's full name, and the guardian's name are collected. After that data have been collected, the guardian is asked to give consent to contact those providers. The majority of refusals occur at the beginning of the provider section when the respondent is first asked for the names of the child's medical providers. When the respondent refuses to give the provider information, the interviewer reads a refusal conversion script designed to elicit cooperation. If that does not avert the refusal, the interviewer ends the

interview. The case is then sent to an experienced refusal converter who attempts to convert the refusal later in the data collection period. For the four-quarter period (Q4/1999-Q3/2000), 35% of refusals were converted.

#### Mailing to Providers

Among parents who give consent to contact their child's immunization providers, some are not able to furnish complete name and address information for those providers. In order to increase the number of children with adequate provider information, the CATI interview includes a provider look-up database, which the interviewer can search for providers within a 50-mile radius of the respondent's ZIP Code. If the provider is not found in the database, the interviewer captures as much name and address information as the respondent can provide. After the interview, the provider names and addresses are reviewed by locating clerks. The clerks first search the entire look up database for the address. If the provider cannot be found in the database, the clerks use American Medical Association listings, web searches, and other locating tools to find a complete address. If the respondent was able to give a phone number for the provider's office, the locator calls to confirm the mailing information. All addresses are reviewed a second time by a supervisor, who approves the address for mailing or codes it as unusable. Approximately 7% of the providers named by respondents can not be located. However, at least one provider can be located for 97% of the children for whom we have consent. This is because most of the unlocated providers are a second or third provider nominated for a child.

#### Increasing Provider Response

In order to increase response rates from providers, the survey follows the Total Design Method described by Dillman (1977). Each provider is sent a packet containing an Immunization History Questionnaire (IHQ), a copy of the consent form to release medical records, a cover letter from the CDC, a copy of an Morbidity and Mortality Weekly Report article that reports national vaccine coverage rates that are derived from the survey data, and a business reply envelope. Two weeks after the initial request a reminder/thank you postcard is sent to every provider. Five weeks after the original mailing, a reminder packet is sent to providers who have not yet responded to the first request. This reminder mailing contains a second questionnaire. Two weeks after the reminder mailing, the non-responding providers are prompted by telephone. During the telephone prompting, most providers request another questionnaire, which is mailed or faxed to them within 24 hours. Other means of increasing provider response rates are being

responsive to our providers' requests. The project maintains a toll-free hotline that the providers can call with questions. Providers are also given several options for returns – they can fax the form back or return it in the business reply envelope. In some instances, the providers call their responses in to the toll free line. Because many providers are contacted repeatedly for the survey over several quarters, attempts have been made to respond to individual provider's requests. Providers who are contacted frequently may supply us with a specific mailing address for all IHQs, or ask that they not receive the reminder postcards.

#### Responses Without Immunization Data

The second largest place where we lose children is when providers respond to the survey but do not provide immunization data. In the last data collection period, 96% of providers responded to the survey, but only 78% responded with immunization data. When providers respond but do not provide immunization data, most indicate that they do not have immunization records for this child. Other types of responses in this category include providers that require written consent and providers that refuse or indicate that there would be a charge for retrieving records. In order to increase the number of responses, the survey has a procedure to attempt to obtain a signed consent form from the parent or guardian when the provider requires one. Also, if a provider that we contact frequently refuses to continue to participate, a representative of the CDC may contact them to try to attempt to convert the refusal.

#### Inadequate Provider Information

Children that fall into this category are cases in which at least one, but not all providers, has responded with some immunization data, but that data does not appear to be a complete vaccination history for the child. This assessment is made by applying six criteria based on the number of doses reported for specific vaccines and the agreement between the household and provider vaccination reports. For example, a child is considered to have adequate provider data if the provider report matches the household shot card report.

#### VII. Conclusions

It is still feasible to attain high response rates in RDD surveys today and to minimize the spread in the response rate across diverse geographic areas. Most providers return the IHQ (96%), with 78% of IHQs returned with immunization data. There is a greater spread across the geographic areas in the PRC survey percentage of children with adequate provider data. The analysis of where attrition occurs in the process of obtaining provider data has led to the development of several procedures that help reduce attrition in the household and provider components of the NIS.

References:

Battaglia, Michael P., Starer, Amy, Oberkofler, Jerry, and Zell, Elizabeth R. 1995. Pre-identification of nonworking and business telephone numbers in list-assisted random-digit-dialing samples. 1995 Proceedings of the Section on Survey Research Methods, Alexandria, VA: American Statistical Association, pp. 957-962.

Buckley, Paul, Dennis, J. Michael, Saulsberry, Candice, Coronado, Victor G., Ezzati-Rice, Trena M., Maes, Edmond F., Rodén, Ann-Sofi, and Wright, Robert A. 1998. Managing 78 simultaneous RDD samples. 1998 Proceedings of the Section on Survey Research Methods, Alexandria, VA: American Statistical Association, pp. 957-961.

Centers for Disease Control and Prevention. 1993. Reported vaccine-preventable diseases—United States, 1993, and the Childhood Immunization Initiative. *MMWR Morb Mortal Wkly Rep*, 43, pp. 57-60.

Centers for Disease Control and Prevention. 2001. Recommended childhood immunization schedule—United States, 2001. *MMWR Morb Mortal Wkly Rep*, 50, pp. 7-10.

Dillman, D. 1978. *Mail and Telephone Surveys: The Total Design Method*, New York: John Wiley & Sons.

Ezzati-Rice, Trena M., Frankel, Martin R., Hoaglin, David C., Loft, John D., Coronado, Victor G., and Wright, Robert A. 2000. An alternative measure of response rate in random-digit-dialing surveys that screen for eligible subpopulations. *Journal of Economic and Social Measurement*, Volume 26, pp. 99-109.

Frankel, L.R. 1983. The report of the CASRO task force on response rates. In: Weisman F., ed. *Improving Data Quality in Sample Survey*, Cambridge, MA: Marketing Science Institute, pp. 1-11.

Lepkowski, J.M. 1998. Telephone sampling methods in the United States. In: Groves, R.M., Biemer, P.P., Lyberg, L.E., Massey, J.T., Nicholls, W.L., Waksberg, J., eds. *Telephone Survey Methodology*, New York: John Wiley & Sons, 73-98.

Massey, J.T., O'Connor, D., and Krotki, K. 1997. Response rates in random digit dialing telephone surveys. 1997 Proceedings of the Section on Survey Research Methods, Alexandria, VA: American Statistical Association, pp. 707-712.

FIGURE 1. BOXPLOT OF OVERALL RESPONSE RATE FOR 78 GEOGRAPHIC AREAS, Q4/1999-Q3/2000 NATIONAL IMMUNIZATION SURVEY

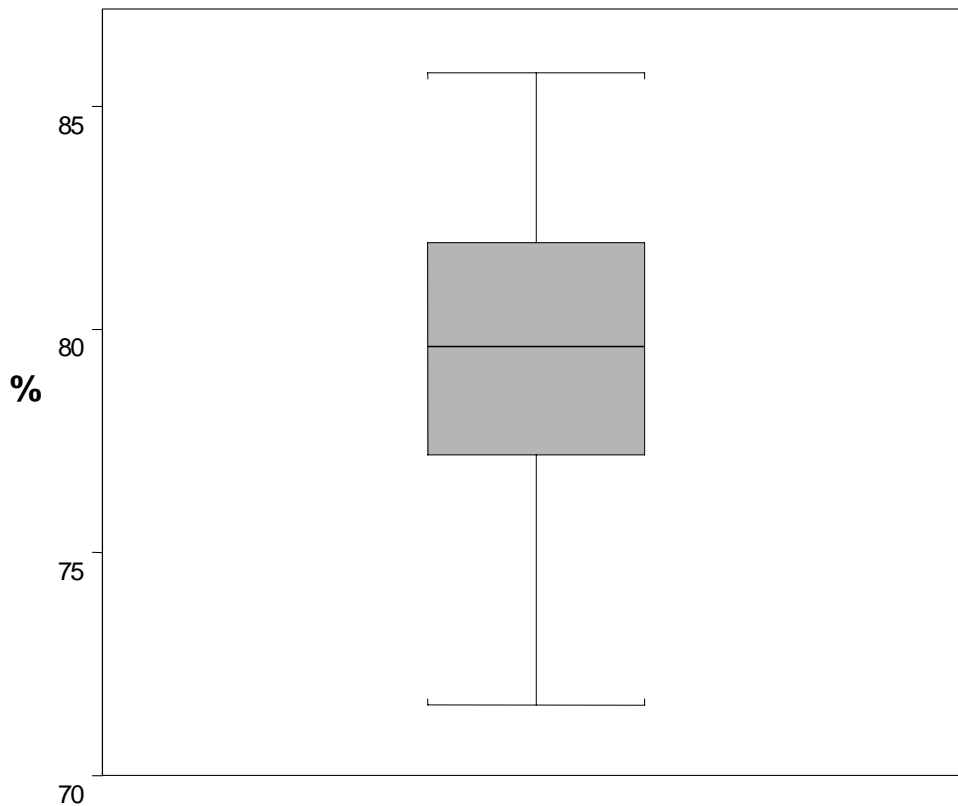


TABLE 1. SELECTED KEY INDICATORS FOR THE PROVIDER RECORD-CHECK STUDY, Q4/1999-Q3/2000 NATIONAL IMMUNIZATION SURVEY

	Frequency	% of total completed interviews
Age-eligible children with completed interviews	34,534	100%
Age-eligible children with useable consent to contact vaccination providers	29,099	84%
		% total of provider-child pairs
Providers identified by households with useable consent	40,492	100%
Immunization history questionnaires (IHQs) mailed to providers	37,701 (28,202 children)	93%
		% of IHQs mailed to provider-child pairs (37,701)
IHQs returned from providers with immunization information	29,335	78%
		% of age-eligible children with completed interviews (34,534)
Age-eligible children with any returned immunization information	23,617	68%
Age-eligible children with adequate provider data	23,188	67%

FIGURE 2. BOXPLOT OF PERCENTAGE OF CHILDREN WITH ADEQUATE PROVIDER DATA FOR 78 GEOGRAPHIC AREAS, Q4/1999-Q3/2000 NATIONAL IMMUNIZATION SURVEY

