Effects of Enhanced Calling Efforts on Response Rates, Estimates of Health Behavior, and Costs in a Telephone Health Survey Using Random-Digit Dialing

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Synopsis

Public health researchers frequently rely on random-digit dialing (RDD) telephone surveys in monitoring trends in health behavior and evaluating health promotion interventions. RDD response rates have declined during the past decade, and cost-effective methods to increase response rates are needed. The authors evaluated two levels of enhanced calling efforts in an RDD survey of cancer-related health behavior in the State of Washington. The first level of enhanced calling effort was 1 month after 11 original calling attempts to a household, when the authors attempted up to 11 recalls. The second level was 6 months after the first answered call, when the authors recalled those persons who could not be interviewed.

Enhanced calling efforts increased the overall survey response rate by 11 percent. Nine percentage points of the increase were attributable to call backs. There were demographic differences among the participants reached at different levels of calling effort, but no consistent associations of level of calling effort with health behavior related to alcohol use, smoking, diet, or health screening. Marginal costs for interviews completed with enhanced calling efforts were about 50 percent higher than costs for interviews reached in the first 11 calls.

The authors concluded that enhanced calling efforts may be justified, because they increase confidence in the generalizability of survey results. However, the authors found very little change in survey results by including interviews from persons who were difficult to reach and to interview.

TELEPHONE SURVEYS using random-digit dialing (RDD) are a standard tool in public health research and program evaluation. Government agencies use RDD surveys in preparing guidelines for program development and in monitoring nationwide trends in health behavior (*1*). Many public health intervention programs rely upon RDD surveys for program evaluation (*2*).

During the past several decades, response rates to all types of RDD surveys have declined, especially in urban areas (*3*). There are two main reasons for this decline. First, households are subject to telephone solicitation for political canvassing, charitable fund raising, and consumer sales (*4, 5*). As a result, householders increasingly are reluctant to participate in telephone surveys. Second, respondents are difficult to reach by telephone, probably because of a combination of factors that include the growing use of answering machines and the large numbers of households in which all adults work. Potential biases from low response rates may limit seriously the generalizability and validity of survey results (*6*), and low-cost methods to enhance response rates clearly are needed.

We evaluated two approaches to the problem of increasing RDD survey response. Specifically, we describe the effects of two strategies on response rates, on estimates of the health behavior of the general population, and on survey costs. The first strategy was to increase the number of calling

attempts to a household from 11 in 1 month to an additional 11 in the following month, in an effort to reach survey respondents who were rarely at home.

The second strategy was to talk to those persons again who had said that they were either unable or unwilling to participate. That effort was designed to reduce the proportion of households in which potential respondents refused to participate. The results reported are based on an ongoing RDD survey of behavior, knowledge, and attitudes related to cancer risk and cancer prevention in the State of Washington.

'We demonstrated that response rates to a RDD survey of health behavior in the State could be substantially increased through additional calling efforts.'

Survey Procedures

Questionnaire. The Cancer Behavior Risk Survey (CBRS) is part of a program for primary prevention of cancer funded by the National Cancer Institute. The goals are to monitor changes in behavior and attitudes related to cancer risk and prevention, with emphasis on screening, diet, and smoking. The text of the health behavior questionnaire is available from the authors. The questionnaire was administered using a computer-aided telephone interview system, known as CATI, and took an average of 25 minutes to complete.

Sample frame. We selected telephone numbers by use of a modified, two-stage Waksburg method (*7*). We developed a sample frame, consisting of three-digit telephone prefixes, that was used to generate the two samples described subsequently. Exchanges that were exclusively assigned to businesses were excluded. We included in the sample frame data on the number of residential lines (or an estimate of the proportion of residential lines) assigned to each prefix, either directly from U.S. West Communications or from a biannual publication listing the number of telephone lines for each of the other 24 independent telephone companies in the State.

The first sample, consisting of 2,100 telephone numbers, was selected to be representative of the entire State and was drawn based on the distribution of residential lines for each telephone prefix within each of the State's 2 area codes. A random four-digit suffix was attached to each of the selected prefixes.

The second sample, also consisting of 2,100 telephone numbers, was drawn from 5 communities in the State. Within each community, we selected 311 prefixes, such that the proportional distribution of prefixes matched the proportional distribution of the number of residential lines within each prefix, to each of which we added a 4-digit suffix. The 5 communities were of roughly equal population, about 150,000, but differed in such sociodemographic characteristics as urbanization, climate, types of industry, and proximity to the major population center of Seattle and King County.

Participant selection. Once we determined that a telephone number reached a household with at least one adult age 18 years or older, we used a second screening process to select at random one man and one woman from each household. We excluded institutional residences, such as dormitories and nursing homes.

If a household consisted of adults of only one sex, we selected a single participant. To select participants we used a modification of the procedure developed by Troldahl and Carter (*8*), in which the selection of a randomly chosen adult within a household is based on the answers to two questions, which ask the number of adults in the household and the number of men. A series of tables is used to specify the sex and age range of the selected respondent, as for example, the oldest man or second youngest woman. We modified this procedure to be sex-specific; interviewers asked how many adults residing in the household were of the same sex as the person answering the telephone.

If more than 1 same-sex adult resided in the household, the interviewer selected a respondent, using 1 of 12 table variations that specify the birth rank of the person to be interviewed, such as youngest, or second oldest. If the selected person was available, the interviewer tried to complete the survey at that time. Upon completion of the survey, the respondent was asked the number of opposite-sex adults residing in the household, and a second participant was selected using the tables described.

We tried to interview two persons per household to increase the efficiency of participant recruitment. The adult answering the phone was likely to be an eligible participant, because most households

Table 1. Response rates of telephone survey participants interviewed at each level of calling effort, and household composition, State of Washington, Cancer Behavior Risk Survey, 1988–89

Calling effort	Two-person eligible households		One-person eligible households		Overall	
	Men	Women	Men	Women	Men	Women
1–11 calls	0.38	0.53	0.60	0.59	0.41	0.55
1–22 calls	0.41	0.55	0.63	0.62	0.44	0.57
1–11 calls plus call backs	0.46	0.60	0.65	0.67	0.49	0.62
All efforts combined	0.50	0.63	0.68	0.69	0.53	0.65

NOTE: See statistical methods section of text for calculation of response rates.

Table 2. Demographic characteristics of telephone survey participants interviewed at each level of calling effort, State of Washington, Cancer Behavior Risk Survey, 1988–89

Characteristic	Men interviewed in—						Women interviewed in—					
	Calls 1–11 (N = 640)		Calls 12–22 (N = 57)		Call backs (N = 128)		Calls 1–11 (N = 980)		Calls 12–22 (N = 39)		Call backs (N = 129)	
	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE
Age (in years)[1] raw	42.4 ± 15.5	...	40.5 ± 13.8	...	44.3 ± 15.2	...	44.5 ± 16.8	...	42.2 ± 12.8	...	48.8 ± 16.3	
College degree:												
Raw	36.3	1.9	47.4	6.7	30.5	4.1	26.2	1.4	35.9	7.8	24.8	3.8
Cumulative	36.2	3.0	37.2	2.9	35.0	2.6	22.5	2.1	22.7	2.1	21.6	1.9
Income level $35,000 or more:												
Raw[2]	48.3	2.0	64.9	6.4	57.6	4.6	37.3	1.6	60.5	8.0	49.1	4.7
Cumulative	47.7	3.1	47.9	3.0	50.3	2.7	40.1	2.5	41.1	2.4	43.4	2.3
Married:												
Raw[2]	65.8	1.9	71.9	6.0	79.7	3.6	63.9	1.3	71.8	7.3	80.5	3.5
Cumulative	60.9	3.0	61.3	2.9	62.3	2.6	57.9	2.5	57.6	2.5	60.0	2.3
Nonwhite:												
Raw[3]	5.6	0.9	10.5	4.1	3.9	1.7	4.5	0.7	12.2	5.3	6.2	2.1
Cumulative	5.2	1.4	6.4	1.5	6.5	1.3	5.3	1.1	5.5	1.1	5.7	1.1

[1] Age is mean age plus or minus the standard deviation.
[2] Chi-square comparison of 3 levels of calling effort: men, $P < 0.01$; women, $P < 0.001$.
[3] Chi-square comparison of 3 levels of calling effort: men, $P < 0.2$; women, $P < 0.05$.

NOTE: Raw values are unadjusted within each level of calling effort; cumulative values are population-adjusted and include all interviews obtained through each level of calling effort. See Statistical Methods section of text. Analysis of variance: men $P < 0.001$; women $P < 0.001$. SE = standard error.

include only two opposite-sex adults (56.6 percent in our sample) or a single adult (26.6 percent). We thought it easier to select the first participant and to begin the interview if we did not have to obtain a complete household census from which to select a single participant at random. To reduce women's reluctance to answer that no men lived in their household, the sex-specific selection procedure delayed asking that question until the survey was completed. We planned all analyses to be sex-specific and thus did not consider the within-household correlation of health behavior to be a serious drawback.

Enhanced calling efforts. The survey incorporated three levels or stages of calling effort. The initial effort included households for which eligibility could be determined, or for which information was refused, with up to 11 calls to that number during a 1-month period. That stage, referred to as calls 1–11, included calls back to the household to interview a second adult and calls back to try to interview if, in the initial conversation, the eligible person gave a soft refusal, such as "call me back and I'll do it later."

The second stage included households reached with up to an additional 11 calls in the following month. This stage, referred to as calls 12–22, included calls to known residential households in which (*a*) eligibility was not or was only partially determined, or (*b*) eligibility was known, but all eligibles had not been reached. The third stage included households reached about 6 months after a potential participant had been reached, but who could not be interviewed. This stage, referred to as "call backs," also called "refusal conversions,"

included attempts to speak with all but those giving hard refusals, such as "don't call this house again."

Statistical Methods

Response rates. Each telephone number called received 1 of 40 final disposition codes, ranging from *1: ring, no answer after all attempts* to *40: both man and woman completed interviews in two-sex households*. The full list of disposition codes and their combination into response rates is available from the authors. We tried to minimize the frequency of final disposition codes that were *ring, no answer* (RNA) by calling telephone companies to find out if those were working numbers. Telephone company cooperation varied, but only 81 of 3,594 numbers (2.25 percent) were given final disposition codes of RNA. We excluded RNAs, nonresidential, and nonworking numbers from all rate calculations.

In brief, we combined disposition codes into seven nonmutually exclusive categories: (*a*) households reached, (*b*) households not reached, (*c*) eligibles reached, (*d*) ineligibles reached, (*e*) eligibility uncertain or partially determined, (*f*) completed interview, and (*g*) eligible but not interviewed. We defined the eligibility rate (*h*) as *c* divided by *c* plus *d*, the interview rate (*i*) as *f* divided by *c*, the estimated number of eligibles (*j*) as *h* times *b* plus *e*, and the effective rate (*k*) as *f* divided by *c* plus *j*.

We calculated response rates stratified by sex and by whether one or two persons in each household were eligible for the interview. To estimate the sex- and household-composition of specific numbers of eligibles not reached, we assumed that these characteristics were distributed in the same proportions as in households that were reached and eligibility determined. We calculated effective rates for 4 combinations of levels of calling effort: 11 call attempts, 22 call attempts, 11 call attempts plus call backs, and 22 call attempts plus call backs.

Survey results. We examined demographic characteristics (age, education, marital status, and race or ethnicity) and health behavior of participants interviewed at 3 stages of calling effort, up to 11 calls, 12–22 calls, and call backs. Results are presented in two ways: (*a*) raw, the unweighted results for participants reached at each level of calling effort, and (*b*) cumulative, the results for the overall study weighted for sampling probability and the county- and sex-specific State populations, with results cumulative through each level of calling effort. The analyses allowed comparisons between participants reached at each level of effort, as well as an evaluation of how stopping the survey at each stage would affect inferences about the health behavior of State residents.

'Based on raw values, there were large and statistically significant differences in age, income, and marital status across participants interviewed at each level of calling effort.'

Sample weights and variance. To generate population-level estimates of health behavior that incorporate the effects of sampling, we calculated individual weights for each completed interview. Interviews from households with *m* number of same-sex adults and *t* telephone lines received an initial weight of *m* divided by *t*. We post-stratified the sample into sex-, community-, and age-specific groups for adjustment to the State 1988 census projections. The numbers of Hispanics, Asians, African Americans, and other minorities in the State living outside of the Seattle-King County area were too small to allow weighting for race or ethnicity. We estimated the variance of weighted results as described by Kish (*9*). Each completed interview could have up to three weights, because weights were calculated based on the total sample at each level of calling effort.

Results

Table 1 gives the response rates for four combinations of levels of calling effort. Overall, all enhanced calling efforts combined resulted in a 12-percentage point increase in effectiveness rates for men and a 10-percentage point increase for women. For men, the effects of increased calling effort were larger for two-person, compared with one-person, eligible households. For both men and women and in both one- and two-person eligible households, the effects of the additional second month's calls (calls 12–22) were only 2 to 3 percentage points; most of the increases in response rates were attributable to call backs.

Table 1 allows comparison of response rates by sex and by whether one or two persons per household were eligible for the interview. Regardless of level of calling effort, response rates were

Table 3. Health-related behavior of telephone survey participants interviewed at each level of calling effort, State of Washington, Cancer Behavior Risk Survey, 1988–89

Behavior	Men interviewed in—						Women interviewed in—					
	Calls 1–11 (N = 640)		Calls 12–22 (N = 57)		Call backs (N = 128)		Calls 1–11 (N = 980)		Calls 12–22 (N = 39)		Call backs (N = 129)	
	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE
Drink alcohol:												
Raw	72.7	1.8	73.7	5.9	74.2	3.9	60.7	1.6	69.2	7.5	53.9	4.4
Cumulative	74.9	2.7	75.6	2.6	75.6	2.3	63.0	2.4	62.9	2.4	61.8	2.3
Drink and drive:												
Raw	47.7	3.4	47.6	11.5	41.9	8.0	19.0	3.7	29.6	17.4	7.3	13.0
Cumulative	48.8	6.4	46.8	5.2	46.1	4.7	18.6	5.6	18.5	5.4	17.3	5.1
Smoke cigarettes:												
Raw	23.1	1.7	22.8	5.6	27.3	4.0	23.4	1.4	10.3	4.9	17.2	3.3
Cumulative	24.0	2.7	24.7	2.6	24.6	2.0	21.8	2.1	21.8	2.0	21.8	1.9
Quit attempt in previous year:												
Raw	74.3	3.6	76.9	12.2	82.9	6.6	71.6	3.0	50.0	28.9	72.7	9.7
Cumulative	73.5	5.9	70.3	5.9	73.3	5.2	70.8	4.9	69.7	4.9	72.4	4.5
Fried food in previous day:												
Raw	20.0	1.6	12.3	4.4	20.3	3.6	18.8	1.0	12.8	5.4	12.5	2.9
Cumulative	22.5	2.6	21.1	2.5	21.7	2.2	12.5	1.7	12.8	1.7	12.7	1.6
Fresh fruit in previous day:												
Raw	65.8	1.9	64.9	6.4	66.4	4.2	70.2	1.5	79.5	6.6	76.7	3.7
Cumulative	64.6	3.0	65.0	2.9	64.4	2.6	70.8	2.3	71.3	2.2	71.5	2.1
One-percent or skim milk in previous day:												
Raw	20.5	1.6	24.6	5.8	14.8	3.2	23.8	1.4	30.8	7.5	27.9	3.9
Cumulative	21.7	2.6	21.3	2.5	19.5	2.1	23.9	2.1	23.8	2.12	3.5	2.0
Dietary fat:[1]												
Raw	35.9	1.9	34.8	6.4	36.3	4.3	34.4	1.5	33.1	7.6	33.3	4.2
Cumulative	35.9	3.0	35.8	2.9	36.1	2.6	34.3	2.4	34.3	2.4	34.2	2.2
Dietary fiber:[2]												
Raw	14.1	1.4	14.1	4.7	13.4	3.0	12.5	1.1	13.2	5.5	12.8	3.0
Cumulative	14.1	2.2	14.1	2.1	13.9	1.9	12.5	1.7	12.5	1.6	12.5	1.4
Digital rectal examination in last 2 years:												
Raw	58.2	2.0	65.6	6.3	51.3	4.4	...	...	...	...	...	...
Cumulative	61.3	3.0	61.8	2.9	59.5	2.7	...	...	...	...	...	...
Mammogram in last 2 years:												
Raw	...	...	...	...	...	...	57.5	1.6	50.0	8.1	59.2	4.3
Cumulative	...	...	...	...	...	...	59.5	2.5	58.6	2.4	58.5	2.3

[1] Mean percent of energy from fat.
[2] Mean number of grams of dietary fiber per day.
NOTE: Raw values are unadjusted within each level of calling effort; cumulative values are population-adjusted and include all interviews obtained through each level of calling effort. See statistical methods section of text. SE = standard error.

similar in one-person eligible households and higher for women in two-person eligible households. Response rates were higher in one-person compared with two-person eligible households, 19 percentage points higher for men, and 6 percentage points higher for women. However, when we calculated response rates at the household level, those in which at least one person per household completed the interview, the response rate for all two-person eligible households was 0.72, similar to the 0.69 response rate for all one-person eligible households.

Table 2 gives selected demographic characteristics of survey participants. As described in the statistical methods section, the data are presented as unadjusted values within each level of calling effort (raw) and weighted values for all participants reached through each successive level of calling effort (cumulative). Based on raw values, there were large and statistically significant differences in age, income, and marital status across participants interviewed at each level of calling effort. Compared with participants reached in calls 1–11, those reached in calls 12–22 were younger, had higher incomes, and were more likely to be college educated and nonwhite. Those interviewed by call backs were older, had higher incomes, and were more likely to be married. Those comparisons were not affected by adjustment for age and sampling probability (number of same-sex adults and telephone lines in the household, data not shown).

Cumulative values, those adjusted for sampling probability and the State's population distribution,

were only minimally affected by adding data from additional calling efforts. Compared with the sample based on calls 1–11 only, the sample after all calling efforts showed nonsignificantly higher mean income, fewer years of education, and a greater proportion of participants married and nonwhite.

Table 3 gives the results on selected health behaviors at each level of calling effort. There were no clear patterns of differences in more healthful or less healthful behavior among participants in each group, and no differences between groups were statistically significant. Adding participants interviewed in calls 12–22 and during call backs had very little effect on population-level estimates of health behavior. Only 6 out of 20 sex-specific population-level estimates of health behavior were affected more than 1 percentage point by adding the participants from additional calling efforts. For alcohol-use behavior, the additional calling efforts decreased estimates of alcohol use by women by 1.2 percentage points and decreased estimates of driving after drinking by 2.7 percentage points for men and 1.3 percentage points for women.

For smoking behavior, additional calling efforts increased the rate of those reporting an attempt to quit smoking in the previous year by 1.6 percentage points for women. For dietary behavior, additional calling efforts decreased the rate of use of skim milk by men by 1.2 percentage points. For screening, increased calling efforts decreased the prostate cancer screening rate by 1.8 percentage points and decreased the mammography rate by 1.8 percentage points.

Table 4 gives data on the marginal costs of the CBRS, stratified by level of calling effort. Development costs, including programming time, pretesting, and scientific staff, were fixed costs in this survey. The marginal costs of a completed interview were primarily a function of interviewer time and supervision. Compared with the marginal cost of an interview completed in calls 1–11, costs were about 64 percent higher for calling efforts 12–22 and 50 percent higher for call backs. However, when costs are expressed as a function of fixed plus marginal costs, the cost of an interview completed in calls 1–11 was about $37.47, and the cost of an interview based on the total sample was $33.28.

Table 4. Telephone survey calling hours, calling attempts, completed interviews, and marginal cost[1] at each level of calling effort, State of Washington, Cancer Behavior Risk Survey, 1988–89

Survey factor	Calls 1–11	Calls 12–22	Call backs	Total
Number of completed interviews	1,620	96	257	1,973
Number of calling attempts	11,522	1,389	3,722	16,633
Number of calling hours	1,350	132	323	1,805
Total interviewer cost (in dollars)	$14,715	$1,439	$3,520	$19,674
Hours per complete interview	0.83	1.37	1.25	0.92
Calling attempts per complete interview	7.11	14.47	14.48	8.43
Interviewer cost per complete interview (in dollars)	$9.08	$14.99	$13.70	$9.97

[1] Cost of interviewers, plus overhead; excludes fixed costs of questionnaire development, training, and computer programming.

Discussion

Several approaches to improving telephone survey response rates have been tested. They have been reviewed by Dillman (*10*), Groves and Lyberg (*11*), and Armstrong and coworkers (*12*). We demonstrated that response rates to a RDD survey of health behavior in the State could be substantially increased through additional calling efforts. Overall, enhanced calling efforts accounted for a sizable proportion of completed interviews, 28.9 percent for men and 17.1 percent for women, and an increase in response rates by 12 percentage points for men and 10 percentage points for women.

The two types of enhanced calling efforts were aimed at different problems in RDD nonresponse. Households not reached in 11 calls were categorized as consisting of persons hard to reach. They may screen calls using an answering machine, rarely be at home, or be traveling. Additional calling attempts will increase the likelihood of reaching a household whose members rarely are at home and will lengthen the survey period, increasing the likelihood of reaching households whose members are traveling.

In our results, answering machines were reached in all call attempts in only 1.1 percent of households, suggesting that they contributed relatively little to survey nonresponse. When we did complete interviews during the second set of call attempts (calls 12–22), 79 percent were completed in calls 12–15. This result suggests that these additional call efforts were reaching households whose members had been away. Our finding of a 2 to 3 percentage point increase in response rates attributable to calls 12–22 were similar to increases reported by Drew and coworkers (*13*), Allison and Yoshida (*14*), and additional studies reviewed by Sebold (*15*). Our

'Future research should examine the effects of enhanced calling efforts in the context of a community-level health promotion intervention to determine if the effects of enhanced calling are similar in intervention and control communities.'

results suggest that waiting until the next month to attempt an additional small number of calls may be an optimal strategy to interview those hard to reach.

The call backs were aimed at persons who are difficult to interview: those too busy to be interviewed when called and persons reluctant to participate in telephone surveys. Call backs were successful in 28 percent of all attempts. Groves and Lyberg (*11*) report that between 25 percent and 40 percent of persons who initially do not agree to be interviewed will participate when called again, but other investigators (*14, 16*) could interview fewer than 10 percent. These results suggest that, at least in some populations, giving potential participants the opportunity to be interviewed at a later date may be a useful addition to standard RDD methods.

Our design did not allow an unbiased comparison of interviewing two different-sex adults in a household, compared with a random selection of only one adult. For both sexes, the response rate was lower in two-person eligible households than single-person eligible households. However, we did find that the household interview rate, that is, reaching and interviewing at least one household member, was slightly higher in two-person eligible households, compared with one-person eligible households. Response rates were higher for women, but only in two-person eligible households. We suspect this was because 60 percent of all first contacts in two-person eligible households were women. Interviewers reported that women answering the telephone would often complete the interview but would then refuse an interview request for an eligible male household member. Many successful call back interviews were among men from these households, in which the interviewer could request to speak to a specific male household member at the beginning of the call. Given that the response rate for completing at least one interview per household was high, interviews that attempt to collect household-level information or surrogate information on a randomly selected household member could be a cost-effective alternative to standard RDD techniques. We are investigating the validity of surrogate information on cancer-related risk behavior collected from an adult household informant.

We were surprised by the lack of a strong and consistent bias in health-related behavior associated with being either hard to reach or difficult to interview. In a similar study, Hornik and coworkers (*17*) found that increased response rates to a health survey resulted in no significant change in survey results. Nonresponse to health surveys is usually associated with low income, male sex, and smoking (*12*), though little is known about nonresponse and diet habits (*18*). To some extent, nonresponse is confounded with noncoverage, because these characteristics are associated with not having a telephone. However, given that telephone noncoverage in the State is less than 3.5 percent, we suspect that noncoverage contributed only minimally to these results. We had expected that those difficult to interview would report, in general, poorer health habits than those responding on first interview. Because final response rates were only about 60 percent, we could not rule out bias attributable to the large number of persons not interviewed, even after the enhanced calling efforts were complete.

Differences in population-level estimates of health behavior attributable to including participants reached through enhanced calling efforts were small (minus 2.7 to plus 1.6 percentage points). However, if RDD surveys were used to evaluate community-level health intervention programs, differences of those magnitudes could be important, because expected differences attributable to intervention would not be large. Future research should examine the effects of enhanced calling efforts in the context of a community-level health promotion intervention to determine if the effects of enhanced calling are similar in intervention and control communities.

The marginal cost of interviews completed during enhanced calling efforts were about 50 percent higher than the costs of interviews completed during the initial calling effort. However, a large proportion of the total cost per interview in this scientific survey was attributable to survey development, pilot testing, and scientific personnel. Thus, the overall cost per interview (fixed plus marginal costs) was lower when enhanced calling efforts were used to increase response rates.

Relevance. We believe that enhanced calling efforts such as we describe can be a cost-effective method of increasing response rates in RDD surveys. There appears to be considerable variability in the survey science literature about the effects of additional call attempts and call backs, suggesting that characteristics of the survey and the population surveyed are important considerations when designing RDD protocols.

We found little evidence that the addition of persons reached with enhanced efforts had a large impact on population-level inferences about health behavior. We urge caution when generalizing from this result, however, because even with enhanced calling efforts, we achieved only a 60 percent overall response rate. The main benefit of the increased response rate was our enhanced confidence in the validity of results as representative of health behavior of the State's population.

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