IMPROVING SURVEY RESPONSE AND COVERAGE RATES THROUGH MULTI MODALITY SURVEYS

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KEY WORDS: List Samples, Nonresponse Bias, Noncoverage Bias

1. Introduction

Surveys are generally conducted primarily by a single mode of data collection -- mail, telephone or in-person. The planned use of more than one mode of data collection in a single survey is not that common, but is on the increase, primarily as a method for reducing survey costs and acheiving an acceptable response rate (Dillman, 1991). This paper addresses the issue of how one can use a multi modality survey design to achieve a high survey response rate, and a high coverage rate of a population contained in a list sampling frame that has name and address but no telephone numbers. The specific target population of interest in our study was noninstitutionalized Medicare beneficiaries of all ages contained in a computer file that included both noninstitutionalized and institutionalized beneficiaries.

2. Survey Methodology

In the Omnibus Budget Reconciliation Act of 1987, Congress mandated a demonstration of the cost-effectiveness of Medicare coverage of influenza immunizations, which are not otherwise routinely covered by Medicare. The main study question was whether influenza immunizations would prevent enough hospitalizations to balance the costs of providing immunizations to Medicare beneficiaries. The demonstration was funded by the Health Care Financing Administration (HCFA). The demonstration consisted of supplying free vaccine to heath care providers, and paying for its administration to Medicare beneficiaries.

The demonstration was implemented in 10 sites nationwide, ranging from single counties to entire states, each of which had a similar area assigned as a comparison site for analytic purposes. In order to determine immunization rates before the demonstration, and in each of the three active years of the demonstration, annual surveys of Medicare beneficiaries were conducted in each of the 20 sites regarding influenza immunization and related health behaviors and risks. The study design called for approximately 500 completed questionnaires per site per year, with a response rate goal of 90 percent or higher. The evaluation of the impact of the demonstration, including the annual surveys, was conducted by Abt Associates Inc., of Cambridge, Mass., under contract to HCFA. This paper examines the fourth and final Medicare beneficiary survey. For each of the annual surveys, a random sample was selected from Medicare Part B eligibility files, stratified within site by age, race and sex. Available Medicare data included beneficiary name and address. Telephone numbers were obtained for approximately 74% of the sampled beneficiaries using a computerized matching service, supplemented with Directory Assistance calls. This process created two groups: those with directory listed telephone numbers and those without. Beneficiaries without directory listed telephone numbers also includes those with no telephone.

The basic approach of the survey methodology was to first conduct as many interviews as possible, at a moderate cost per completed interview, by telephone. This was followed by a mail survey, at a moderate cost per complete, to obtain as many completed questionnaires as possible from those without directory listed telephone numbers, and also from beneficiaries with directory listed telephone numbers who were not interviewed by telephone. As a final resort, a high cost per complete field effort was made to complete interviews with remaining nonrespondents.

For beneficiaries with directory listed telephone numbers, an initial postcard was mailed informing them that they would receive a

telephone call to conduct a survey and asking for their cooperation. Up to six attempts were made to complete each telephone interview. A computer assisted telephone interviewing (CATI) system was used for the telephone wave of the survey. Any interviews that were not completed (including refusals and break-offs) went on to a second wave of mailed surveys. In this wave each beneficiary received a printed copy of the survey in the mail. In the mailing they were offered an 800 number to complete the interview by telephone, if they preferred. In the third wave any outstanding incompletes were sent to field interviewers in each site. These field staff first attempted to contact the beneficiary by telephone. When that failed, at least two visits were made to try to locate and interview each respondent in person. Persons who mailed back the survey blank or wrote to refuse, and those who called the 800 number to refuse, were not pursued by field staff. Finally, for persons without directory telephone numbers, the mail survey (with the 800 number option) was employed first and incompletes were pursued by field staff. Table 1 shows the total number of completed questionnaires, and percent of completed questionnaires by survey modality for the entire sample and each of the stratification variables. For whites 65.2% of the total completed questionnaires were completed by telephone while for nonwhites only 49.4% were completed by telephone. The percent of total completed questionnaries completed in the field for nonwhites is double the white percentage (21.1% versus 10.7%).

3. Response Rates, Eligibility Rates And Coverage Rates

At the completion of each wave of the survey, the sample beneficiaries were classified as 1) eligible-completed (E-C), 2) eligible-not completed (E-NC), 3) ineligible (I), or 4) of unknown eligibility status (U). To be considered eligible, a sample beneficiary needed to be alive, noninstitutionalized, and to have not moved out of the site before October 1991. We computed response, eligibility, and coverage rates for the telephone (T) only modality, for the telephone plus mail (T+M) modality, and for the telephone plus mail plus field (T+M+F) modality. The overall response rate equals the product of the screener and interview response rates. The screener response rate is equal to (E-C + E-NC + I) / (E-C + E-NC + I + U). The interview response rate equals E-C / (E-C + E-NC). The eligibility rate is defined as (E-C + E-NC) / (E-C + E-NC + I). Similarly, the percent with an unknown eligibility status equals U / (E-C + E-NC + I + U). The calculation of these rates for the telephone only modality ignores the group of sample beneficiaries without directory listed telephone numbers, because the telephone only modality can only be used to draw inferences about the target population of eligible beneficiaries with directory listed telephone numbers. Table 2 presents these rates for the entire sample.

The telephone mode of data collection by itself only offers 74% coverage of the target population, because beneficiaries without directory listed telephone numbers are excluded from this wave of the survey. The addition of the mail mode brings the coverage rate essentially up to 100%. The overall response rate for the telephone only modality is 79%. The telephone plus mail modality increases the response rate by a small degree, 3.8 percentage points. The full telephone plus mail plus field modality, however, resulted in a 96.1% response rate, an increase of 13.3 percentage points over the telephone plus mail modality. Note that as one adds modalities, the eligibility rate declines, indicating that a disproportionate share of beneficiaries with an initially unknown eligibility status and those with no directory listed telephone number, were ineligible. The percent of the sample with an unknown eligibility status rises slightly as one moves from the telephone only modality to telephone plus mail modality, primarily due to the addition to the survey of the beneficiaries without directory listed telephone numbers. The sample, however, becomes much better resolved when the field modality is included; the percent of the sample with an unknown eligibility status declines to only 1.4%.

Table 3 shows the telephone only modality coverage rates and change in the overall response rate for the categories of the three stratification variables. The telephone only coverage rate is lowest for beneficiaries under 65 years of age and

for nonwhites. The under 65 years of age beneficiary group includes the disabled, End Stage Renal Disease (ESRD) beneficiaries, and dependents of beneficiaries age 65 years and over. The change in the overall response rate for the telephone plus mail modality versus telephone only modality is fairly small for all of the categories examined, and actually declines for a few categories, because sample beneficiaries without a directory listed telephone number now enter into the response rate calculation. Large gains in the overall response rate are however found when the field modality is included. A comparison of the telephone plus mail plus field modality with the telephone plus mail modality response rates indicates that the largest gains were encountered for beneficiaries under 65 years of age, those over 75 years and older, and for nonwhites.

The overall increase in response rate (telephone plus mail plus field modality versus telephone only modality) is largest for beneficiaries age 75 years and over and for nonwhites. The same pattern holds when we examine the percent change in the response rate for the telephone plus mail plus field modality versus the telephone only modality. It is also worth noting that the 6.6 percentage point difference in response rates between whites and nonwhites that existed at the telephone only modality declined to a 3.4 percentage point difference for the telephone plus mail plus field modality, with both the white and nonwhite response rate ending up above 90%.

4. Modality Bias Estimates

In order to compare survey estimates by modality it was necessary to weight the interviews completed for the telephone only, telephone plus mail, and the telephone plus mail plus field modalities. The weighting methodology involved multiplying the population count for each stratum by the (E-C + E-NC) / (E-C + E-NC + I) eligibility rate value for each stratum, and then dividing the estimated eligible population size by the number of completed interviews in that stratum. The sampling variance of the difference between modality estimates takes the general form: $(S^2/n_{T+M+F})(1-P)$, where P represents the overlap between the samples. Tests of differences between modality estimates were all statistically significant at the .05 level. We can estimate the magnitude of the bias associated with the telephone only modality, and the telephone plus mail modality by treating the telephone plus mail plus field modality as the "gold standard", that is, we can assume it provides estimates that are subject to little if any nonresponse bias. Our analysis concentrates on two key survey variables: 1) whether the beneficiary received a flu vaccine shot during the fall or winter prior to the survey, that is, for the winter of 1991-92, and 2) whether the beneficiary ever received a vaccine for pneumonia.

One could argue that the influenza immunization rate declines with the addition of the mail and field modalities due to increased recall error. We however do not believe recall error accounts for the mode differences for two reasons. First, the same pattern holds for the "ever received" an pneumonia vaccination question. Second, nonwhites have a lower immunization rate than whites and 20% of the nonwhite interviews were completed in the field compared to 10% for whites.

Table 4 shows the magnitude of the bias and the relative bias of the estimates for the telephone only, and telephone plus mail modalities. The bias of the telephone plus mail modality estimates can essentially be solely attributed to nonresponse, while the bias of the telephone only modality estimates is due to a combination of nonresponse and noncoverage.

The relative biases shown in Table 4 are almost all negative, indicating that the telephone only and telephone plus mail modalities overestimate the two vaccination rates. The relative bias is largest for beneficiaries under 65 years of age, and for nonwhites. The relative bias of the telephone only modality estimates is particularly large for nonwhites, around -20 percent.

The relative bias almost always declines in absolute value when one moves from the telephone only modality to the telephone plus mail modality. On average, the addition of the mail modality reduces the absolute value of the relative bias of the telephone only modality by about 40 percent.

5. Components of the Bias

A telephone plus mail plus field survey estimate, p_{T+M+F}, can be decomposed into three components:

$$p_{T+M+F} = w_c p_c + w_{nc} p_{nc} + w_{nr} p_{nr}$$

where w_c = proportion of the population accounted for by the telephone completes, w_{nc} = proportion of the population accounted for by interviews completed by mail or in the field among sample beneficiaries without a directory listed telephone number, w_{nr} = the proportion of the population accounted for by interviews completed by mail or in the field among sample beneficiaries with directory listed numbers that had an eligible or unknown status at the end of the telephone survey, the p's are the vaccination estimates for the three sample groups. The bias of a telephone only modality estimate equals $p - p_c$. Substituting the above quantity for p yields a bias equal to:

$$\begin{aligned}
\text{Bias} &= [w_c p_c + w_{nc} p_{nc} + w_{nr} p_{nr}] - p_c \\
&= [w_c p_c - p_c] + p_{nc} w_{nc} + p_{nr} w_{nr} \\
&= p_c[1 - w_{nc} - w_{nr}] - p_c + p_{nc} w_{nc} + p_{nr} w_{nr} \\
&= -p_c w_{nc} - p_c w_{nr} + p_{nc} w_{nc} + p_{nr} w_{nr} \\
&= [p_{nc} - p_c] w_{nc} + [p_{nr} - p_c] w_{nr}
\end{aligned}$$

The first component of the bias of a telephone only modality estimate is due to noncoverage while the second component is due to nonresponse. Taking the absolute value of each component allows us to compute the percent of the total bias due to each component. The results are shown in Table 5.

Looking at the entire sample, we find a 61%:39% split between noncoverage and nonresponse bias components for the influenza vaccination rate estimate, while for the pneumonia vaccination rate estimate the split is 53%:47%. For the influenza vaccination estimates, the noncoverage component accounts for the majority of the overall bias for 10 of the 11 estimates examined. For 7 of the 11 pneumonia estimates, the noncoverage component accounts for a majority of the overall bias. Interestingly, the noncoverage bias component for nonwhites is 76.1% for the influenza vaccination rate, but declines to 39.2% for the pneumonia vaccination rate.

6. Conclusions

The largest gains in response rate for our multi modality survey came from the field survey; a telephone plus mail modality by itself did not allow us to reach the response rate goal of 90%. A comparison of the telephone plus mail plus field modality with the telephone only modality found a fairly large relative bias. The addition of the mail survey reduced the bias by about 40 percent, on average. A decomposition of the bias of the telephone only modality estimates indicates that noncoverage plays an important contribution to the overall bias.

At some level, multi modality survey designs can be viewed as compromise designs (Lyberg and Kasprzyk, 1991), because one of these three modalities might be most appropriate for the information being sought, and therefore use of additional modalities may reduce data quality. Cost constraints tied to high response rate goals however make multi modality worth considering as a practical design alternative. There is now considerable evidence (Groves, 1989) of response effects due to mode of data collection. For the survey discussed here, response effects due to mode of data collection were not expected to reduce data quality. However, before using a multi modality survey design, one needs to give careful thought as to whether key survey variables will be subject to significant mode effects on response.

REFERENCES

Dillman, D.A., 1991. The design and administration of mail surveys. Annu. Rev. Sociol., 17:225-49

Groves, R.M., 1989. Survey Errors and Survey Costs, New York, John Wiley & Sons, Ch. 11.

Lyberg, L., Kasprzyk, D., 1991. Data collection methods and measurement error: an overview. In Measurement Errors in Surveys, ed. Paul Biemer et al., Ch. 13, New York, John Wiley & Sons.

Table 1: Number And Percent of Completed Questionnaires By Survey Modality

	Telephone	Mail	Field	Total Number Of Completed Questionnaires
Entire Sample	64.1%	24.4%	11.5%	10,815
Age:				
<65	52.2%	31.7%	16.2%	1,077
65–74	66.6%	23.3%	10.1%	5,644
75+	63.8%	24.1%	12.1%	4,094
Sex:				
Male	66.5%	22.5%	11.0%	4,434
Female	62.4%	25.8%	11.8%	6,381
Race:				
White	65.2%	24.1%	10.7%	9,746
Nonwhite	49.4%	29.6%	21.1%	802
Unknown	68.5%	22.1%	9.4%	267

Table 2: Response, Eligibility and Coverage Rates – Entire Sample

Modality	Coverage Rate	Screener Response Rate	Interview Response Rate	Overall Response Rate	Elegibility Rate	Percent With An Unknown Status
Telephone Only	74.3%	87.0%	90.8%	79.0%	96.9%	13.0%
Telephone & Mail	100.0%	85.9%	96.4%	82.8%	94.7%	14.1%
Telephone & Mail & Field	100.0%	98.6%	97.5%	96.1%	92.2%	1.4%

Table 3: Coverage Rates, and Response Rate Changes by Modality For Key Domains of the Population

Category	Telephone Coverage Rate	Telephone Response Rate	Response Rate Change: T+M Versus T Only	Response Rate Change: T+M+F Versus T+M	Response Rate Change: T+M+F Versus T Only	Percent Change: T+M+F Versus T Only
Age:						
<65	57.2%	76.7%	−0.2%	15.8%	15.7%	20.5%
65–74	77.3%	81.8%	4.0%	10.8%	14.8%	18.1%
75+	75.3%	75.7%	5.2%	15.7%	20.9%	27.6%
Sex:						
Male	76.3%	79.9%	3.5%	12.6%	16.1%	20.2%
Female	73.0%	78.2%	4.2%	13.8%	18.1%	23.1%
Race:						
White	75.5%	79.2%	4.5%	12.7%	17.1%	21.6%
Nonwhite	59.0%	72.6%	−1.1%	21.6%	20.4%	28.1%
Unknown	78.0%	83.2%	3.9%	10.4%	14.3%	17.2%

Table 4: Magnitude of Bias and Relative Bias of the Telephone Only and Telephone Plus Mail Modalities

		Magnitude of Bias For:		Relative Bias For:	
	T+M+F Estimate	T+M+F Versus T Only	T+M+F Versus T+M	T+M+F Versus T Only	T+M+F Versus T+M
INFLUENZA VACCINE					
Entire Sample	53.9%	−3.4%	−2.4%	−5.9%	−4.3%
Age:					
<65	35.4%	−4.0%	−2.4%	−10.2%	−6.2%
65−74	55.0%	−2.5%	−4.0%	−4.3%	−3.4%
75+	57.5%	−3.5%	−3.0%	−5.6%	−4.9%
Sex:					
Male	55.5%	−4.1%	−2.4%	−6.9%	−4.1%
Female	52.8%	−2.9%	−2.5%	−5.1%	−4.5%
Race:					
White	55.4%	−2.7%	−2.1%	−4.7%	−3.6%
Nonwhite	39.3%	−10.0%	−6.2%	−20.3%	−13.6%
Unknown	48.1%	−3.4%	−2.1%	−6.7%	−4.1%
High Risk:					
Yes	56.4%	−3.0%	−2.7%	−5.1%	−4.6%
No	50.2%	−4.1%	−2.1%	−7.6%	−4.0%
PNEUMONIA VACCINE					
Entire Sample	25.8%	−1.9%	−0.8%	−6.9%	−3.0%
Age:					
<65	16.3%	−2.3%	0.8%	−12.2%	5.2%
65−74	25.8%	−2.3%	−1.0%	−12.2%	−3.7%
75+	28.3%	−2.1%	−1.0%	−6.7%	−3.4%
Sex:					
Male	26.0%	−1.7%	−0.9%	−6.0%	−3.3%
Female	25.7%	−2.1%	−0.8%	−7.5%	−3.1%
Race:					
White	26.7%	−1.6%	−1.0%	−5.8%	−3.8%
Nonwhite	16.4%	−3.5%	0.9%	−17.6%	5.7%
Unknown	23.3%	−1.4%	0.6%	−5.6%	2.7%
High Risk:					
Yes	29.0%	−2.0%	−0.9%	−6.5%	−3.0%
No	21.0%	−2.0%	−0.8%	−8.7%	−3.7%

Table 5: Bias Components Of Telephone Only Modality Estimates

	Noncoverage	Nonresponse
INFLUENZA VACCINE:		
Entire Sample	61.3%	38.7%
Age:		
<65	61.3%	38.7%
65−74	53.8%	46.2%
75+	57.2%	42.8%
Sex:		
Male	65.9%	34.1%
Female	55.3%	44.7%
Race:		
White	57.3%	42.7%
Nonwhite	76.1%	23.9%
Unknown	20.5%	79.5%
High Risk:		
Yes	51.2%	48.8%
No	70.4%	29.6%
PNEUMONIA VACCINE		
Entire Sample	53.2%	46.8%
Age:		
<65	52.9%	47.1%
65−74	41.4%	58.6%
75+	51.5%	48.5%
Sex:		
Male	52.5%	47.5%
Female	53.6%	46.4%
Race:		
White	53.2%	46.8%
Nonwhite	39.2%	60.8%
Unknown	36.1%	63.9%
High Risk:		
Yes	45.4%	54.6%
No	81.6%	18.4%