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Response Rates to Random Digit Dialing for Recruiting Participants to an Onsite Health Study

SYNOPSIS

Objective. To evaluate the response rates when random digit dialing was used as a substitute for geographic area sampling and household interviews to recruit 2100 African Americans for a blood pressure measurement and hypertension-related knowledge and attitudes survey.

Methods. Random digit dialing was used to identify African American adults living in 12 low-income ZIP code areas of Houston, Texas. A brief survey of hypertension awareness and treatment was administered to all respondents. Those who self-identified as African American were invited to a community location for blood pressure measurement and an extended personal interview. An incentive of \$10 was offered for the completed clinic visit. A substudy of nonrespondents was carried out to test the effectiveness of a \$25 incentive in increasing the response rate. Data from the initial random telephone interview were used to identify differences between those who did and did not attend the measurement session.

Results. Ninety-four percent of eligible persons contacted completed the telephone survey, and 65% agreed to visit a central community site for blood pressure measurement. In spite of the financial incentive and multiple attempts to reschedule missed appointments, only 26% of the 65% who agreed to attend completed the scheduled visit. In the substudy of the higher financial incentive, all of those who missed the original appointment agreed to another appointment, and 85% of this subgroup kept it. Not being employed full-time and a history of hypertension were consistently associated with agreement to be measured and keeping an appointment. In spite of the low response rate for scheduled appointments, differences—other than in employment status and a history of hypertension—between responders and nonresponders were small and consistent with what is usually observed in health surveys.

Conclusions. The use of random digit dialing as a substitute for area sampling and household screening resulted in unacceptably low response rates in the study population and should not be undertaken without further research on ways to increase response rates.

Choosing an optimal design for local population health surveys involves balancing cost, data quality, potential nonresponse bias, and time considerations. Measuring physical parameters such as height, weight, blood pressure, and blood chemistries adds logistical concerns, and surveys designed to measure health characteristics

of hard-to-reach populations, such as low-income minority groups, present special problems with regard to representative sampling and response rates.¹

The two major design decisions in health surveys are sampling strategy and data collection. When complete listings of the target population are unavailable, the most common probability sampling strategy is the multi-stage cluster design, such as that used in the National Health and Nutrition Examination Survey.² A data collection method frequently used with this sampling approach is the in-home personal interview. If physical measurements are required, these are done onsite or at a common clinic location.

An increasingly popular sampling and data collection strategy is the random digit dialing (RDD) telephone survey. RDD, using either unrestricted random dialing of the final four digits in selected prefix areas or other efficient dialing methods produces self-weighting probability samples of households with telephones.^{1,2} Thus, it is possible to avoid the large design effects that characterize multi-stage cluster designs. Random digit telephone surveys can be carried out at 50 to 75% less cost than household interviews.¹ They have been found to be feasible and reliable in minority populations,^{6,7} and data quality appears to be comparable to that obtained in face-to-face interviews.^{8,9} The major disadvantages of random digit phone surveys are the possible biases in sample estimates because of lack of telephone coverage in certain population segments and the limitation of data collection to self-reported health information.^{2,4}

Random digit telephone surveys have been used to monitor national trends in health behaviors¹⁰ and to select population controls for case-control studies.^{11,12} Although people with telephones tend to be younger and better educated than those without, the difference between estimates obtained using phone surveys and the household interview approach has generally been found to be small.⁵

Because of the low cost of telephone surveys compared with household interviewing, using RDD to sample households for participation in health surveys involving personal interviews or examinations may be a reasonable alternative to the multi-stage area sampling design if response rates are satisfactory. As long as the exclusion of persons without telephones is insignificantly small or is methodologically justified, using RDD to select and screen is particularly attractive when survey costs or the personal safety of household interviewers are major concerns. In addition, in certain hard-to-reach population groups, such as urban minorities, people may be more accessible by telephone than in door-to-door canvassing.

In the fall of 1993, we undertook a survey to determine the prevalence of undetected and uncontrolled hypertension and related knowledge, attitudes, and behaviors among African Americans residing in 12 ZIP code areas of Houston, Texas. The purpose of the survey was to collect baseline information prior to implementation of a two-year hypertension control intervention in 8 of the 12 surveyed ZIP code areas. The 12 ZIP code areas were in the inner city and had a popu-

lation that was predominantly African American and of low socioeconomic status. Census data from 1990 indicated that 89% of the households in the survey area had telephones.

Statistical power requirements for detecting an improvement in blood pressure control called for blood pressure measurements to be completed on approximately 2100 people. Because of the high cost of screening households for so many participants, the large geographic area covered by the selected ZIP codes, safety concerns for survey personnel, and limited time, we chose RDD as an appropriate sample selection methodology to screen and recruit participants for blood pressure measurement and personal interviews at a clinic location in the target ZIP codes.

We report on the response rates obtained using this two-stage survey approach in an urban African American population. We also report the effect of increasing incentives for participation on response rates in people who did not keep their initial scheduled appointments.

Methods

Random digit telephone survey to identify and recruit eligible respondents. The RDD phone survey was carried out by a local commercial survey research firm, using unrestricted dialing of random digits without substitution in telephone exchanges falling within the 12 target ZIP codes. When a residential number was reached, the person in the household age 18 or older with the birthday nearest to the date of the telephone call was the eligible respondent. Interviewers from the survey research firm called back as many times as necessary to reach eligible respondents until an overall minimum response rate of 70% was attained. The average number of callbacks required to achieve this rate was four.

After obtaining consent, the interviewers administered a brief health survey. Items on self-reported hypertension and current hypertension medication usage were drawn from the Behavioral Risk Factor questionnaire developed by the Centers for Disease Control and Prevention. Respondents were also asked about current health insurance coverage, availability of primary care, time since last blood pressure check, employment status, education, and ethnicity.

Clinic blood pressure measurement and questionnaire. At the end of the telephone survey, all respondents who identified themselves as black or African American were asked to participate in a community blood pressure screening study. They were given a choice of several dates, times, and clinic locations, and offered \$10 compensation for a completed visit. Clinics were located within the survey neighborhoods. Those who agreed to clinic appointments received confirmation letters signed by the project director. The project sponsors were clearly identified as a local traditionally African American university, the public health care system that serves a substantial proportion of the target population, and the medical school whose faculty and residents staff the public hospital system.

The clinic blood pressure measurement and an extended hypertension-related knowledge, beliefs, and health behaviors interview were conducted by research technicians trained and supervised by the study investigators. The majority of the research technicians were African American health professions students familiar with the communities surveyed.

As it became apparent that the rate at which appointments were kept was lower than expected, research technicians telephoned people to remind them of their appointments. Those missing appointments were called one or more times to reschedule. The maximum number of attempts to reschedule an appointment was not fixed and varied with the scheduler's ability to contact the person during a particular rescheduling session and the person's responses to the attempts to reschedule. Reminder letters and phone calls appealed to the respondents' social responsibility to provide important health data for the benefit of their community.

Substudy of increased incentives for participation of those who missed an initial clinic appointment. To assess the differences between those who did and did not keep the clinic appointment scheduled during the phone survey and to determine what level of incentives and research staff effort was needed to obtain at least an 80% appointment rate in this population, a random sample was drawn of 324 of the 1573 people who agreed to an appointment in the RDD phone survey but did not keep it. The sample size was chosen to determine with 95% confidence if the prevalence of undetected hypertension was greater among nonrespondents than respondents. Four to six months elapsed between the initial RDD interview and the substudy.

People in the substudy sample received a letter stating that their participation was extremely important and that they would be compensated \$25 for a kept appointment. The letter was followed up one week later by a phone call to make a specific clinic appointment. Again, the letter and phone calls appealed to the person's community responsibility. In addition, the letter offered free transportation or a home visit to complete the survey, if needed. The clinic locations and hours offered to participants were the same as in the initial contact.

Analysis of response rates. In a two-stage survey, the overall response rate depends both on the initial agreement to be measured and on the completion of the measurement process. We used information obtained during the telephone interview, before people were invited to attend a clinic blood pressure measurement, to predict both the overall response rates (number of people measured divided by the number of those in the sample) and kept-appointment rates (number of people completing the measurement process divided by the number of those who agreed to be measured) in each phase of the survey. The variables available from the telephone survey were: age (in years), sex, total number of people living in the household, employment status (dichotomized as full-time employee versus non-full-time employee), educational level, availability of

primary care and of some form of health insurance (either public or private), number of years since blood pressure was last checked, and whether the person had ever been told that he or she had hypertension. A question regarding income level was not included, because it was felt that the answers might be unreliable or result in refusals to continue the survey. The last question on the phone survey asked respondents to classify themselves in one of the racial-ethnic categories recognized by the U.S. census.

Inasmuch as the characteristics of the respondents who refused to participate in the phone survey were not known, and only self-identified African Americans were invited to attend the clinic measurement phase, the analyses of variables associated with response rates include only those people who completed the phone survey and identified themselves as African Americans.

The sex and age distributions of respondents were monitored continuously during the phone survey. It became apparent that designating the adult in the household with the most recent birthday as the eligible respondent was resulting in a substantial under-representation of African American males and younger people in general compared with 1990 census data (33% in the phone survey compared with an expected 45% based on census estimates). After 70% of the recruitment goal had been reached, the investigators used a quota approach to fill under-represented age and sex categories to increase the precision of estimates of blood pressure levels in young males. However, the brief telephone survey was not administered to people recruited by the quota method, and therefore they were not included in this analysis of predictors of response.

An analysis of the patterns of item nonresponse in the phone survey indicated that the only variable with a significant number of missing values was age, with women twice as likely as men to refuse to report their age. Because of the importance of this variable in predicting health states and individual behavior, the gender-specific means of people completing the phone survey were used to impute the 212 missing age values.

Differences between respondents at each stage of the survey and the population they were intended to represent were compared using means or proportions and 95% confidence intervals. The extent to which significant differences in respondent versus nonrespondent characteristics remained after adjustment for other variables was examined using logistic regression analysis.¹³

All analyses were performed on a microcomputer using SPSSPC^R and Stata^R. The conventional probability level of 0.05 for a Type I error was used to decide if an odds ratio was significantly different from 1.

Results

Response and kept-appointment rates. A total of 18,158 random digit telephone numbers were dialed, of which 12,838 were excluded from the sample because they were businesses, disconnected, or residential numbers outside of the 12 target

ZIP code areas. Of the 5320 remaining numbers, 1234 (23%) did not result in an attempted interview because the phone was never answered after multiple call-back attempts. Using the 5320 non-deleted numbers as the denominator, the phone survey response rate was 71% (Table 1). However, only 6% of interviews in which a household member answered the phone resulted in refusals to participate. Eight-seven percent of respondents ($n=3273$) self-identified themselves as African Americans and were invited to participate in the blood pressure measurement portion of the survey.

Figure 1 presents the overall response rates initially obtained in the clinical examination portion of the survey and in the substudy of a random sample of people recontacted. Agreement to a clinic blood pressure measurement was 65%—slightly less than the 70% hypothesized when the survey was planned. However, only 17% of the 3273 African Americans who were respondents in the phone survey attended the clinic for a blood pressure measurement.

In the substudy of people who failed to keep the clinic appointment during the RDD phase, the overall response rate remained low, due primarily to the investigators' inability to recontact people who had been interviewed in the RDD. Of the 324 people randomly sampled in the substudy, 38% could not be recontacted—22% because they no longer lived in the household or the phone number was never answered, and 16% because they did not come to the phone or return messages. People who could not be recontacted were more likely to be young (mean age 36.3 years versus 43.2 years for those who could be recontacted) and employed (71% employed versus 53% unemployed).

In Figure 2, the initial kept-appointment rate and the substudy kept-appointment rate are presented. The agreement rate of 74% for a clinic visit and 85% for a kept

Table 1. Response rates in random digit dialing telephone survey, Houston, TX, 1993

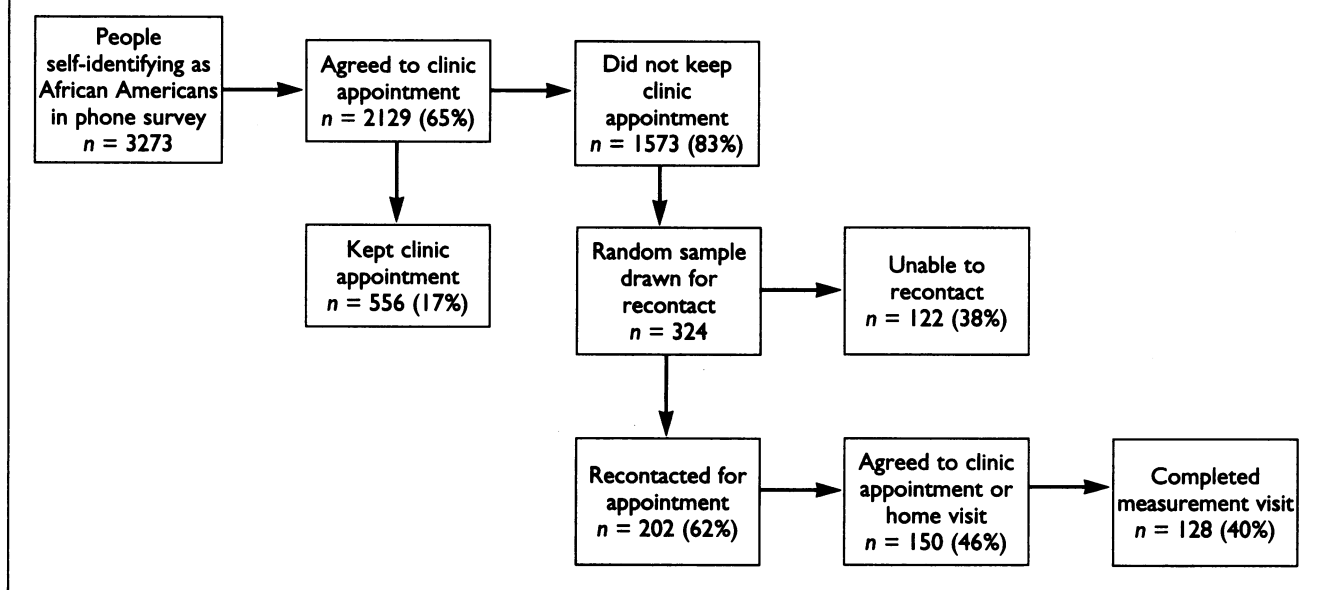
Variables	Number	Percent
Total random digits dialed	18,158	—
Nonworking numbers, businesses, or outside of target ZIP code areas	12,838	71
Remaining sample	5,320	29
Unable to make contact with household member (no answer, busy, answering machine)	1,234	23
Refusals	319	6
Completed interviews	3,762	71
Those who self-identified as African Americans	3,273	87

appointment in the substudy is substantially higher than the corresponding rates of 65% and 26% for the initial clinic examination. Eleven percent of the visits in the substudy were completed in the person's home.

Variables associated with response and kept appointment rates. Table 2 contains means and 95% confidence intervals of the variables collected during the RDD for the total telephone survey sample, the RDD respondents who agreed to attend the community site for a blood pressure measurement, those who kept the appointment made during the RDD, and the people who kept an appointment in the substudy when a higher incentive was offered. The means of the binary variables are expressed as percents.

The means and confidence intervals indicate that differences between the total phone survey sample and the three subsets defined by response status are generally small, except

Figure 1. Overall response rates for initial clinic examination and substudy samples



for age, employment status, and history of hypertension.

Younger age, male gender, not being employed full-time, not having completed college, and a history of hypertension were significantly associated with initial agreement to a clinic visit. However, fewer variables were associated with the overall response rate for the initial clinic exam. People who kept their clinic appointments differed from the total phone survey sample only in age, likelihood of being employed full-time, and history of hypertension. These three variables were found to be independently associated with attendance at the initial clinic examination when logistic regression analysis was performed using all measured variables to predict attendance (details available from the authors on request). A detailed analysis of the age variable indicated that the likelihood of response was highest among middle-aged people.

In the comparison between those who agreed to a clinic appointment and those who kept the initial appointment, a higher age remained a significant predictor of response status. Fewer people in the household and a lower proportion of people employed full-time were also associated with kept appointments among those who agreed during the phone survey. Although the prevalence of self-reported hypertension was much higher in the group that kept the initial clinic appointment, multivariable modeling indicated that this difference was no longer statistically significant when the higher age of examinees was taken into account.

The characteristics of people in the substudy of higher incentives were similar to the total survey sample except for their younger age and lower probability of being employed full-time. The important finding in the substudy was that younger people were motivated to come in for an examination, but full-time employment status continued to be associated with failure to complete the measurement process.

Discussion

The use of RDD to recruit a large sample of African Americans for a clinic blood pressure examination resulted in a high phone interview participation rate, but an examination participation rate lower than that obtained in surveys among African Americans that rely on an in-home screening interview followed by an invitation to attend a clinic examination location. Sprafka and colleagues¹⁴ reported a response rate of 75% for an in-home interview and 65% for a subsequent clinic visit among African Americans in the Minnesota Heart Survey. In the third National Health and Nutrition Examination Survey (NHANES III), the in-home interview response rate among African Americans was 85%, with a 91% mobile examination completion rate.¹⁵ In the Minnesota Heart survey, the response rate among whites was higher, but in NHANES III it was significantly lower than among African Americans.

RDD has been used with some success in case-control studies as a method of efficiently screening for people with specific characteristics and inviting them to participate in in-home interviews.^{11,16} In the study reported by Olson and coworkers, the RDD phone interview response rate was 87%, and 75% of the people recruited by RDD participated in an in-home interview, for an overall response rate of 65%. Lele and colleagues¹⁶ compared population controls selected through area sampling and RDD. Participation in in-home interviews was the same among people recruited through area sampling and RDD, but factoring in the RDD component of recruitment resulted in a lower overall response rate (74% for the RDD-recruited sample compared with 85% for the sample recruited through an area survey). We have not been able to identify published articles that report on the use of RDD to recruit people to come to a central location for examination.

We were unable to ascertain the reasons for the low clinic examination participation rate during reminder and rescheduling phone calls. People tended to assure project staff members that they would keep their appointments but then did not appear. In the statistical analysis, the differences between respondents and

Figure 2. Kept appointment rates in initial clinic examination and substudy samples

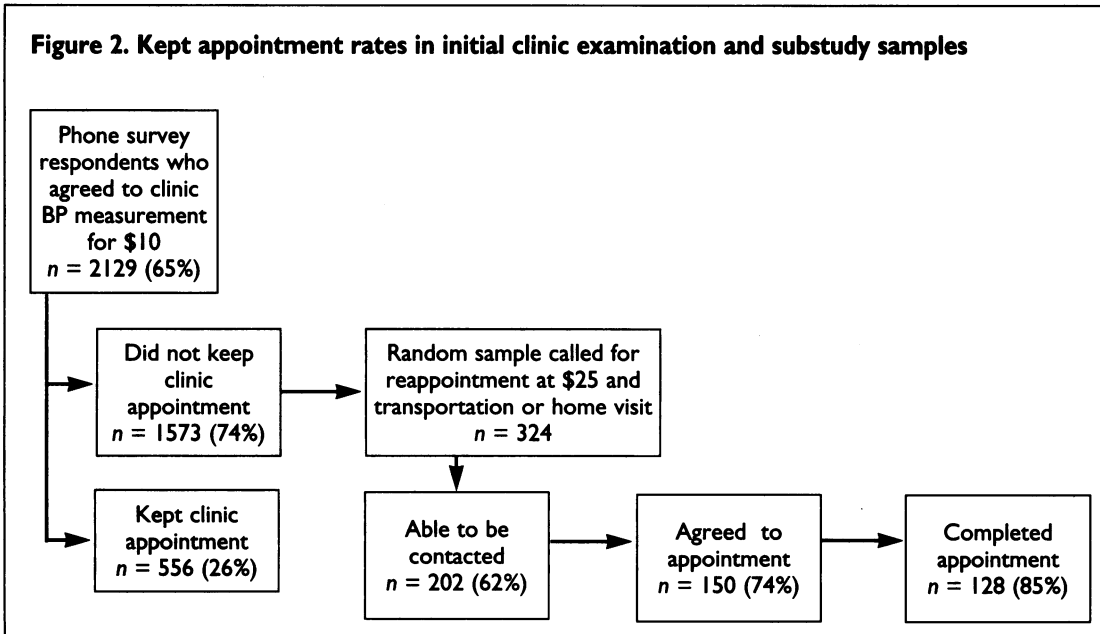


Table 2. Percentage distribution and 95% confidence intervals (CI) of measured variable in people participating in each phase of the 1993 telephone survey on hypertension, Houston, TX

Variable	All survey respondents (n=3273)	Agreed to clinic appointment (n=2129)	Kept first clinic appointment (n=556)	Kept clinic appointment in substudy (n=128)
Sociodemographics				
Age (years).....	44.9	43.0	48.7	40.1
95% CI.....	44.4,45.5	42.0,43.7	47.4,50.0	38.2,43.2
Gender (% male).....	33.7	36.2	33.5	33.6
95% CI.....	32.0,35.3	34.2,38.3	29.5,37.4	25.3,41.9
Number of persons in household.....	2.9	3.0	2.7	3.0
95% CI.....	2.8,3.0	2.9,3.1	2.5,2.8	2.7,3.3
Employment (% full-time).....	45.2	42.7	36.9	37.5
95% CI.....	43.4,46.9	40.5,44.8	32.9,40.9	28.9,46.0
Education				
Less than high school graduate.....	23.7	23.3	26.8	18.8
95% CI.....	22.3,25.2	21.5,25.1	23.2,30.5	11.9,25.6
High school graduate.....	60.4	63.0	59.6	61.7
95% CI.....	58.7,60.0	60.9,65.1	55.5,63.7	53.2,70.3
College graduate.....	15.9	13.7	13.5	19.5
95% CI.....	14.6,17.2	12.3,15.2	10.8,16.6	13.1,27.5
Health Care Access				
Primary care source.....	79.6	77.9	79.2	81.3
95% CI.....	78.3,81.0	76.2,79.7	75.8,82.6	74.4,88.1
Health insurance.....	77.0	75.7	77.8	75.0
95% CI.....	75.6,78.5	73.8,77.5	74.3,81.3	67.4,82.6
Hypertension Measurement and Awareness				
Self-reported hypertension (% yes).....	34.0	35.2	43.3	35.2
95% CI.....	32.4,35.6	33.1,37.2	39.2,47.5	26.8,43.5
Years since last blood pressure check.....	0.5	0.5	0.5	0.5
95% CI.....	0.45,0.51	0.46,0.53	0.41,0.56	0.37,0.63

nonrespondents appeared to reflect a convenience factor (full-time employment and age) and awareness of having the specific health condition that was being screened for in the clinic examination portion of the survey. However, such variables as access to care, use of health services, or gender were not consistently related to participation.

Some of the comparisons of participants versus nonparticipants in this survey of urban African Americans are worth highlighting. Although gender was significantly associated with the initial agreement to an appointment, it was not predictive of keeping an appointment, either when the analysis included all eligible people or only people who agreed to an appointment in each phase. Men were more likely to agree to the initial appointment than women, and in this sample there was no evidence African American men were less likely to participate in a health screening activity than women. Paradoxically, although phone coverage is likely to be lower among the unemployed, the direction of bias resulting from nonresponse in this sample recruited

through RDD was toward under-representation of employed people.

The 17% of all phone survey respondents who attended the initial clinic appointment differed only in age, employment status, and history of hypertension from the total phone survey sample. The magnitude of the differences between the groups was generally small and not unlike what is typically observed in comparisons of respondents and nonrespondents in surveys with much higher response rates. Criqui and coworkers reported differences in a number of cardiovascular risk variables between respondent and nonrespondents in the Rancho Bernardo baseline survey.¹⁷ Adams and colleagues¹⁸ found a relationship between age and living arrangements and willingness to participate in a population-based household interview survey of elderly people. Even when high overall response rates (more than 80%) are achieved, significant differences between people measured and the total sample may be observed. In NHANES III, statistically significant differences in demo-

graphic and health status variables have been reported between respondents and nonrespondents.¹⁵ In an HIV seroprevalence in which 84% of eligible people agreed to participate, a substantial difference in HIV risk factors was detected when people who initially refused were examined in a followup study using higher incentives.¹⁹

The dramatic increase in the kept-appointment rate when a \$25 incentive was offered suggests that the original amount was too low. The compensation of \$10 was designed to offset transportation costs while keeping down survey costs. In planning sessions, community leaders felt the original amount was appropriate, that people would participate regardless of reimbursement, and that a large incentive might be viewed with suspicion.

The optimal incentive level for survey participation is likely to be specific to the community being surveyed, the topics covered, and the inconvenience generated. People were reimbursed \$20 for completing the mobile examination portion of the NHANES III survey, but participation rates only reached satisfactory levels when multiple members of a household were sampled.² In pilot studies to plan for a national household HIV seroprevalence survey, \$50 was offered to eligible people who agreed to participate, but when response rates were less than satisfactory, the incentive was increased to \$175 to obtain questionnaire data and blood specimens from people who refused to participate initially.²⁰ These high incentive levels were apparently felt to be necessary because of the sensitive nature of the survey questions and the requirement that participants provide a blood sample.

In our survey, people who did not keep an appointment until a higher incentive was offered tended to be younger and not employed full-time compared with the participants who kept the initial appointment. However, the two groups did not differ on any hypertension-related variables. In the HIV seroprevalence pilot survey cited previously, the respondents to a higher incentive were also different from the remainder of the sample. It appears that within a given population sample there is a range of "price sensitivity," which may include people who will not participate for any amount of compensation.

The use of RDD to obtain a population sample for physical measurements has a number of practical advantages when the population must be screened for people with specific characteristics, when the survey is to be conducted primarily in neighborhoods where the safety of survey personnel is a concern, where security measures limit access to a large number of households, and funding for the study is limited. It is possible that adequate response rates for attendance at a central clinic examination cannot be obtained with RDD because personal contact with a household interviewer is essential for compliance with the clinic appointment. On the other hand, the higher response rate obtained in our study when the financial incentive was increased sug-

gests that this method deserves further investigation as a sampling approach that can be used by local or regional agencies that need to collect health information on a specific segment of the population in a timely manner.

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