

## **Assessment and Evaluation of Nonresponse Error in the Medical Expenditure Panel Survey (MEPS): Assessing Nonresponse Bias Reduction in MEPS<sup>1</sup>**

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### **Abstract**

Nonresponse in surveys can lead to potential bias in estimates. A strategy to address potential nonresponse bias is to carry out weighting adjustments to reduce nonresponse bias in the survey estimates. Auxiliary variables (nonresponse adjustment covariates) available for all sample persons are used in constructing nonresponse adjusted weights. With the sample for the MEPS being drawn from respondents to the National Health Interview Survey (NHIS), variables from the NHIS sampling frame are available on both MEPS respondents and nonrespondents. Theory and previous research indicate to effectively reduce bias without increasing variance, nonresponse adjustment covariates should be highly related to both response propensity and actual survey outcome variables. In this study, we examine the association between the covariates and selected survey outcome variables as a measure of potential reduction of nonresponse bias of the outcome variables. In addition, we assess the association between the nonresponse adjusted weights and the selected survey variables as an additional measure of the relationship between nonresponse adjustment covariates and survey outcome variables.

**Key words:** nonresponse, bias, covariates, auxiliary variables, association

### **1. Introduction**

The Medical Expenditure Panel Survey (MEPS) is a complex national probability sample survey sponsored by the Agency for Healthcare Research and Quality (AHRQ). The MEPS sample is drawn from respondents to the previous year's National Health Interview Survey (NHIS), conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention. 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. Detailed information on the MEPS sample design has been previously published (Cohen, 1997; Cohen, 2000; Ezzati-Rice, et al, 2008).

The MEPS, 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. Nonresponse adjustment methods make use of covariates that are available for both respondents and nonrespondents. With the sample for the MEPS being drawn from respondents to the National Health Interview Survey (NHIS), variables from the NHIS are available for both MEPS respondents and nonrespondents.

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Theory and previous research indicate that to effectively reduce bias without increasing variance, nonresponse adjustment covariates should be highly related to both the response propensity and the survey outcome variables (e.g., Little and Vartivarian (2005)). In this paper, we assess the association between the auxiliary variables (covariates) used for nonresponse adjustment of the weights and selected key outcome variables as an indication of potential reduction of nonresponse bias. We also assess the association between nonresponse adjusted weights and the selected key outcome variables as another indication of nonresponse bias reduction by the covariates. The data used in this report are the 2006 MEPS Panel 11 data.

## 2. Nonresponse and Weight Adjustment in MEPS

The MEPS 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. Two separate nonresponse adjustments are performed as part of the process for development of the analytic weights in MEPS. The first is an adjustment for dwelling unit (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 assesses bias reduction properties of the DU level nonresponse adjustment.

The current method implemented in the MEPS to compensate for nonresponse at the DU level uses CHAID's "tree algorithm" response propensity approach to form nonresponse adjustment cells (Cohen, DiGaetano, and Goksel, 1999). Previous studies (Cohen and Machlin (1998), and Kashihara, et al (2003)) have identified 29 variables in 5 categories from NHIS that are related to response propensity as potential auxiliary variables for adjusting weights to compensate for DU level nonresponse. For each new panel of MEPS, a subset of these 29 covariates is selected via CHAID to form adjustment cells for adjusting weights. The 29 covariates in the 5 categories are given in Table 1, with the 19 selected via CHAID for the 2006 MEPS Panel 11 denoted by '\*\*'.

## 3. Assessment I

In this section, we examine the association between the nonresponse covariates from the NHIS and selected outcome variables from the MEPS.

The procedures implemented in MEPS for adjusting the weights to compensate for nonresponse are designed to reduce potential nonresponse bias in survey outcome estimates. As indicated by Little and Vartivarian (2005), to effectively reduce the nonresponse bias the covariates used in the adjustment need to be related to the response propensity as well as the outcome variables. The covariates used in MEPS for weight adjustment were previously identified as significantly related to response propensity. In this research, we assess whether the identified covariates are also related to selected key outcome variables to ascertain Little and Vartivarian's second requirements as an additional measure of the effectiveness of the MEPS DU level nonresponse adjustment. Table 2 displays the 33 MEPS key outcome variables according to nine major survey topics that were selected for this assessment.

We assess to what extent a survey topic area has benefited from the nonresponse covariates in terms of the strength of association between the survey topic area and the nonresponse covariates. The strength of association is measured at four levels in terms of

the number of specific variables within the individual survey topic area that are significantly associated with a nonresponse covariate. The significance of the association is determined by the chi-square statistic between a nonresponse covariate and an outcome variable. If the p-value of the chi-square is equal to or less than 0.05, the association is considered significant. The association of a nonresponse covariate and a survey topic area is:

- Strong: if 100% of the associations of the nonresponse covariate with the outcome variables in an individual survey topic area are significant.
- Medium: if less than 100% but more than 50% of the associations are significant.
- Weak: if less than 50% but more than 0% of the associations are significant.
- Nonsignificant: if none of the associations are significant.

The following is an example. The survey topic area of expenditures has seven outcome variables (Total, Office-based, Outpatients, etc., see Table 2.). Among the 19 covariates used for nonresponse weight adjustment, each of the following six: age, race/ethnicity, gender, DU size, health status, and census region, is significantly associated with all seven expenditure outcome variables. Thus, each of these six nonresponse adjustment covariates was labeled as strongly associated with expenditures. Another five nonresponse covariates (poverty status, education, income, medical expenditure, and home ownership) had four to six significant associations with the seven expenditure outcome variables, and therefore they have medium association with expenditure. The eight remaining nonresponse covariates (any black (in the household), has phone, MSA size, MSA/nonMSA, urban/rural, type PSU, home type, and hospital nights) each had one to three significant associations with the expenditure outcome variables, and thus they were identified as weakly associated with expenditures.

Table 3 provides the summary counts and degree of association between the nine survey topic areas and the 19 nonresponse covariates. Among the 171 ( $9 \times 19 = 171$ ) associations, 102 were found to be strong, 41 medium, 22 weak, and 6 were insignificant. Thus, over 80% of the associations were found to be medium to strong, indicating the nine key survey topic areas appear to have significantly benefited from the 19 nonresponse covariates (based on the panel 11 data used in this study).

#### 4. Assessment II

In this section, we examine the association between the nonresponse adjusted weights and the outcome variables. Since the MEPS sample is a complex stratified sample with oversampling of selected policy level domains, the variation of the weights included the effect of those complexities. Therefore, to assess the association between the nonresponse adjustment and the outcome variables, we need to work with the ‘uncontaminated’ effect of the nonresponse adjustment. We assess the association using the ratio of the nonresponse adjusted weights and the pre-adjusted weights, i.e. the adjustment factor, as representative of the effect of the nonresponse adjustment. Again, we use the p-value of the chi-square statistics between the adjustment factor and the outcome variable to determine the significance of the association. If the p-value is equal to or less than 0.05, the association is considered significant.

Among the 33 outcome variables, only two: Doctor advised to quit smoking, and go to USC (usual Source of Care) for preventive care, were not significantly associated with the nonresponse adjustment factor.

## 5. Summary

The majority of the covariates currently used in adjusting weights to compensate for MEPS DU level nonresponse are significantly related to key outcome variables. Nonresponse adjusted weights, as assessed through adjustment factors, are also significantly related to most of the outcome variables. This research provides a good indication that the nonresponse weight adjustments implemented in MEPS are effective in reducing nonresponse bias in key outcome measures. The results can be used to inform future research on types and number of adjustment variables to reduce nonresponse bias in the MEPS survey.

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Table 1. NHIS nonresponse covariates\* by variable categories, 2006 MEPS Panel 11 Round 1

Category →	Demographics	Household Characteristics	Socio-Economic Status	Geographic	Health
29 Nonresponse Covariates	Age**	DU size**	Poverty status**	Census region**	Health status**
	Race/ethnicity**	Has phone**	Education**	MSA size**	Need help with personal care needs
	Marital status	Type of PSU**	Income**	MSA/nonMSA**	Not working – health reasons
	Gender**	Type of home**	Employment status	Urban/Rural**	Number of nights in hospital**
	Any Asian in household	Time without phone	Family medical expense category**		Healthcare coverage
	Any Black in household**		Home ownership**		
	Interview language				
	US citizenship				
	Born in US				

\* Covariates at person level are based on the reference person of the dwelling unit (DU)

\*\* selected via CHAID to form the nonresponse adjustment cells

Table 2. MEPS key survey outcome variables according to 9 major survey topic areas

Survey Topic Area →	Income	Employment Status	Expenditures	Health Status	Mental Health	Insurance Coverage	Access to Care	Utilization	Prevention
33 Survey Outcome Variables	Total income	Employment status	Total	Perceived health status	Mental health status	Insurance coverage	Unable to get medical care	Office based visits	Time since 1 <sup>st</sup> blood pressure check
			Office-based	Limitation in function			Unable to get dental care	Outpatient visits	Advised to exercise more
			Outpatient	Social limitation			Unable to get prescribed medicine	Emergency room visits	Dr. advised to quit smoking
			Emergency room doctor	Cognitive limitation			Reason do not have usual service	Inpatient stays	How long since the 1 <sup>st</sup> routine check up
			Emergency facility	Limitation on work			Have usual service provider	Dental visits	Go to usual source of care for preventive care
			Hospital doctor					Home health care	
			Hospital facility					Rx purchase	

Table 3. Summary table of the level of association between 9 key MEPS survey topic areas and the DU level nonresponse covariates

Survey topic area ↓	Strength of association with DU level nonresponse covariates			
	strong	medium	weak	nonsignificant
Total income	18			1
Employment status	18			1
Mental health	18			1
Insurance coverage	17			2
Health status	11	7	1	0
Access to care	7	8	4	0
Expenditures	6	5	8	0
Utilization	6	10	3	0
Prevention	1	11	6	1
Total = 171 (100%)	102 (59.6%)	41 (23.9%)	22 (12.9%)	6 (3.5%)