INVESTIGATION OF ALTERNATIVE NONRESPONSE ADJUSTMENT METHODS IN THE MEDICAL EXPENDITURE PANEL SURVEY (MEPS)¹

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Introduction

The Medical Expenditure Panel Survey (MEPS) is a complex national probability sample survey sponsored by the Agency for Healthcare Research and Quality (AHRQ). MEPS is designed to provide nationally representative estimates of health care use, expenditures, sources of payment, and insurance coverage for the U.S. civilian noninstitutionalized population. It comprises three component surveys with the Household Component (HC) as the core survey. The MEPS-HC, like most sample surveys, experiences unit, or total, nonresponse despite intensive efforts to maximize response rates. Survey nonresponse is usually compensated for by some form of weighting adjustment to reduce the potential bias in survey estimates. Currently, a weighting class nonresponse methodology socio-economic, adjustment using demographic, and other variables is used in the MEPS to create the weighting classes (cells) to adjust for potential nonresponse bias at the dwelling unit (DU), i.e., household level (Cohen, DiGaetano, and Goksel, 1999). An alternative approach for forming nonresponse adjustment cells is to use predicted response propensities. This paper summarizes research undertaken to investigate the potential use of response propensities to form DU nonresponse adjustment cells in the MEPS. DU level survey estimates for selected survey components, coefficients of variation (CVs), and distributions of weights based on the two alternative nonresponse adjustment methods are compared and methodological issues discussed.

Background: MEPS Sample and Weights

The sample for the MEPS-HC is drawn from respondents to the National Health Interview Survey (NHIS), conducted by the National Center for Health Statistics. The MEPS-HC uses an overlapping panel design in which data are collected through a series of five rounds of interviews over a two and one-half year period. Detailed information on the MEPS sample design has been previously published (Cohen, 1997; Cohen, 2000).

Two separate nonresponse adjustments are

performed as part of the process for development of analytic weights in MEPS. The first is an adjustment for DU nonresponse at round 1 to account for nonresponse among those households subsampled from NHIS for the MEPS. The second is a person level nonresponse adjustment to account for survey attrition across the various rounds of data collection. This paper deals only with the DU nonresponse adjustment.

The base weight in the MEPS is the reciprocal of an intermediate weight from the NHIS reflecting the disproportionate sampling of minorities in NHIS with a ratio adjustment to NHIS population estimates to account for NHIS nonresponse and undercoverage. This ratio adjusted base weight is then adjusted for nonresponse of MEPS eligible sample DUs at round 1. More specifically, the base weights of MEPS responding DUs are adjusted to compensate for the nonresponding DUs. The 1996 to 2000 MEPS DU response rates ranged from 80-83 percent (among the NHIS households fielded for MEPS).

Nonresponse Weighing Adjustment

The use of classifying or auxiliary variables, i.e., covariates, to form nonresponse adjustment cells is a commonly used method for nonresponse adjustment. It has been shown by Cochran (1968) that it is effective in removing nonresponse bias in observational studies. Rosenbaum and Rubin (1984) have indicated that as the number of covariates increases, the number of classes grows exponentially and suggest using predicted response probabilities or propensity scores from a logistic regression model based on the covariates to form the weighting classes or cells. A propensity score of response in surveys is essentially the conditional probability that a person or household responds given the covariates. More elaboration of the propensity score and its application in nonresponse adjustments can be found in Little (1986) and Little and Rubin (2002) among others. A previous comparison of the use of covariates versus the use of response propensities to form classes for nonresponse adjustment in the third national Health and Nutrition Examination Survey (NHANES III) was reported by Ezzati-Rice and Khare (1994).

The current method implemented by Westat for MEPS to compensate for nonresponse to the survey at the

¹ The views expressed in this paper are those of the authors and no official endorsement by the Department of Health and Human Services or the Agency for Healthcare Research and Quality is intended or should be inferred.

DU level uses the method of cell classification based on levels of covariates. In this research study, we investigate the use of response propensities to construct nonresponse adjustment cells, and we assess the difference between the two methods of forming cells for nonresponse adjustment to compensate for DU nonresponse at round 1 of the 2000 MEPS. There were two aspects of our research. The first compared the two alternative nonresponse adjustment methods based on 17 covariates that are currently used in MEPS. The second comparison of the two adjustment methods involved the use of the 17 covariates for formation of the weighting classes and an updated set of 13 covariates identified through an analysis of 2000 MEPS data for the response propensity classes.

Methods

Part 1

The basic calculation for adjustment of the MEPS base weights to compensate for DU nonresponse was the same for both methods investigated in this report. The main difference was the way in which the adjustment cells were formed, i.e., how to classify the sample DUs.

In the method currently used for MEPS, Westat uses a tree diagram generated by the computer package CHAID to form nonresponse adjustment cells using 17 classifying variables. Cells are collapsed if necessary to assure that the number of respondents in a cell was no less than 20 (Göksel, Alvarez-Rojas, and Hao, 2001). It should be noted that because of the unique sample linkage of MEPS and the NHIS, a sizeable number of variables are available from the NHIS for responding and nonresponding eligible MEPS DUs. The following is the list of 17 variables used by Westat to construct subclasses for the DU nonresponse adjustment in the 2000 MEPS-HC. These classifying variables were determined based on analysis of 1996 MEPS-HC data (Cohen and Machlin, 1998).

- 1. Age of the reference person
- 2. Race/ethnicity of the reference person
- 3. Marital status of the reference person
- 4. Gender of the reference person
- 5. Number of persons in the DU
- 6. Education of the reference person
- 7. Family income of the reference person
- 8. Employment status of the reference person
- 9. Whether there is a working phone inside the house
- 10. Major work status working or reason of not working
- 11. DU level health status
- 12. If anyone in the DU needs help with daily activities
- 13. Census region
- 14. Metropolitan Statistical Area (MSA) size
- 15. MSA/Non MSA residence

- 16. Urban/Rural residence
- 17. Type of primary sampling unit (PSU)

The alternative method of forming adjustment cells which is investigated in this paper uses propensity scores to categorize sample units. Propensity score of response in surveys is essentially the conditional probability of response given the covariates. For this study, it was calculated through the following steps:

- 1. Run a logistic regression with response/nonresponse indicator as the dependent variable using the 17 significant covariates described above.
- 2. Convert the estimated logit value obtained from the logistic model established in step 1 into predicted probability of response, i.e., the propensity score, through the following equation:

PROB=EXP(LOGIT)/(1+EXP(LOGIT)).

The sample was then grouped into classification cells, based on those propensity scores. In this study we present the results from groupings of 5 and 100 to compare with the results from the current method. The selection of 5 groups was based on the optimality established by Cochran (1968), and extended to propensity scores in observational studies by Rosenbaum and Rubin (1984). These studies showed that five classes were often sufficient to remove 90% of the bias due to the covariates. The inclusion of 100 groups was designed to assess the effect of a much finer classification using propensity scores while keeping the number of respondents in a cell at no fewer than 20 to match the criterion used in the current method by Westat.

Part 2

Since the above 17 covariates were based on 1996 MEPS data, an updated set of covariates was identified using 2000 MEPS data (panel 5, round 1) in a related research project by Kashihara *et. al.* (2003). In that project, the following 10 variables were evaluated as potential additional covariates:

- 1. Type of home House/apt/flat/condo, other type of dwelling
- 2. Language used in the interview
- 3. Whether the reference person is U.S. citizen
- 4. Amount spent on family medical expenses
- 5. Home ownership
- 6. Born in the U.S.
- 7. Main reason the reference person did not work last week
- 8. How long the household was without phone service in the last 12 months
- 9. Number of nights the reference person was hospitalized in the past 12 months

10. Whether the reference person has health care coverage

A backward elimination procedure was then carried out to identify the significant covariates from the combined 27 variables (17 current and 10 new). The following were the ones identified as significant:

- 1. Race/ethnicity of the reference person
- 2. Marital status of the reference person
- 3. Family income of the reference person
- 4. If anyone in the DU needs help with daily activities
- 5. Census region
- 6. Metropolitan Statistical Area (MSA) size
- 7. Whether there is a working phone inside the house
- 8. Number of persons in the DU
- 9. Type of primary sampling unit (PSU)
- 10. Language used in the interview
- 11. Amount spent on family medical expenses
- 12. Number of nights the reference person was hospitalized in the past 12 months
- 13. Whether the reference person has health care coverage.

These 13 variables were used as covariates in an updated model for the propensity scores in part 2 of our investigation.

Adjustment and Evaluation Approach

After sample dwelling units were classified into cells by one of the three methods of forming adjustment classes (the current cross classification scheme, the 5 groups, and 100 groups using predicted response propensities), the base weights of responding DUs were inflated by an adjustment factor within each cell. The adjustment factor was the ratio of the sum of the base weights of all units in the cell to the sum of the base weights of only the respondents in the cell.

The DU nonresponse adjusted weights based on each of the nonresponse adjustment methods were then applied to selected health and expenditure variables to calculate DU level nonresponse adjusted estimates. The resulting distributions of the weights and weighted summary statistics of the selected analytical variables from the three methods (one weighting class and two groups of response propensities) were compared. These DU nonresponse adjusted estimates are for research purposes only and do not reflect the full set of adjustments undertaken in the survey to produce national estimates.

The analytical variables selected for this research were: insurance coverage, health status, and total health care expenditures (payments). Insurance coverage was defined in three categories:

1=all members in the DU were insured (for approximately first half of the year),

2 = some of the members were insured (for approximately first half of the year),

3 = none of the members were insured (for approximately first half of the year).

Health status was also defined in three categories:

1=all members in the DU were reported as in fair or poor health at the round 1 interview,

2 = some members were reported as in fair or poor health at the round 1 interview,

3=all members were reported as in good to excellent health at the round 1 interview.

The total health care expenditures variable reflects total payments for health care services during the year for all persons in the DU (household).

For Part 1 of the evaluation, there were 5,357 DUs in the first round of panel 5 (the 2000 MEPS panel), of which 4,334 responded to the survey. The comparison of the first set of adjusted weights based on the three adjustment methods with the 17 covariates as currently used by Westat was done with these 4,334 units. There was one unit with missing insurance coverage and health status. Hence, the number of units used in the analysis of insurance coverage and health status was 4,333. There were thirty-five units that had missing health care expenditures values because while they were respondents to round 1, they later became survey nonrespondents at subsequent rounds and therefore only had expenditures for part of the year. Therefore, the number of units used in the analysis of health care expenditures was 3,999.

For Part 2 of the analysis, when adding the additional 10 potential covariates from the NHIS data, there were only 5,056 DUs in the first round of panel 5 (the 2000 MEPS panel) which had available data from NHIS. Among these 5,056 DUS, there were 4,173 who were respondents to the survey. The comparison of the updated propensity models and the current method was done with these 4,173 units and using the 13 significant covariates from the evaluation of the combined 27 current and new variables. The one unit with missing insurance coverage and health status is among these 4,173. Hence, the number of units used in the analysis of insurance coverage and health status was 4,712 and 3,864 of these 4,173 units had values for health care expenditures. Thus, the number of units used in the analysis of health care expenditures was 3,864.

Results

In this section, we present the results of the alternative nonresponse adjusted weights and their application to the selected analytical variables. Tables 1 to 4 show the results of the current weighting class method and the method of propensity scores based on the 17 covariates as currently used in the MEPS. Tables 5 to 8 present parallel results of the current method using 17 covariates (but based only on the subsample of cases used for the 13 variable analysis), as well as the results of the propensity score method using the new set of 13 covariates.

Part 1

Table 1 shows the standard deviation, mean, minimum, and maximum of the weights after adjustment for DU nonresponse using each of the three methods of adjustment. The means are very close to one another. The standard deviation using the method of propensity scores with 5 groups is the smallest (10,558) followed by the current method (10,806).

Table 2 shows the proportion in each category of insurance coverage using weights adjusted for DU nonresponse under each of the three methods of adjustment. All the estimated values are close to one another. However, the standard errors using the method of propensity scores with 5 groups are slightly smaller than the ones from the other two methods.

Table 3 shows the weighted proportion in each category of health status using weights adjusted for nonresponse under each of the three methods. Again, all the estimated values are very close to one another. However, the standard errors using the method of propensity scores with 5 groups are slightly smaller than or equal to those from the other two methods.

Tables 4 (A) and (B) show the mean and median and their standard error (SE) and coefficient of variation (CV) of the total DU health care expenditures under each of the three alternative methods. The estimated means and medians are close to one another. However, the CVs using the method of propensity scores with 100 groups are slightly smaller than those from the other two methods.

Part 2

Table 5 shows the standard deviation, mean, minimum, and maximum of the weights after adjustment for nonresponse using each of the three methods of adjustment. The means are very close to one another. The standard deviation using the method of propensity scores with 5 groups is the smallest followed by the current method.

Table 6 shows the weighted proportion in each category of insurance coverage using weights adjusted for nonresponse under each of the three methods of adjustment. All the estimated values are close to one another. However, the standard errors using the method of propensity scores with 5 groups are slightly smaller than or equal to the ones from the other two methods.

Table 7 shows the weighted proportion in each category of health status using weights adjusted for nonresponse under each of the three methods. All the estimated values are very close to one another. All the standard errors are nearly identical to one another.

Tables 8 (A) and (B) show the means and medians and their standard errors (SE) and coefficient of variation (CV) of the DU total health care expenditures under each of the three alternative methods. The estimated means and medians are close to one another. The CV for the estimated mean using the method of propensity scores with 100 groups was slightly larger, whereas the CV for the median was slightly smaller than those from the other two methods.

Discussion

From the results presented in the previous section, the differences between the current and the alternative response propensity method were very small. However, the standard deviation of the adjusted weights and the standard errors of the estimated quantities from the method of using 5 groups based on predicted response propensities are usually less than or equal to those of the current method. This gives some support to the optimality of five subclasses suggested by Cochran (1968). The body of theory developed on the issue of using propensity scores and applications in real studies indicates that methods using propensities are preferable to the traditional cross-classification of variables method, e.g., Rosenbaum and Rubin (1984). In the case of the MEPS where a large number of auxiliary variables are available from the NHIS due to the unique linkage of the MEPS and NHIS, the ability to incorporate a sizeable amount of auxiliary information in the propensity score methodology could be potentially beneficial. However, based on our initial analysis, the differences observed between the current weighting class cross-classification versus formation of weighting classes based on propensity scores were not significant. But, it should be recognized that the results presented in this report apply only to an intermediate step of the full weight development process in the MEPS-HC. Further differences between the methods investigated may be revealed in later stages of nonresponse adjustment, for example, for survey attrition after round 1, which is currently under investigation. Adjustments for panel attrition in the MEPS using predicted response propensities to form the weighting cells could be useful since a sizeable amount of information is available from the early rounds of data collection. In the future, we will also assess the use of direct propensity scores with interactions in the model. In addition, the use of a combination of methods may also be investigated.

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Table. 1. Distribution of Nonresponse Adjusted Dwelling Unit (DU) Weights (Propensity models based on 17 variables) n=4,334

| NR Adj. Method* | Standard deviation | Mean | Minimum | Maximum |
|-----------------|--------------------|-------|---------|---------|
| Current Method | 10806 | 24738 | 4193 | 105669 |
| 5 groups | 10558 | 24748 | 4488 | 88251 |
| 100 groups | 10945 | 24740 | 4217 | 100431 |

Source: Round 1, 2000 MEPS.

Table 2. Percent distribution of insurance coverage (DU level), with standard errors in () (Propensity models based on 17 variables) n=4,333

| NR Adj. Method* | All members insured | Some members insured | No members insured |
|-----------------|---------------------|----------------------|--------------------|
| Current method | 75.88 (0.82) | 15.60 (0.58) | 8.52 (0.55) |
| 5 groups | 75.87 (0.80) | 15.70 (0.57) | 8.43 (0.53) |
| 100 groups | 75.82 (0.81) | 15.66 (0.58) | 8.51 (0.54) |

Note: Estimates are for research purposes only and do not reflect national estimates. Source: Round 1, 2000 MEPS.

Table 3. Percent distribution of health status (DU level), with standard errors in ()(Propensity models based on 17 variables) n=4,333

| NR Adj. Method* | All members reported as in | Some members reported as | All members reported as in |
|-----------------|----------------------------|--------------------------|----------------------------|
| | fair or poor health | in fair or poor health | good to excellent health |
| Current method | 6.84 (0.47) | 16.48 (0.57) | 76.68 (0.68) |
| 5 groups | 6.66 (0.46) | 16.38 (0.56) | 76.96 (0.67) |
| 100 groups | 6.79 (0.48) | 16.31 (0.56) | 76.90 (0.67) |

Note: Estimates are for research purposes only and do not reflect national estimates. Source: Round 1, 2000 MEPS.

Table 4. Weighted mean and median of total health care expenditures (DU level)(Propensity models based on 17 variables) n = 3,999

(A) Mean

| NR Adj. Method* | Mean | SE of Mean | CV of Mean |
|-----------------|---------|------------|------------|
| Current method | 5867.31 | 233.43 | 0.0398 |
| 5 groups | 5857.27 | 226.60 | 0.0387 |
| 100 groups | 5834.02 | 224.89 | 0.0385 |

(B) Median

| NR Adj. Method* | Median | SE of Median | CV of Median |
|-----------------|---------|--------------|--------------|
| Current method | 2454.52 | 85.80 | 0.0350 |
| 5 groups | 2479.67 | 87.46 | 0.0352 |
| 100 groups | 2466.89 | 82.69 | 0.0335 |

Note: Estimates are for research purposes only and do not reflect national estimates. Source: Round 1, 2000 MEPS.

* NR. Adj. Method = Nonresponse adjustment methods:

Current method = method of classification on levels of covariates currently used in MEPS.

5 groups = method of using propensity scores to classify units into 5 groups.

100 groups = method of using propensity scores to classify units into 100 groups.

Table. 5. Distribution of Nonresponse Adjusted Dwelling Unit (DU) Weights(Current method based on 17 variables and propensity models based on 13 updated variables) n=4,173

| NR Adj. Method* | Standard deviation | Mean | Minimum | Maximum |
|-----------------|--------------------|-------|---------|---------|
| Current Method | 10645 | 24519 | 4193 | 105669 |
| 5 groups | 10332 | 24499 | 4506 | 88028 |
| 100 groups | 10729 | 24500 | 4309 | 92443 |

Source: Round 1, 2000 MEPS.

Table 6. Percent distribution of insurance coverage (DU level), with standard errors in () (Current method based on 17 variables and propensity models based on 13 updated variables) n=4,172

| NR Adj. Method* | All members insured | Some members insured | No members insured |
|-----------------|---------------------|----------------------|--------------------|
| Current method | 76.02 (0.83) | 15.53 (0.60) | 8.45 (0.53) |
| 5 groups | 76.14 (0.81) | 15.55 (0.58) | 8.32 (0.52) |
| 100 groups | 76.09 (0.82) | 15.53 (0.59) | 8.38 (0.52) |

Note: Estimates are for research purposes only and do not reflect national estimates. Source: Round 1, 2000 MEPS.

Table 7. Percent distribution of health status (DU level), with standard errors in ()(Current method based on 17 variables and propensity models based on 13 updated variables) n=4,172

| NR Adj. Method* | All members reported as in | Some members reported as | All members reported as in |
|-----------------|----------------------------|--------------------------|----------------------------|
| | fair or poor health | in fair or poor health | good to excellent health |
| Current method | 6.70 (0.48) | 16.73 (0.58) | 76.57 (0.68) |
| 5 groups | 6.57 (0.48) | 16.72 (0.58) | 76.72 (0.67) |
| 100 groups | 6.57 (0.48) | 16.77 (0.58) | 76.66 (0.67) |

Note: Estimates are for research purposes only and do not reflect national estimates. Source: Round 1, 2000 MEPS.

Table 8. Weighted mean and median of health care expenditures (DU level) (Current method based on 17 variables and propensity models based on 13 updated variables) n=3,864

(A) Mean

| NR Adj. Method* | Mean | SE of Mean | CV of Mean |
|-----------------|---------|------------|------------|
| Current method | 5862.24 | 232.41 | 0.0396 |
| 5 groups | 5858.53 | 230.54 | 0.0394 |
| 100 groups | 5863.74 | 233.23 | 0.0398 |

(B) Median

| NR Adj. Method* | Median | SE of Median | CV of Median |
|-----------------|---------|--------------|--------------|
| Current method | 2490.46 | 92.41 | 0.0371 |
| 5 groups | 2496.19 | 91.73 | 0.0367 |
| 100 groups | 2517.22 | 89.97 | 0.0357 |

Note: Estimates are for research purposes only and do not reflect national estimates. Source: Round 1, 2000 MEPS.

* NR. Adj. Method = Nonresponse adjustment methods:

Current method = method of classification on levels of covariates currently used in MEPS.

5 groups = method of using propensity scores to classify units into 5 groups.

100 groups = method of using propensity scores to classify units into 100 groups.