SMALL-COMMUNITY–BASED SURVEYS

Ralph R Frerichs and Magda A Shaheen
Department of Epidemiology, School of Public Health, University of California at Los Angeles, Los Angeles, California 90095-1772; e-mail: frerichs@ucla.edu, mshaheen98@hotmail.com

Key Words cluster surveys, rapid surveys, face-to-face interviews, immunization coverage

■ **Abstract** Rapid, small surveys are routinely done in much of the developing world but are less common in the United States. We present as an example a rapid survey of immunization status and other factors in a predominantly Hispanic region in Los Angeles. The survey united county employees, students, and community volunteers, first to enumerate the eligible population and then to conduct in-person interviews. Sampling was done in two stages in a downtown region of Los Angeles. Over the course of two weekends and during clean-up the following week, volunteers and others enumerated 718 eligible children in 30 clusters (i.e. groups of blocks). At the second stage, also in two weekends with midweek clean-up, we selected by simple random sample 10 children per cluster. The parents or legal guardians of 270 children were interviewed about vaccination issues, including home presence of an immunization card. Nearly one fourth of the respondents did not have a home telephone number and thus would have been underrepresented in a telephone survey. Information from such rapid surveys is important for local program planning and evaluation.

INTRODUCTION

Surveys have long been viewed as important tools for obtaining information about people who live in a given community. Counts of the total population occur at decade intervals in the United States Census. Although providing important demographic and economic information, the US Census collects almost no health data. Thus, for local health departments or other agencies, surveys are often the only practical alternative for obtaining current information. Internationally, perhaps the most common survey method for gathering information about such variables as immunization coverage, diarrheal diseases, respiratory conditions, or smoking behavior is the cluster sampling approach promoted by the World Health Organization (WHO) (2, 13). Typically, such surveys have 210–300 subjects and are completed in a short period of time. The method is based on a two-stage sampling process, with probability-proportionate-to-size (PPS) sampling of 30 clusters at the first stage and quota sampling after a random start of 7–10 subjects per cluster at the second. Such surveys tend to be inexpensive and easily carried out, although they are subject to bias (15). Two-stage cluster surveys are preferable to one-stage, simple random sample surveys because all eligible persons in the population do not have to be identified and listed prior to selection. In recent years, modifications have been suggested to reduce potential biases in such WHO-style surveys, including random sampling at the second stage (1, 4). Earlier the sampling method had been adapted for doing rapid surveys in developing countries, using portable computers and current software to provide timely results (9, 10). For the past decade, a course featuring this modified method has been taught at the University of California, Los Angeles (UCLA), intended primarily for health professionals from developing countries. The method has also been used by former course participants to survey inner city areas of Los Angeles and communities of Kern County, California (8, 11, 16).

In the United States, it is no longer common for local health departments to conduct community-based surveys. Partially this is due to lack of expertise. Schools of public health routinely teach epidemiologic and statistical aspects of cohort and case-control studies but typically omit details of doing small, inexpensive two-stage cluster surveys. Funding for major surveys is sometimes available to academic or research institutions, and to companies in the private sector that do opinion and political polling. Such funds, however, are generally not available to health departments wanting to use their own staff to address perceived local problems. In such settings, rapid face-to-face interview surveys become a desirable alternative.

National Immunization Survey

Telephone opinion surveys are routinely conducted in North America, as they are in much of the developed world. Perhaps the most widely known health-related telephone survey in the United States is the National Immunization Survey (NIS), commissioned by the Centers for Disease Control and Prevention (CDC) to provide national, state, and urban area data on vaccination coverage among children aged 19–35 months (18). Households in defined geographic areas are first randomly called to determine whether they are eligible for the survey (i.e. have a 19- to 35-month-old child) and, if so, whether they are willing to participate. Given consent, the mother is interviewed and the child's medical care provider is contacted in a follow-up effort to gain access to the vaccination record. To get such consent, the NIS staff sends a letter to the provider. Two weeks later a postcard is sent, followed 3 weeks later by a second letter. Following that, they telephone. Thus, the entire provider-contact process after the initial telephone interview could take 2 months or longer, thereby adding expense and delaying the time to completion.

The vaccination coverage estimate varies widely between the parental response at the initial telephone call and the provider follow-up of patient records. Such comparisons were published by the NIS staff for all states and large counties (18). In Los Angeles County, when using records of medical care providers, the estimate for up-to-date coverage of the 4:3:1:3 series (i.e. ≥4 diphtheria, tetanus toxoids and pertussis vaccine; ≥3 poliovirus vaccine; ≥1 measles-mumps-rubella vaccine; and ≥3 *Haemophilus influenzae* type b vaccine) increased 26% over the findings from the telephone survey (see Figure 1). Similar differences occurred in other states and counties, ranging from a low increase of 6.4% in Utah to a high increase of 41.4% in New York state excluding New York City (18). These results suggest that telephone surveys by themselves may not be sufficiently accurate for the assessment of immunization status, and possibly of other health parameters.

Besides requiring provider follow-up, the NIS also employs a complex sampling scheme that precludes simple analysis of regional or community data by local health department personnel. Thus, they become dependent on the NIS staff for determining local findings and have no personal knowledge of factors related to nonparticipation that may have biased the data. For example, in 1996, the response rate for the 1996 NIS was estimated by traditional methods to be 84.5%. Yet when taking into account homes with no telephones and other factors, the more realistic response was reported to be 69.5% (18). Are the 30.5% in areas such as Los Angeles County who did not participate different in some meaningful way from the 69.5% who did? The local health department staff has no way of knowing and, without local survey experience, no way of even estimating the extent of the bias.

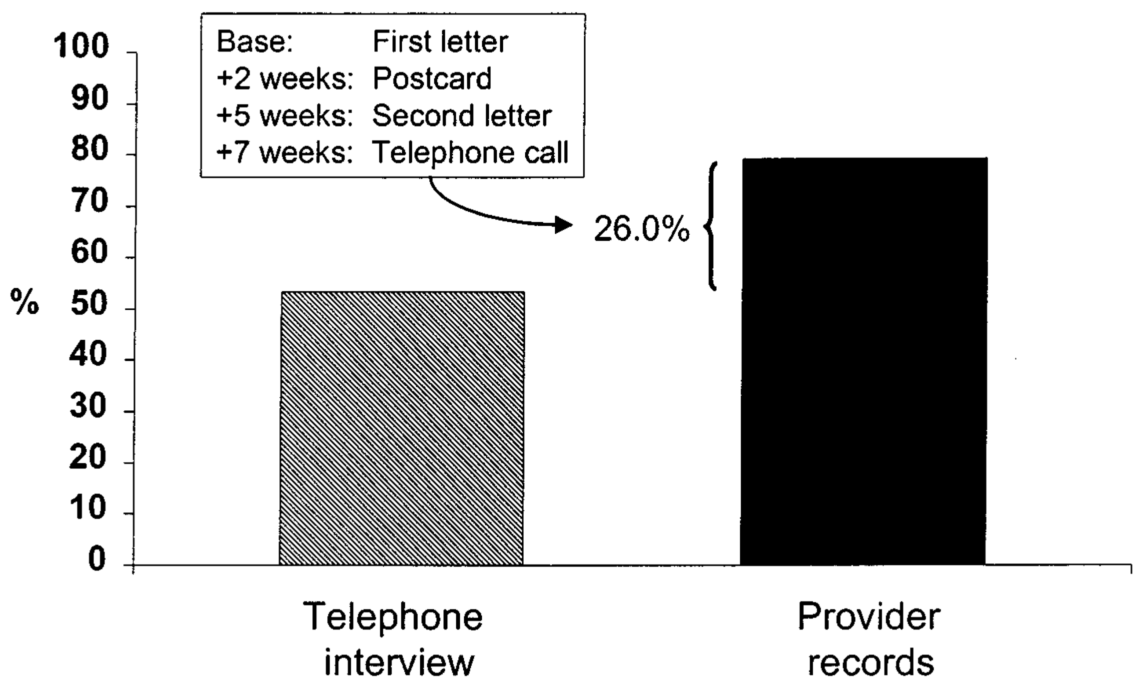

Figure 1 Difference in percentage of children in Los Angeles County up to date for 4:3:1:3 vaccination series as determined by telephone interview and follow-up of provider records after supplementary contact (National Immunization Survey, 1996) (18).

Immunization Survey in Los Angeles

Several years ago, we approached health professionals at the Immunization Program of the Los Angeles County Department of Health Services to determine their interest in doing immunization surveys in various regions of Los Angeles. We wanted to improve the survey method that has been successfully employed in developing countries while retaining the ease and timeliness that characterize such investigations. We reasoned that telephone surveys might not work well in urban neighborhoods of Los Angeles, where the population is often highly mobile, speaks languages other than English, and may not have home telephones. We intended to improve the precision of the survey method with random rather than quota sampling at the second stage. We wanted to include community volunteers in the survey process, getting them involved with the collection of information that would be used to plan or evaluate local health services. Finally, we enjoined local health department staffs to participate in the survey design and data collection process, anticipating that they would better understand potential biases in the findings.

A small pilot study of 26 children was organized and carried out during the summer of 1996, providing us with expertise on how to approach and recruit volunteers, and how best to train and supervise health department staffs and volunteers in survey work. We also developed the sampling scheme, using the 1990 United States Census computer tape for Los Angeles County and various software, and field tested different versions of data management and collection forms and their instructions.

The survey described here was done during the summer of 1997. This article presents both the method of two-stage cluster surveys as adapted to urban United States and the operational results of a small survey of vaccination coverage and related factors among children, aged 24–47 months, in three zip code areas in and around downtown Los Angeles. The immunization findings from the survey have been reported elsewhere (16).

METHODS

Sampling Scheme

Our study features a two-stage cluster survey design that uses census counts at the first stage and local enumeration at the second stage. The population to be investigated is first divided into geographic areas or clusters, based on their location of residence (Figure 2). The clusters may be composed of census tracts, block groups, or blocks. In our survey, we used groups of blocks, combined so that each cluster had at least 20 children, aged 24–47 months at the time of the 1990 Census. At the first stage, 30 clusters are sampled with PPS of the population, or in our case, children aged 24–47 months. (PPS sampling is further described in Figure 3.) At the second stage, the eligible population in the selected cluster is enumerated and a constant number of persons is randomly selected from each

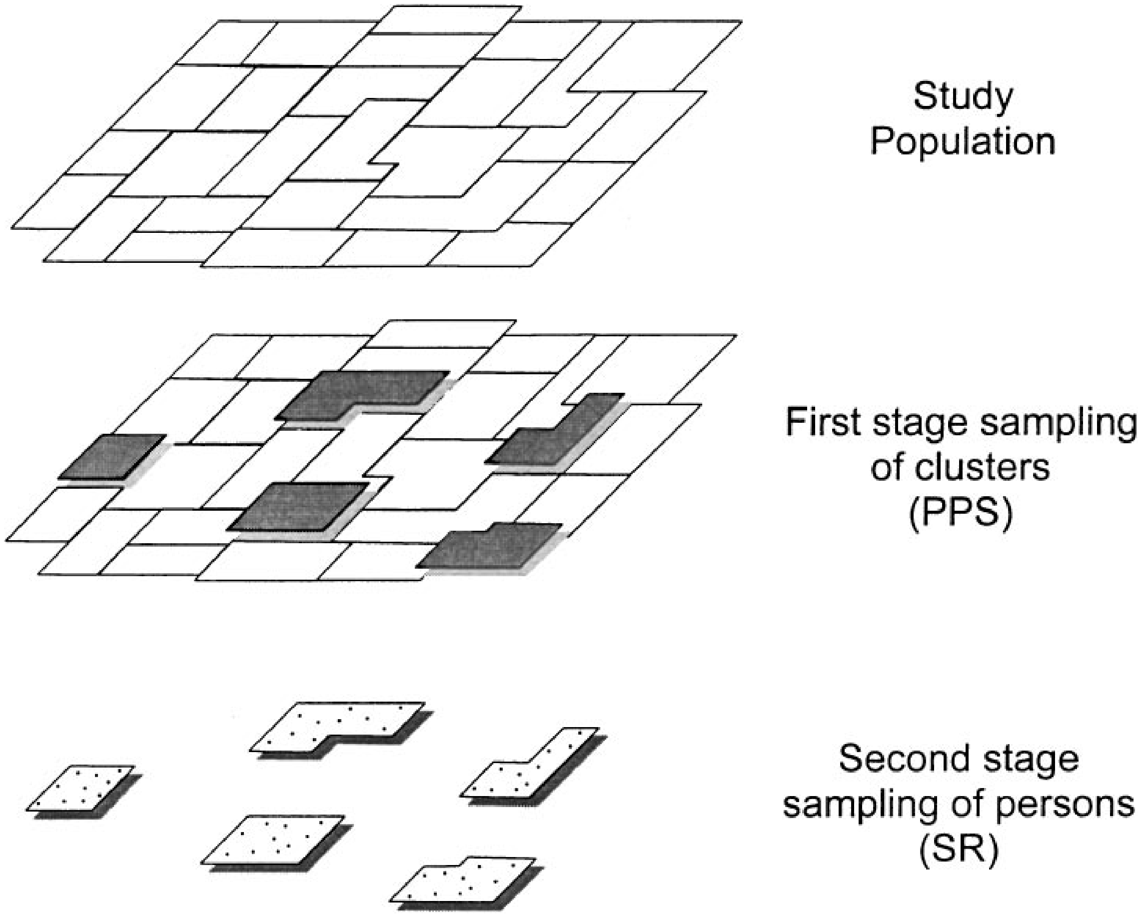

Figure 2 Sampling scheme for two-stage cluster survey.

cluster (Figure 2). In our study, we planned to randomly sample 10 children per cluster from 30 clusters, or a total of 300 children. By combining PPS sampling at the first stage with a constant number of subjects at the second stage, the sample is self-weighted, meaning that each person represents a constant number of individuals in the community. Self-weighted samples are much easier to analyze than are weighted samples (14).

The steps necessary to complete such two-stage cluster samplings are shown in Figure 3. First, the clusters in the study population are assembled in no special order (Figure 3*A*) and the eligible population in each cluster is tallied in a cumulative list (Figure 3*B*). The different clusters occupy numeric space in the cumulative list that is proportional to their eligible population (Figure 3*C*). For each of 30 clusters to be selected, a random number is generated, ranging from one to the last number in the cumulative list. A cluster is selected if the random number falls in the interval occupied by that cluster in the cumulative list. Because small clusters occupy less listed numeric space than do large clusters, the selection is with PPS (Figure 3*D*). The first stage sample of clusters is drawn with replacement by computer program, different from the slightly biased WHO method, which features

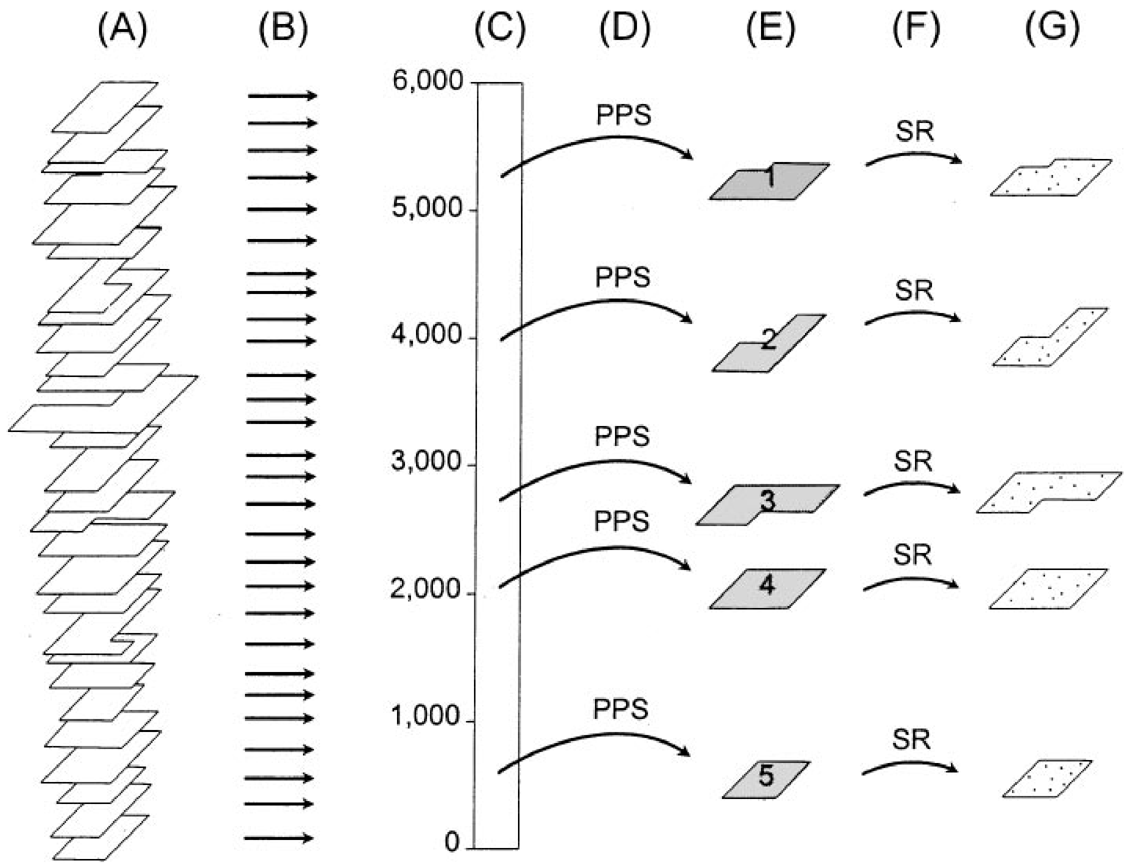

Figure 3 Steps for probability-proportionate-to-size (PPS) sampling at first stage and simple random (SR) sampling at second stage of two-stage cluster survey.

sampling at the first stage without replacement. Next, the selected clusters are arranged for the second stage of sampling (Figure 3*E*). At this point, all eligible persons in the sampled cluster are enumerated. In each cluster, a constant number of subjects is then selected from the enumerated population by simple random sample (Figure 3*F*), again different from the slightly biased WHO method, which features quota sampling of next nearest neighbors after a random start. Finally, the sampled individuals are asked to participate in the survey (Figure 3*G*).

The various tasks necessary for our style of two-stage cluster survey are presented in Tables 1 and 2, along with the category, number of personnel, and software used. The various components are further described in the following sections.

Study Population

All children aged 24–47 months living in zip codes 90007, 90011, and 90015 in the downtown area of Los Angeles were eligible to participate in the rapid survey and, thus, comprised the study population. This area was chosen by the Immunization Program because it represents a low-income community at possible high risk for inadequate immunization coverage. For the first stage of sampling, the area was

TABLE 1 Tasks, personnel, and software for first stage of rapid survey for immunizations, Los Angeles, 1997[a]

	Personnel		
Tasks	**Category**	**No.[b]**	**Software**
Identification of study population	Information contractor	—	—
Selection of study population from most recent census tapes	E/B specialist	1	US Census[c]
Creation of clusters from census block groups in study area	E/B specialist	1	Landview II[d]
PPS sample of 30 clusters from total clusters in study area	E/B specialist	1	Csurvey[e]
Creation of maps for 30 clusters	E/B specialist	1	Landview II[d] and GeoFinder
Creation of enumeration forms for 30 clusters	E/B specialist	2	WordPerfect[f]
Enumeration (2 weekends)			
Recruitment of volunteers	Study coordinator	1	—
Training of volunteers	Study coordinator/training specialist	1	—
Supervision of volunteers	Study coordinator and staff	4	—
Enumeration of selected clusters	Students, community volunteers, STD and Immunization Program staff	75	—
Enumeration (clean-up)			
Supervision of clean-up	Study coordinator	1	—
Clean-up (i.e. final) enumeration	STD and Immunization Program staff	14	—
Computer entry of enumeration data	E/B specialist and student volunteers	7	Quattro Pro[g]

[a]E/B, Epidemiological/biostatistical; PPS, probability proportionate to size; STD, sexually transmitted diseases.

[b]Part-time activity of personnel.

[c]STF1B tape, US Census, Los Angeles County, 1990.

[d]LandView II™. Mapping of selected Environmental Protection Agency–regulated sites, Tiger/Line® 1992, and 1990 Census of Population and Housing, Los Angeles, 1992.

[e]I Ariawan and RR Frerichs, Csurvey: a cluster sampling utility program for IBM-compatible microcomputers. Department of Biostatistics and Population Studies, University of Indonesia, Depok, and Department of Epidemiology, UCLA, Los Angeles, February 1997.

[f]Thomas Brothers, The Thomas Guide® for Windows™. Geofinder®, State of California on CD-ROM, Los Angeles, 1994.

[g]Corel WordPerfect® suite 8, Corel Corporation, Ltd., 1997.

TABLE 2 Tasks, personnel, and software for second stage and analysis of rapid survey for immunizations, Los Angeles, 1997[a]

Tasks	Personnel		Software
	Category	No.[b]	
Second stage			
Creation of interview schedules and management forms for each cluster and for the final study disposition	E/B specialist	2	WordPerfect[c]
SR sample per cluster of original set of 10 children and supplemental set of 5 children	E/B specialist	1	Quattro Prob[c]
Interview (2 weekends)			
Training of staff and volunteers	Study coordinator/ training specialist	1	—
Supervision of staff and volunteers	Study coordinator and staff	4	—
Interview of parents of selected children	STD and Immunization Program Staff, students, and community volunteers	52	—
Interview (clean-up)			
Supervision of clean-up	Study coordinator	1	—
Clean-up (i.e. final) interview	Immunization Program staff	14	—
Clinic/provider contact (clean-up)			
Supervision of clean-up	Study coordinator	1	—
Clean-up (i.e. final) clinic/provider contact	Immunization Program staff	4	—
Computer entry and data management of interview data	E/B specialist	1	EpiInfo[d]
Issuance of certificate of appreciation to volunteers, students, and staff	E/B specialist	1	WordPerfect[c]
Analysis stage			
Frequencies and bivariate relationships	E/B specialist	2	EpiInfo[d]
Confidence intervals with variance that accounts for cluster survey	E/B specialist	2	Csample module in EpiInfo[d]
Multivariate relationships, including confidence intervals	E/B specialist	2	Survey module in Stata[e]
Preparation of final report	E/B specialist	2	WordPerfect[c]
Preparation of slides for presentations	E/B specialist	2	Harvard Graphics[f]

[a]E/B, Epidemiological/biostatistical; STD, sexually transmitted diseases.

[b]Part-time activity of personnel.

[c]Corel WordPerfect® suite 8, Corel Corporation, Ltd., 1997.

[d]AG Dean, JA Dean, D Coulombier, et al, EpiInfo: a word processing, database, and statistics program for epidemiology on microcomputers. Centers for Disease Control and Prevention, Atlanta, Georgia.

[e]Stata Statistical Software: Release 5.0, StataCorp, College Station, Texas, 1997.

[f]Harvard Graphics 4.0 for Windows 95, SPC Software Publishing Corp., Santa Clara, California, 1996.

divided into 236 clusters (groups of blocks), each with at least 20 eligible children identified 7 years earlier during the US Census. Data by census tract are included in the STF1B tape of the US Census Bureau maintained at UCLA. We used the *Landview II* mapping program to determine the spatial relationship between blocks listed in the census file to create the super blocks or clusters. We assumed that although the actual children would change, the proportion of children in each area would remain similar over the years. Using *Csurvey*, a computer program designed jointly at the University of Indonesia and UCLA that incorporates analytic procedure developed at UCLA (9), we sampled 30 of the 236 clusters with PPS of the eligible children's population. The *Csurvey* program is available for downloading in the software section of the UCLA Department of Epidemiology internet site (www.ph.ucla.edu/epi/software.html).

Our intent was to have the field personnel count all eligible children aged 24–47 months in the 30 clusters sampled at the first stage, and then at the second stage to randomly sample 10 children per cluster for interview and review of home immunization cards or records maintained by a medical provider. The 30 selected clusters contained one or more city blocks. Each block has four sides or segments. Thus, for enumeration, the clusters were divided into a series of four or more segments. A map was created for each cluster showing the blocks and segments, using both the *Landview II* and the *GeoFinder* mapping programs.

Training

The project was divided into two phases, enumeration and interview, and training was necessary for both. The intent of the enumeration phase, done at the first stage and shown in Table 1, was to determine during two weekends how many eligible children lived in each cluster. The objective of the interview phase was to sample and interview during two different weekends 10 eligible children per cluster (see Table 2 for tasks). To gain trust and promote community and student involvement, we recruited several groups to participate in the enumeration phase. The goals were to collect data in a timely manner and keep costs at a minimum, without compromising the validity of the findings. Seventy-five volunteers were recruited. Some of the time provided by the workers from the Los Angeles County Sexually Transmitted Diseases (STD) Program was funded as overtime by the CDC. Several 2-h training sessions were held to review the protocol, standardize the method, and answer field-related questions. The training sessions included a full description of the project and its methodology. Examples were given as to how to complete the necessary forms for enumeration. Based on the previous experience from the pilot study and other surveys, possible problems the field workers might encounter were discussed in details. For the interview portion (see Table 2), a detailed explanation was given to insure that the forms were completed accurately and in a timely manner. Most of the UCLA students and many of the Immunization Program staff had taken the rapid survey course at UCLA, whereas the federal employees had done many interviews as part of their STD work. By using the UCLA students, the Immunization Program staff, and the federal employees, we were able to insure that there was a highly trained and experienced group that could assist the others.

Because of time constraints, all other personnel and volunteers who worked on the project were minimally trained. Many were bilingual in Spanish and English and were responsible for translating the information requests to the parents. Yet, the availability of these workers was highly variable, with much turnover from one day to the next. Thus much of their training occurred on the morning or early afternoon of the enumeration and interview session.

Enumeration

Households in each segment were visited on Saturday and Sunday of the second and fourth weekends in July 1997 by community volunteers, Immunization Program staff, and UCLA students (see Table 1). People living in the various residences were asked about the presence of children 24–47 months of age. This information was recorded on a management form. As part of their enumeration efforts, the field workers were instructed to contact the manager of apartment buildings to ask about occupants and to look for signs of occupancy, such as water or electrical use, or of children, such as toys or children's clothing. In case no one was home or no information was available about the household, the enumerators were instructed to revisit the household at least one more time before reporting it as missing or having no information. Three of the 30 initial clusters had to be replaced because of a shortage of enumerated children. In one such cluster, all residential apartments had been converted since the time of the US Census in 1990 to commercial garment factories, whereas in another cluster a large housing project was recently closed for renovation. Residences with no one home were tallied at the end of the day for revisit and were reassigned either for the next day or for clean-up later in the week by the Immunization Program staff.

Interview

We entered the data gathered by the enumerators into a computer spreadsheet program and randomly sampled 15–20 children from each cluster, 10 of whom were included in an original list, with the remaining 5–10 placed in a supplementary list. Because of small numbers of children, some clusters had fewer than five in the supplementary list. When contacted by the interviewers, some of the sampled children were found to be ineligible because they were over- or underage. To address this problem, we expanded the supplementary list to 10 children. This problem was minimized later in the survey, however, by having the enumerators list exact birth dates. The interviews were conducted on Saturday and Sunday of the third weekend in July and first weekend in August, alternating with the enumeration weekends. Approximately 52 volunteers, students, and Immunization Program and STD Program staff participated in this process (see Table 2). The interviewers were instructed to visit each eligible household at least two times, and a third time if warranted.

A signed consent form was obtained from parents before conducting the interview or abstracting the information from the immunization card. The data collection form included demographic questions about the child's age, sex, and race. It also had questions on (*a*) the mother's perception about the immunization status of the child, (*b*) barriers to immunization, (*c*) the immunization provider, (*d*) participation in the Women, Infant, and Child program, and (*e*) insurance coverage. The vaccine doses and time of immunization were determined via the in-house immunization card. If the immunization card was not available at the time of the interview, immunization information was obtained through a follow-up telephone call or revisit. In cases where the immunization information could not be obtained from the card by the previous methods, we contacted the health care provider who supplied the immunization. The latter information was formally requested by the Immunization Program staff and was obtained either by facsimile, mail, or clinic visit.

Certificate

Persons who volunteered to assist with the study were given a personal certificate that acknowledged their efforts (see Table 2). Also letters of appreciation were sent to each of the organizations who supplied volunteers. We reasoned that with such gestures, more people would remain willing to participate in future surveys.

Data Management

After the survey forms and the immunization record abstractions were returned from the field, the data were manually checked for missing information or inconsistencies. Then the information was coded and entered into the computer. The data were edited and cleaned with a process that checked for missing information and tested for logic errors. Programs for data entry, checking, and analysis had been developed at the UCLA Department of Epidemiology using the *EpiInfo* statistical and data management program (see Table 2). From the individual variables, an expanded set of variables was derived to satisfy the objective of the study. An example of such variables was age at immunization, which was calculated for each child and for each vaccine dose. The age of the child was calculated from the date of enumeration (i.e. the first time the household was contacted) and the date of birth of the child. We used the date of enumeration rather than the date of the interview to avoid any bias that might have come from parents having their children immunized as a result of the enumeration visit. In cases of missing data, or unclean or incompatible information, the survey schedule was returned to the field staff to again contact the household for the proper information. After being cleaned and edited, the forms and schedules were filed at UCLA in a confidential location.

Data Analysis

Data were analyzed using the *Csample* module of the *EpiInfo* program and the *Survey* module of the *Stata* statistical program (see Table 2). As it is a self-weighted cluster survey, point estimates for variables are the same no matter what statistical package is used. Variance estimates, however, tend to be larger with cluster surveys than with data gathered by simple random samples. Because conventional statistical programs assume variables are independently distributed, such programs underestimate the variability of clustered data. The *Csample* module in *EpiInfo* and the *Survey* modules in *Stata* are intended for cluster surveys and, thus, derive unbiased variance estimates and 95% confidence intervals.

The Recommended Childhood Immunization Schedule published by the CDC was used for analyzing the immunization coverage levels (5). We calculated immunization coverage as the percentage of sampled children who received the specified vaccine dose, deriving both the percentage coverage (or point estimate) and the 95% confidence limits.

Logistic regression in the *Stata* program was used to calculate odds ratios and 95% confidence limits for odds ratios, to assess relationships between immunization status (as an outcome variable) and factors expected to be associated with the outcome. The odds ratio is an estimation of the ratio of the odds of an outcome in a group compared with the same outcome for a reference group. Finally, we derived odds ratios and 95% confidence limits adjusted for possible factors that could distort the relationship between the selected exposure factors and the outcome.

RESULTS

The three zip code areas in and around downtown Los Angeles were divided into 236 clusters, from which 30 clusters were sampled (see Table 3). After starting the enumeration, three of the 30 clusters had to be replaced for reasons presented in Table 3. In the 30 clusters that were eventually sampled, there were 276 segments (or sides of blocks) with a total of 5300 visited households containing 718 children, aged 24–47 months. Thus, an average of 7.4 households needed to be visited by the enumeration teams in order to find one eligible child. The 718 eligible children represented the enumerated sampling frame in the 30 clusters.

At the second stage, each interviewing team went into the field with a target list of 10 children, and a supplemental list of about five children, all selected by simple random sample from the enumerated children in the cluster. Selected randomly for interview and immunization record extraction were 428 eligible children. Among these eligible children, 332 children were at home at the time of the interview (77.6%). When asked to participate, the parents or guardians of 270 (81.3%) of the 332 at-home eligible children agreed to do so. Although we intended to select 10 children per cluster, this was not to be. Instead, for the 270 sampled children, one cluster provided 11 children, 14 had 10 children, five had nine children, four

TABLE 3 Enumerated and sampled units, and study participation, rapid survey for immunizations, Los Angeles, 1997[a]

Determinant	No.	Unit
First stage		
Total clusters[b] created in the 90007, 90011, and 90015 zipcode areas of downtown Los Angeles	236	Clusters
PPS sample of total clusters	30	Clusters
Replacement of underpopulated clusters[c]	3	Clusters
Enumeration of all children, aged 24–47 months in clusters		
Sides of blocks (i.e. assigned segments)	276	Segments
Total housing units visited	5300	Households
Total children, aged 24–47 months, in the housing units	718	Children
Second stage		
SR sample derived from original and supplemental lists[d]	428	Children
Parent or adult guardian is at home one or more weeks after enumeration and willing to be interviewed	332	Children
Parent or adult guardian signs consent form and completes the interview	270	Children
Participation		
(Interviewed children/total sampled children) $\times$ 100	63.1	Percent
(Interviewed children/total at home children) $\times$ 100	81.3	Percent

[a]PPS, probability-proportionate-to-size; SR, simple random sampling.

[b]Each cluster has at least 20 children, aged 24–47 months, based on the 1990 Census.

[c]Apartments were converted to garment factories; large housing project was evacuated and being renovated; a large apartment complex was created that houses primarily adults.

[d]Original list had 10 children and supplementary list was planned to have 5 children but actually had 3–10 children (some clusters had too few children in residence and others needed more replacements because of incorrect tallies of age at enumeration).

had eight children, and six had seven children. When we used the same method of assessing participation as is used by random digit dialing telephone surveys, such as the NIS, the participation for our study was 270 of 322 at-home children, or 81.3%. When we used the method of conventional household interview surveys (but slightly different, in that enumeration was done 1 or more weeks earlier and some of the eligible population may have changed residence), the participation was 270 of 428 children, or 63.1% (see Table 3).

Characteristics

Nearly 92% of the children were Hispanic (i.e. 247 of 270), and most of their parents chose to speak Spanish with the interviewers, often requiring translation by accompanying volunteers. About one fourth (24.8%) of the households did not have a home telephone number and, thus, would have been underrepresented in a random digit-dialing telephone survey.

Immunization Card

In 219 (81.1%) of the sampled households, immunization information was obtained directly from the home immunization card during the time of the interview. Information about the child's immunization history was obtained from 19 parents (7.0%) over the telephone or by revisit after the interview was completed. These parents did not have the card available at the time of interview but located it later. Finally, clinics were contacted to get the immunization records of 27 surveyed children (10.0%) for whom parents did not have the immunization card at home during or after the interview when again contacted by telephone. In about 2% of the sample (i.e. five children), there was no information about the child's immunization history, that is, there was no available home immunization card or clinic record. Other findings of the survey are presented elsewhere (16).

Design Effect

The variance of two-stage cluster surveys, as promoted by WHO, is often twice that of simple random samples of the same number of subjects, resulting in large confidence intervals. The main reason for the increased variance is that persons at the second stage are not sampled independently but rather are selected as a group following a random start. Because we sampled children randomly at the second stage, we would expect a greater precision (i.e. small variance) for our approach than for most cluster surveys, as in fact occurred. As presented in Table 4, the

TABLE 4 Design effect for selected variables, rapid survey for immunizations, Los Angeles, 1997 ($n = 270$)

Variable (response)	No.	%	Design effect[a]
Age (2 years)	159	58.9	1.19
Gender (male)	134	49.6	0.59
Telephone at home (yes)	203	75.2	2.06
Family has health insurance coverage (yes)	178	65.9	1.46
Immunization card at home (yes)	219	81.1	1.09
First dose of DTP/DTaP/DT vaccine (yes)	260	96.3	1.15
Second dose of DTP/DTaP/DT vaccine (yes)	254	94.1	0.93
Third dose of DTP/DTaP/DT vaccine (yes)	248	91.9	1.22
Fourth dose of DTP/DTaP/DT vaccine (yes)	226	83.7	0.83
Measles, mumps, and rubella vaccine (yes)	244	86.3	0.89

[a]Variance of cluster survey divided by variance if analyzed as simple random sample.

design effect that compares the variance of our cluster survey to that of a simple random sample of the same sized sample is near 1.0 for most variables. Thus, confidence intervals in our style of urban survey have nearly the same limits as more desirable, but much more expensive, one-stage surveys based on simple random sampling.

DISCUSSION

Population-based surveys have become common in the United States. They provide current information on the health practices and beliefs of the nation, as well as opinions on a wide variety of topics, including the popularity of sports figures or political candidates. Yet although timely, such surveys are only occasionally conducted by local health departments (8, 12). Our objective was to determine whether such a survey could be done by the Immunization Program of the Los Angeles County Department of Health Services for vaccination coverage, using community volunteers, staffs, and university students to do the field work. Volunteers were especially important for the labor-intensive enumeration phase. We reasoned that if there was an interesting problem and effective recruitment, volunteers would come forward and give of their time for a survey, especially if done on weekends. The results presented here and in the publication of results (16) show that such a survey is possible and that volunteers can effectively be used in surveys of immunization status.

Because the survey needed the assistance of many people, we relied on several community organizations to recruit volunteers and arrange for them to be at the survey sites during the enumeration and interview weekends. Although not paid, the volunteers required special attention. We recognized that volunteers must be guided rather than ordered and encouraged rather than criticized, and we managed the study accordingly. Perhaps most important to our success was having an amiable staff at the Immunization Program who reacted well when things went wrong during the day-to-day operations of the survey. We ended the field work with a celebration of effort and gave certificates to each of the volunteers, staffs, and students, showing our appreciation for their time and effort. This should help stimulate similar support in future surveys. We also presented slide shows of the findings to the Immunization Program staff, and to students and faculty at UCLA.

Rapid surveys such as ours have many uses beyond immunization, and they should be viewed as an important tool for gathering information on a wide range of common attributes. For immunization coverage, other methods exist or are being planned that have advantages of their own. One is retrospective assessments of immunization levels, using current records of children newly enrolled in school (17). Records are reviewed for vaccine coverage 4 years earlier, when the children were 24 months of age. Such retrospective assessment provides useful information in communities with constant immunization policies and practices, and with low in- or out-migration, conditions that unfortunately do not exist in Los Angeles.

A second method for determining vaccination coverage—an immunization registry—is not yet in practice but holds great promise. Information is collected from health care providers on all children in the community in an internet-based information system (7). Participation in such registries has become an important goal of the US Healthy People 2010 national objectives, intending to increase to 95% the proportion of children younger than 6 years old who are enrolled in a population-based immunization registry (7). In the meantime, local surveys of immunization coverage are still a useful option.

Where small-community–based surveys could have the greatest impact is in community development efforts that reach out to volunteers as part of the process. For those planning to adopt our approach, however, more work needs to be done in such surveys on creating simplified forms and user-friendly training programs that do not require too much time of volunteers. We also suggest developing audio recordings for use by tape or compact disc (CD) players so that interviews can be done in languages other than English or Spanish. This is especially important for cities with large immigrant populations similar to Los Angeles. Small hand-held computers are becoming more common and should be incorporated to increase the speed of data collection and to reduce coding errors (3). Finally, we encourage public agencies to conduct such rapid face-to-face interview surveys, recognizing that the effort, especially if volunteers are included, creates a sense of community responsibility and satisfaction, in addition to obtaining knowledge of population-based health practices, opinions, and understanding.

ACKNOWLEDGMENTS

Many people assisted this project and their efforts are greatly appreciated. Notable for their leadership and helpful assistance were Cheri Todoroff, Dr. Luis Montes, Karrar Ali, Kristin Brusuelas, Nicole Alexopoulos, Jeanette Rainey, and Loren Lieb of the Immunization Program, and Dr. Marc Strassburg, all of the Los Angeles County Department of Health Services. Offering time, energy, and expertise were staff from the Immunization Program and STD Program of the Los Angeles County Department of Health Services; volunteers from the Esparanza Community Housing Corporation, Hope for Kids, and VISTA; and students from the UCLA School of Public Health. To all we extend our warm thanks.

LITERATURE CITED

1. Bennett S, Radalowicz A, Vella V, Tomkins A. 1994. A computer simulation of household sampling schemes for health surveys in developing countries. *Int. J. Epidemiol.* 23:1282–91
2. Bennett S, Woods T, Liyanage WM, Smith DL. 1991. A simplified general method for cluster-sample surveys of health in developing countries. *World Health Stat. Q.* 44(3):98–106

3. Bride JS, Anderson RT, Bahnson JL. 1999. Using a hand-held computer to collect data in an orthopedic outpatient clinic: a randomized trial of two survey methods. *Med. Care* 37(7):647–51
4. Brogan D, Flagg EW, Deming M, Waldman R. 1994. Increasing the accuracy of the Expanded Programme on Immunization's cluster survey design. *Ann. Epidemiol.* 4:302–11
5. Cent. Dis. Control. 1997. Recommended childhood immunization schedule—United States, 1997. *Morbid. Mortal. Wkly. Rep.* 46:35–40
6. Cent. Dis. Control. 1999. National vaccination coverage levels among children aged 19–35 months—United States, 1998. *Morbid. Mortal. Wkly. Rep.* 48(37):829–30
7. Cent. Dis. Control. 2000. Progress in development of immunization registries—United States, 1999. *Morbid. Mortal. Wkly. Rep.* 49(13):274–78
8. Ewert DP, Thomas JC, Chun LY, Enguidanos RC, Waterman SH. 1991. Measles vaccination coverage among Latino children aged 12 to 59 months in Los Angeles County: a household survey. *Am. J. Public Health* 81:1057–59
9. Frerichs RR. 1989. Simple analytic procedures for rapid microcomputer-assisted cluster surveys in developing countries. *Public Health Rep.* 104(1):24–35
10. Frerichs RR, Tar KT. 1989. Computer-assisted rapid surveys in developing countries. *Public Health Rep.* 104(1):14–23
11. Goodman K, Wu JS, Frerichs RR. 2000. Compliance with childhood immunizations in Kern County, California. *J. Immigr. Health.* 2(4):213–22
12. Kenyon TA, Matuck MA, Stroh G. 1998. Persistent low immunization coverage among inner-city preschool children despite access to free vaccine. *Pediatrics* 101:612–16
13. Lemeshow S, Robinson D. 1985. Surveys to measure programme coverage and impact: a review of the methodology used by the expanded programme on immunization. *World Health Stat. Q.* 38(1):65–75
14. Levy PS, Lemeshow S. 1999. *Sampling of Populations: Methods and Applications*. New York: Wiley
15. MacIntyre K. 1999. Rapid assessment and sample surveys: trade-offs in precision and cost. *Health Policy Plan.* 14(4):363–73
16. Shaheen M, Frerichs RR, Alexopoulos N, Rainey JJ. 2000. Immunization coverage among predominantly Hispanic children, aged 2–3 years, in Central Los Angeles. *Ann. Epidemiol.* 10(3):160–68
17. Zell ER, Dietz V, Stevenson J, Cochi S, Bruce RH. 1994. Low vaccination levels of US preschool and school-age children. Retrospective assessments of vaccination coverage, 1991–1992. *JAMA* 271:833–29
18. Zell ER, Ezzati-Rice TM, Battaglia MP, Wright RA. 2000. National immunization survey: the methodology of a vaccination surveillance system. *Public Health Rep.* 115(1):65–77