ADJUSTMENT FOR NONRESPONSE IN A PHYSICIAN SURVEY

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I. Introduction

The American Medical Association (AMA)'s Socioeconomic Monitoring System (SMS) is an ongoing annual telephone survey of patient care physicians, which collects data on medical practice characteristics. Each year, surveys are completed with approximately 4,000 physicians; survey response rates in recent years have been approximately 65%.

In 1986, AMA staff reviewed the determinants of survey response and alternative weighting strategies for the SMS survey (Thran et al., (1986)). Based on data for 1983-1985, the weighting methodology was selected and has been used for all surveys to date. In response to recent concerns about the appropriateness of the methodology used, this paper examines recent data on characteristics of survey respondents/nonrespondents and alternative approaches to adjust for survey nonresponse. The remainder of the paper is organized as follows: AMA's Socioeconomic Monitoring System Core Survey is described in the next section; the weighting methodology currently employed is discussed in section III; procedures utilized to select the classification variables for weighting are discussed in section IV; results from alternative weighting strategies are presented in the next section; conclusions are presented in the final section.

II. The AMA Socioeconomic Monitoring System Survey

The first Socioeconomic Monitoring System (SMS) Core survey was conducted in the spring of 1982. Originally, the survey was conducted four times a year; since 1991, the survey has been conducted annually. This telephone survey program replaced an annual mail survey, which had collected similar information throughout the 1970s. The survey covers a broad range of economic and practice characteristics. Approximately 4,000 interviews are completed with a computer assisted telephone interviewing (CATI) system each year; the survey is generally fielded from March through July. The average interview lasts 25 minutes. Since 1992, the surveys have been conducted by RAND; prior to that they were conducted by Mathematica Policy Research (MPR). For a complete description of the SMS survey, see Gonzalez (1995).

The SMS surveys are designed to provide representative information on the population of nonfederal physicians who spend the majority of their time in patient care activities. This includes both office- and hospital-based physicians, but excludes residents. Samples for SMS surveys are drawn from the AMA Physician Masterfile. The Masterfile contains current and historical information on every medical school graduate, including both members and nonmembers of the AMA.

The sample design is a random sample from the eligible physicians on the Masterfile. In order to provide reliable estimates of short-term changes in certain indicators, the SMS survey also includes a panel component. The panel consists of a portion of the sample interviewed in the prior SMS survey; approximately 35 percent of the completed interviews are reinterviews of physicians who had been initially interviewed in the SMS survey of the previous year. Individuals are in the panel no longer than two consecutive years.

Since inadequate coverage is a potential problem for telephone surveys, the survey contractor expends considerable effort to locate sample physicians. If the information on the AMA Masterfile is incomplete or incorrect, attempts are made to obtain updated information from a variety of sources including: directory assistance, state and county medical societies, state licensing boards, and hospitals.

Field procedures developed for SMS reflect a complex effort to minimize bias from nonresponse and to accommodate the busy schedules of physicians, through advance preparation and intensive follow-up efforts to complete interviews. Shortly before the field period begins, sampled physicians are sent an advance mailing, which includes: a letter from the Executive Vice President of the AMA; an endorsement letter from the appropriate major specialty society; a brochure describing the survey; and a worksheet for preparing information on practice expenses (information to be collected in the interview).

Due to the relatively short field period, vigorous efforts also are made to achieve the cooperation of physicians. These efforts include:

- scheduling appointments at the physicians' convenience, at any time 14 hours per day Monday through Friday;
- making repeated callbacks to nonrespondents;
- sending personalized letters addressing specific concerns of physicians who initially refuse to be interviewed;
- using a select group of highly skilled interviewers for refusal conversion attempts;
- allowing the use of designated proxies for some or all of the interview; and
- allowing for the completion of the interview in several shorter segments.

III. Current Weighting Methodology

The SMS survey is designed to measure accurately the changing physician practice environment. However, even with a high overall response rate, variations in response rates across subpopulations can significantly reduce the ability of a sample survey to describe accurately the characteristics of the population of interest. This section describes the weighting methodology currently used to correct for survey nonresponse in SMS.

The current weighting strategy was developed in 1986, based on analyses of the 1983 through 1985 surveys. Since the survey samples are drawn from the AMA Physician Masterfile, the weighting analysis could utilize demographic information from the Masterfile that is available for both survey respondents and nonrespondents. The physician characteristics examined were: specialty, census division, location (urban vs. rural), years since graduation from medical school, gender, board certification status, AMA membership status, country of medical school, and major professional activity (office- vs. hospital-based).

Response rates across various subpopulations were examined, and a number of significant differences were found. In order to determine which characteristics to incorporate into the weighting scheme, a multivariate probit analysis of survey response was conducted; in addition, least squares regressions of key survey variables (annual net income, and annual practice expenses) were estimated using the same explanatory variables as in the probit analysis. The objective here was to find characteristics related to survey response as well as to the values of the key survey variables, and to select as comprehensive a set of explanatory variables as possible while restricting the number of weighting classes with no observations. The variables selected for use in devising weighting cells were:

- specialty (10 categories);
- AMA membership status (2 categories);
- board certification status (2 categories); and
- years since graduation from medical school (5 categories).

Thus, there are 200 (= 10 x 2 x 2 x 5) weighting cells. The response weight was derived by first dividing the eligible population (from the version of the Masterfile from which the survey sample was drawn) and the survey respondents into these cells. The response weight was defined as the ratio of the proportion of the eligible population in that cell to the proportion of survey respondents in that cell.

Since in recent years, approximately 8% of the survey sample has been ineligible for the survey, an eligibility correction is also employed. The categories of ineligibility include:

- physicians who spend less than 20 hours per week spent in patient care;
- employees of the federal government;
- resident physicians;
- those who are temporarily not practicing medicine;
- those who are outside the U.S.;
- those who are not physicians;
- retired physicians; and
- those who are deceased.

The subset of the SMS sample for whom eligibility is known (i.e., the survey respondents and those found to be ineligible) was divided into 40 cells - according to years in practice (5 categories), AMA membership status (2 categories), gender (2 categories), and board certification status (2 categories); these were the characteristics found to be predictors of eligibility in the 1986 analysis. The proportion of physicians in each cell who were eligible was calculated; this was the eligibility weight.

The overall weight applied to a given respondent was the product of the response weight and the eligibility correction. Finally, these overall weights were normalized, so that the mean weight was 1.00. A variable was added to the data file which had the value of the weight for each respondent.

This approach to nonresponse adjustment was chosen rather than a regression adjustment. The two techniques yielded similar results, but it was felt that the weighting cell technique was more widely accepted, simpler to understand, and easier to implement.

IV. Selecting Classification Variables for Weighting

Survey response

As the first step in selecting classification variables, we examined survey response rates for 1991 through 1994, with respect to a number of demographic and practice characteristics. (These and other results not presented here are available upon request.) While response rates differed significantly across specialties, the patterns remained fairly constant over the time span. AMA members had significantly higher response rates than nonmembers for the period from 1991 to 1994. Except for 1993, physicians in rural locations were the most likely to respond, while those in large metropolitan areas had the lowest response rates. In 1991, there were significant geographic variations in response rates. In the last two years of the survey, board certified physicians had higher response rates than non-certified physicians. In those same years, U.S. medical graduates also had significantly higher response rates than foreign medical graduates. For all years except 1994, hospital-based physicians had higher response rates than office-based physicians. Finally, there were significant differences by age group in all years except 1992, although the response rate pattern was different each year.

Table 1 reports the odds ratios for the explanatory variables from the survey response logistic regressions. The dependent variable had a value of 1 for respondents and 0 for nonrespondents. Dichotomous variables were created from the categorical variables presented previously; years since graduation and the square of that value (EXPER and EXPER2) were also included as explanatory variables. The reference categories were: general/family practice, office-based practices, physicians in New England, large metropolitan areas, males, U.S. medical graduates, physicians who were not board certified, and non-AMA members. The results suggest that specialty, location (urban-rural), and AMA membership status are consistently related to survey response. In 1994, neither years of experience nor years of experience squared were significant predictors of survey response. In 1991, 1993 and 1994, board certification status was significantly related to survey response (note the change in direction of this relationship after 1992). As indicated by the -2 log likelihood, these explanatory variables were jointly significant in predicting the probability of survey response.

Joint tests of hypotheses about the effect of groups of weighting variables on the probability of survey response were performed by employing a likelihood ratio test statistic. Under the null hypothesis that the variables had no effect on the response probability, minus twice the loge likelihood ratio has asymptotic chi square distribution with the degrees of freedom equal to the number of variables being tested. Except for experience and experience squared in 1992 and 1994, and rural and small metropolitan area in 1991 and 1993, the null hypotheses of no effect of the groups of variables in the weighting cells on the probability of survey response are rejected. (Joint tests of the groups of variables for each of the alternative weighting strategies are discussed below.)

Least squares regression models of annual net income and practice expense equations, using the same set of explanatory variables as in the logistic regressions, were also estimated. In selecting weighting variables, it is desirable to find characteristics related to survey response as well as to the value of key survey variables. This, however, proved not to be a constraint since practically every characteristic examined was related to the value of net income (e.g., in 1994, the only explanatory variables not significantly related to income were type of practice and country of medical school, and the only characteristics not related to expenses were census region and gender).

Eligibility

The final step in evaluating possible changes in the weighting strategy was an examination of determinants of survey eligibility. As mentioned previously, the current weighting strategy utilizes an eligibility correction, where the eligibility rate in each of 40 cells (defined by gender, board certification status, country of medical school, and years of experience) is calculated. We selected those sampled physicians for whom eligibility was known (i.e., complete and partial interviews, break-offs, and those who were found to be ineligible) and created a dichotomous variable indicating whether the individual was eligible. The odds ratios from the logistic regressions of eligibility on the full set of physician characteristics are reported in Table 2. The variables used in the current correction were found to be consistently related to probability of eligibility. Thus, in examining alternative weighting schemes, no modifications to the eligibility correction currently used are proposed.

V. Alternative Weighting Strategies

To find a weighting technique to apply to the 1995 and future surveys, the analysis is focused on adjustments

for nonresponse in 1993 and 1994. The current methodology uses four variables to construct the weighting classes (specialty - 10 categories, board certification status - 2 categories, years of experience - 5 categories, and AMA membership status - 2 categories); this results in 200 weighting cells. Since experience was not found to be a significant predictor of survey response in 1994, we replaced that variable with each of several other characteristics that were previously shown to be related to survey response -- country of medical school, location (large metropolitan vs. rural or small metropolitan), and gender. In addition, we considered a weighting scheme that uses only three variables to construct the weighting classes -- specialty, board certification, and AMA membership. Finally, a weighting scheme with 13 specialty categories (including additional categories for internal medicine subspecialties, surgical subspecialties, and emergency medicine) was used in place of the 10 category specialty in the current weight construction. In each case the response weight was combined with the usual eligibility correction, resulting in a "unit" weight.

The log likelihood test statistics for the tests of joint significance of the groups of variables in the current and the alternative weighting strategies were examined (not presented here). The test statistics for the unrestricted models with the 10 category and the 13 category specialty variables are presented in panel A and B, respectively. All of the null hypotheses that the group of variables in the alternative weights has no effect on the survey response probability can be rejected. The values of the test statistic provide little support for selecting among the alternative weighting strategies.

We also examined, for 1993 and 1994, descriptive statistics (minimum, maximum, and standard error) and the percentage of weighting cells with at least 5 respondents for the current and alternative weights not presented here. The current weight, and its 13 category specialty variation, have larger standard errors than the alternative weights considered. The weighting scheme using only three variables (specialty, board certification, and AMA membership) has the smallest standard error, and range of values of all the weights. Although the minimum values of the weights do not vary among the weighting strategies in either year, the maximum values for weights employing the alternative strategies with the 10 category specialty variable tend to be lower (2.85 to 3.44) than the maximum value from employing the current weight (4.73) in 1994, but higher (4.69 to 6.92) than the current weight (3.59) in 1993. Also each alternative, except for the 13 category specialty variation of the current weight, has a higher proportion of weighting cells with 10 or more respondents than the current weight.

Turning to the weighted means and standard errors for key survey variables reported in Table 3, the current weight results in a slightly lower mean and standard error for net income and practice expenses than the alternative weighting schemes, except for the scheme using the 13 specialty categories. The differences among the weights, and particularly among the alternatives, are small, however. There is even less variation in means and standard errors of hours and visits across the alternative weights, perhaps because of the high item response rates for these variables. The findings suggest that reducing the number of weighting classes, as in the alternative 10 category specialty weighting strategies, reduces the variability (standard errors) of the weights, while having little impact on the variability of the survey estimates. Of the alternative strategies, the weight constructed from specialty, board certification, and AMA membership should be considered as a replacement for the current weighting strategy.

VI. Conclusions

We have conducted a thorough review of the determinants of survey response and eligibility for recent years of the SMS survey, and compared these results to those on which the current weighting strategy is based. We were surprised to find very few differences in the results between the periods examined.

Several alternative response adjustments were developed and implemented using data for 1993 and 1994. Of the alternatives examined, the weight constructed from three variables (specialty, board certification, and AMA membership), should be considered as a replacement for the current weighting strategy. While the results suggest that there are viable substitutes for the current weighting methodology, given the inherent difficulties in changing strategies (particularly in terms of publications which summarize trend data and public use versions of the data set), analysis of the rates of survey and item response in the 1995 SMS survey (and in earlier years) would provide added support for that substitution.

The results of this analysis also suggest that a periodic re-examinations of determinants of survey response and eligibility be undertaken. In addition, other weighting strategies should be considered, as time permits.

Ideally, determinants of response and eligibility should be examined as each survey is completed, and adjustments made if necessary.

References

Kalton, Graham, *Compensating for Missing Survey Data*, Research Report Series 1983.

Gonzalez, Martin L., 1995, *Socioeconomic Characteristics of Medical Practice 1994.*

Brown, Roger L., Christine C. Cannella, William S. Custer, Martin L. Gonzalez and Richard J. Wilke, "Interim Report of the Weighting Committee", Center for Health Policy Research, American Medical Association, Chicago, IL, October 1986

Table 1 **Logistic Regression of Survey Response - Odds Ratio**

	1994	1993	1992	1991
INTERCEPT	0.962	1.448	1.294	3.277
IM	0.835	0.967	0.912	0.703***
SURG	1.077	1.102	0.903	0.931
PED	1.721***	1.534***	2.084***	1.388*
OBGYN	1.190	1.185	1.110	1.088
RAD	1.556***	1.937***	1.946***	1.364*
PSYCH	1.321	1.465**	1.551***	1.430**
ANES	1.164	1.497**	1.577***	1.412*
PATH	1.983	5.258***	4.267***	1.773**
OTHER SPECS	0.816	1.664***	0.960	1.330*
HOSPBASE	1.011	1.265*	1.214	1.335**
EXPER	1.003	0.955***	0.980	0.945***
EXPER2	1.000	1.001***	1.000*	1.001***
MIDATL	0.971	1.001	1.114	1.107
ENCENT	1.076	0.936	1.054	1.002
WNCENT	1.172	1.176	1.124	1.132
SATL	1.011	0.912	1.093	1.102
ESCENT	1.036	0.936	1.084	0.960
WSENT	0.982	0.946	1.117	0.963
MOUNTAIN	1.138	1.143	1.109	1.032
PACIFIC	1.038	1.138	1.298*	0.915
RURAL	1.389***	1.236*	1.429***	1.188*
SMALLMET	1.037	0.987	1.190**	1.076
FEMALE	0.829*	1.084	1.026	0.913
FMG	0.900	0.867*	0.983	1.072
CERT	1.323***	1.187**	0.950	0.835**
AMA	1.764***	1.457***	1.414***	1.407***
-2 Log Likelihood	8294.112***	8231.630***	7800.441***	7542.153***

*p<0.05
**p<0.01
***p<0.001

Table 2 **Logistic Regression of Eligibility - Odds Ratios**

	1994	1993	1992	1991
INTERCEPT	4.914	6.209	2.858	2.113
IM	1.226	0.775	0.684*	0.850
SURG	1.575**	0.894	0.890	1.144
PED	1.232	0.957	1.054	1.006
OBGYN	1.310	1.376	1.145	1.533*
RAD	1.442	1.361	0.831	1.067
PSYCH	2.000	0.949	0.907	1.207
ANES	0.971	0.767	0.687	1.230
PATH	1.288	0.751	0.664	0.843
OTHER SPECS	0.999	0.780	0.667*	1.163
HOSPBASE	0.627***	0.748	0.907	1.020
EXPER	1.044**	1.053***	1.104***	1.104***
EXPER2	0.998***	0.998***	0.997***	0.997***
MIDATL	1.631*	1.296	1.111	1.219
ENCENT	1.496	0.817	1.152	1.223
WNCENT	1.158	0.932	0.661	1.268
SATL	1.141	1.152	1.006	1.460
ESCENT	1.191	1.029	0.846	1.303
WSENT	1.246	0.964	0.977	1.257
MOUNTAIN	0.841	0.669	0.718	0.895
PACIFIC	1.129	0.962	0.974	1.087
RURAL	1.143	1.402*	1.377*	0.991
SMALLMET	0.889	0.896	1.229*	0.997
FEMALE	0.498***	0.459***	0.763*	0.724*
FMG	1.423**	1.683***	1.109	1.260
CERT	1.383**	1.493***	1.470***	1.428***
AMA	2.111***	2.136***	2.014***	2.397***
-2 Log Likelihood	3301.152***	3207.981***	3589.338***	3533.400***

*p<0.05
**p<0.01
***p<0.001

Table 3 **Mean and Standard Errors of Key Variables, Current and Alternative Weights**

	Current	Alternatives				
1994	**SP10/CERT/ EXPER/AMA**	**SP10/CERT/ FMG/AMA**	**SP10/CERT/ LARGEMET/AMA**	**SP10/CERT SEX/AMA**	**SP10/CERT/AMA**	**SP13/CERT/ EXPER/AMA**
Net Income	189,300 (2305)	191,200 (2335)	191,200 (2342)	190,200 (2346)	191,200 (2338)	189,100 (2306)
Practice Expenses	182,200 (4213)	184,700 (4223)	183,500 (4204)	183,800 (4198)	183,700 (4219)	181,800 (4230)
Patient Care Hours/Week	52.14 (0.26)	52.37 (0.25)	52.36 (0.25)	52.24 (0.25)	52.37 (0.26)	52.10 (0.26)
Visits/Week	109.53 (1.06)	110.88 (1.07)	110.34 (1.06)	110.22 (1.06)	110.71 (1.07)	109.50 (1.06)
	Current	**Alternatives**				
1993	**SP10/CERT/ EXPER/AMA**	**SP10/CERT/ FMG/AMA**	**SP10/CERT/ LARGEMET/AMA**	**SP10/CERT SEX/AMA**	**SP10/CERT/AMA**	**SP13/CERT/ EXPER/AMA**
Net Income	181,700 (2233)	183,400 (2264)	183,600 (2278)	182,500 (2263)	183,300 (2259)	181,800 (2236)
Practice Expenses	183,400 (3853)	185,900 (3914)	185,400 (3912)	185,400 (3891)	185,300 (3899)	184,000 (3831)
Patient Care Hours/Week	52.86 (0.27)	52.94 (0.27)	52.94 (0.27)	52.85 (0.27)	52.98 (0.27)	52.92 (0.27)
Visits/Week	112.36 (1.09)	113.14 (1.10)	112.73 (1.09)	112.86 (1.10)	113.16 (1.10)	112.65 (1.10)