# An Evaluation of Nonresponse Adjustment Cells for the Household Component of the Medical Expenditure Panel Survey (MEPS)<sup>1</sup>

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# **KEY WORDS:** Weight adjustment, Nonresponse bias

# Introduction

Despite intensive efforts to maximize participation in household sample surveys, most surveys experience some level of nonresponse. Nonresponse in sample surveys can lead to potential bias of population estimates. In household surveys, there are two kinds of nonresponse: "unit" or "total" nonresponse and "item" nonresponse. Unit nonresponse occurs when a sample household fails to respond to the survey. Item nonresponse occurs when a respondent fails to answer a specific survey question or questions. For both types of nonresponse, potential bias in the survey estimates can result, especially if nonresponding units differ from responding units according to specific characteristics.

It is common to use some type of post-survey nonresponse adjustment to compensate for unit nonresponse and to reduce the impact of missing data from sampled units, that is, to reduce potential nonresponse bias in the estimates from the sample survey. The focus of this paper is on the adjustment for dwelling unit (DU) nonresponse in the Medical Expenditure Panel Survey (MEPS). The MEPS Household Component (HC), sponsored by the Agency for Healthcare Research and Quality, is a large, ongoing, national probability sample survey of the U.S. civilian noninstitutionalized population. The MEPS-HC collects information from household respondents to produce national- and regional-level estimates of health care use, health status, health conditions, medical expenditures, sources of payment, insurance coverage, and health care access for the U.S. civilian noninstitutionalized population and selected policy-relevant sub-population groups. The MEPS-HC consists of an overlapping panel design in which persons in each new panel are interviewed five times over a 30-month period. The DUs in the MEPS survey are a sub-sample of the households who participated in the prior year's National Health Interview Survey (NHIS) conducted by the National Center for Health Statistics. Thus, demographic, socio-economic, and health characteristics data are available from the NHIS for both responding and non-responding DUs in MEPS for use in adjusting for DU nonresponse at Round 1 of the MEPS.

A weighting class (cell) adjustment procedure is used for the MEPS-HC to adjust the base weights of responding dwelling units using variables related to response status. The weighting class adjustment makes the assumption that respondents and nonrespondents in the same weighting adjustment class are similar with respect to a set of demographic, socio-economic, health, and other characteristics. The current set of classifying variables was based upon analyses of nonresponse data from Round 1 of the 1996 MEPS survey and auxiliary data from the 1995 NHIS (Cohen and Machlin, 1998). Specifically, a number of the demographic and socioeconomic variables were based on the characteristics of the reference person in the primary NHIS reporting unit (person who owns or rents the unit) at the time of the NHIS interview. The current set of 18 classifying variables include: age, race/ethnicity, gender, marital status, work and activity status, employment status, education, region, MSA size, MSA/non-MSA residence, health status, at least one person in the DU needs help with activities of daily living, working telephone, number of persons in the DU, urban/rural residence, type of primary sampling unit (PSU), family income, and flag for families - whether income is known (Goksel, et. al., 2001).

# Methods

In this paper, we first examine the set of 18 variables currently used to group respondents and nonrespondents into weighting class cells and then we evaluate additional potential auxiliary variables using recent MEPS data. This study is based on data from the 2000 (Panel 5) MEPS survey and the 1999 NHIS. A linked file was created between the 2000 MEPS sample DUs and the 1999 NHIS. This file permitted a comparison of the characteristics of MEPS respondents and nonrespondents at Round 1 of the 2000 MEPS.

The first step in the evaluation of the model of DU nonresponse was an examination of the 18 variables that

<sup>&</sup>lt;sup>1</sup> 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.

are currently used in the MEPS DU nonresponse adjustment. The current set of 18 classifying variables were identified based upon analysis of 1996 MEPS data; however, recent trends in health care, survey responsiveness, and other related issues may have altered the influence of these variables on survey response. Thus, for step 1 of the analysis, the 18 current variables, using 1999 NHIS data, were crossed with response status to the 2000 MEPS to identify characteristics that distinguish responding DUs from nonresponding DUs. Overall tests for associations were conducted using chi-square tests of significance at the alpha = 0.05 level.

The second step of our analysis involved canvassing the 1999 NHIS for additional auxiliary variables that might be useful in the cell weighting adjustment. Again, overall tests for associations were conducted using chi-square tests of significance at the alpha = 0.05 level.

In the third step, a logistic regression analysis was carried out to identify the most important variables to consider for inclusion in the MEPS DU nonresponse adjustment. An unweighted backward elimination logistic regression was run to remove variables that did not meet a Wald chi-square test statistic significance level of five percent, the SAS default level (SAS Institute, Inc., 1995). The measures remaining from this variable reduction process defined the final model for this study.

# Results

Based on 2000 Panel 5 MEPS data, of the 5,357 sample DUs, 4,386 (81.9%) responded to Round 1 of the survey and 971 (18.1%) did not respond. It should be noted that for this analysis, the responding DUs include 52 DUs that participated at Round 1, but were later classified as ineligible for the survey. The 52 DUs were part of the initial NHIS delivery file prior to editing. Due to the timing of the MEPS sample selection, this initial NHIS file must be used.

Table 1 provides a summary of the characteristics of DU respondents and nonrespondents for the 2000 Round 1 MEPS based on the current 18 variables used to adjust for DU nonresponse in MEPS. Of the 18 variables in Table 1, four did not have an overall significant chi-square when crossed with response status: age (p=.1048), gender (p=.2586), marital status (p=.5922), and the help measure for people in the DU (p=.8031). In the earlier analysis of 1996 Round 1 data, age and the help measure were significant, while gender and marital status were not significant (Cohen and Machlin, 1998). However, gender and marital status were included in the 1996 set of 18 auxiliary variables used to adjust for

# nonresponse.

Table 1 illustrates some interesting characteristics of respondents and nonrespondents. For example, based on the race/ethnicity of the reference person in the primary reporting unit, the nonresponding DUs had a higher representation of nonminority (other) persons (79%) compared to the responding DUs (67%), who were more likely to have black and Hispanic reference persons. Also, the nonresponding DUs were less likely to have a reference persons under the age of 25(3%) as compared to the responding DUs (5%) and the nonresponding DUs were less likely to have an employed reference person (56%) compared to the responding DUs (62%). In addition, the nonresponding DUs were more likely to consist of a one person DU (31%) compared to the responding DUs (25%). With respect to family income, the nonresponding DUs had a higher representation of high income (\$35K+) classification (18%) compared to the responding DUs (13%). For the health status measure, nonresponding DUs were more likely to report excellent, very good, or good health status (86% versus 81%) and more likely to have not provided their telephone number (11% versus 4%). These results were generally consistent with the 1996 profiles.

Twenty-nine additional variables from the linked MEPS and NHIS files were identified for possible use in the expanded nonresponse adjustment model. However, the list was reduced to ten variables due to one or more of the following factors: high item nonresponse, lack of a significant chi-square test result, or there were other similar variables already selected for the model. Table 2 summarizes the characteristics of DU respondents and nonrespondents for the ten additional variables. All of the ten variables from the linked file were significant, except for one variable that represents the reason the reference person did not work in the previous week. This variable was included as one of the ten possible new variables because it represented an indicator that related work status to health status. The categories for this variable were: unable to work for health reasons or disabled; other reasons such as retired, attended school, or took care of house or family; and "missing" (refused, not ascertained, or don't know).

Some interesting results were also observed from the analysis of the ten new variables. For example, as shown in Table 2, the nonresponding DUs were less likely to have a reference person who was not a U.S. citizen (7% versus 9%) and more likely to have missing data for this variable (3% versus 1%). Further, the nonresponding DUs had a higher representation of reference persons who had no overnight stays in the hospital in the past year (93%) compared to those in

responding DUs (89%). With respect to health care coverage, reference persons in nonresponding DUs were more likely have health coverage (88%) compared to those in responding DUs (85%).

While some of the variables from the two chi-squared analyses were not significant, all 28 (eighteen current and ten new) variables were included as potential measures in the multivariate analysis. Specifically, the 28 variables were entered into a backward elimination logistic regression as a variable reduction technique. The variable retention threshold level of significance was set at .05 for this procedure. The model for the predicted probability (p) of DU response had the form:

$$logit(p) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_{28} X_{28} + \varepsilon$$

where

$$logit(p) = ln\left(\frac{p}{1-p}\right)$$

Of the 18 original variables, one-half were removed from the final model: age, gender, employment, MSA status, DU health, DU help, major work status, urban/rural status, and family income flag. Among the 10 new variables, 4 were added to the final model: interview language, amount of family medical expenses, number of nights in the hospital, and health insurance Therefore, from the multivariate coverage status. analysis, the13 most significant variables related to DUlevel response status were: race/ethnicity, marital status, income, education, region, MSA size, telephone number provided, DU size, type of PSU, interview language, family medical expenses amount, number of nights in a hospital in the past twelve months, and health insurance coverage status. Additional research is warranted to determine the existence and effects of significant interaction terms which could supplement the main effects model initially examined in this paper to produce a more accurate model of dwelling unit response.

#### Discussion

Since the models are not nested, direct tests of significant difference are not readily available. An adjusted coefficient of determination developed by Nagelkerke (Nagelkerke, 1991) can be used to compare the original, 18 variable DU nonresponse model to the new 13 variable model. The SAS Online Documentation (SAS Institute, Inc., 1999) shows that the Nagelkerke  $R_N^2$  is a ratio of a generalized coefficient of determination  $R^2$  and its maximum  $R_{max}^2$ :

$$R_{N}^{2} = \frac{R^{2}}{R_{max}^{2}}$$

where

$$R^{2} = 1 - \left[\frac{L(0)}{L(\hat{\beta})}\right]^{2/n}$$

and

$$R_{\text{max}}^2 = 1 - [L(0)]^{2/r}$$

L(0) is the likelihood of the intercept-only model and  $L(\hat{\beta})$  is the likelihood of the specified model. The Nagelkerke  $R_N^2$  of the original model was 0.0936. The Nagelkerke  $R_N^2$  of the new model was 0.1015. Thus, the new model has at least the same information as the original model, while reducing the number of predictor variables from 18 to 13. Because the new model is more parsimonious, it is a more desirable model.

#### **Future Research**

The set of 13 variables identified in this study will be part of an evaluation to examine the use of response propensities versus traditional classifying variables to form weighting class adjustment cells to adjust for nonresponse. Initial research on this issue is discussed by Wun et al. (2003). Additional future research will examine the impact on survey estimates, variances, and bias reduction from the use of 13 classifying variables to form the DU nonresponse weighting classes in comparison to the current 18 variables.

This paper has focused only on the MEPS dwelling unit nonresponse. Using the most recent survey data, future research will evaluate characteristics that distinguish persons that participate across all five rounds of data collection from those that only participate in the initial rounds. The future methods research, along with the findings in this paper, will provide important information for the most efficient nonresponse adjustment strategy to reduce the impact of nonresponse bias attributed to DU nonresponse and survey attrition in the MEPS survey.

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	Overall		Responding		Non-responding			
	n = 5,357		n = 4,386		n = 971			
Measure		Percent	(Standar	d Error)				
1. Age	<i>Chi-square</i> = $7.66$ , <i>p</i> = $.1048$							
< 25	4.89	(0.29)	5.24	(0.34)	3.30	(0.57)		
25-34	19.96	(0.55)	20.06	(0.60)	19.46	(1.27)		
35-44	22.68	(0.57)	22.73	(0.63)	22.45	(1.34)		
45-64	32.57	(0.64)	32.33	(0.71)	33.68	(1.52)		
65+	19.90	(0.55)	19.63	(0.60)	21.11	(1.31)		
		()		()				
2. Race/ethnicity	Chi-square = 50	).79, p <	.0001					
Hispanic	16.39	(0.51)	17.44	(0.57)	11.64	(1.03)		
Black/non-Hispanic	14.13	(0.48)	15.18	(0.54)	9.37	(0.94)		
Other	69.48	(0.63)	67.37	(0.71)	78.99	(1.31)		
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3. Gender	Chi-sq1	uare = 1.2	28, p = .2	2586				
Male	53.67	(0.68)	53.31	(0.75)	55.30	(1.60)		
Female	46.33	(0.68)	46.69	(0.75)	44.70	(1.60)		
4. Marital status	Chi-sq1	uare = 0.1	29, p = .5	5922				
Married - spouse present	51.45	(0.68)	51.62	(0.75)	50.67	(1.60)		
Other	48.55	(0.68)	48.38	(0.75)	49.33	(1.60)		
		1-	10 15	0001				
5. Employment status	Chi-sqi	uare = 1/	2.13, p < 1.15, p < 1.15	(0.72)		(1.50)		
Employed	60.50	(0.67)	61.56	(0.73)	55.72	(1.59)		
Unemployed	1.70	(0.18)	1.82	(0.20)	1.13	(0.34)		
Less than 18 years old	31.42	(0.63)	32.28	(0.71)	27.50	(1.43)		
Otherwise	6.38	(0.33)	4.33	(0.31)	15.65	(1.17)		
6 Size of dwelling unit	Chi sa	uare - 27	55 n <	0001				
1 person	26.12	(0.60)	2400	(0.55)	31.20	(0.32)		
2 people	20.12	(0.00)	27.22	(0.55)	33.06	(0.32)		
2 people	16.00	(0.04)	16 14	(0.00)	15 35	(0.32)		
4 people	10.00	(0.30)	10.14	(0.40)	12.55	(0.22)		
4 people	10.27	(0.49)	10.07	(0.40) (0.20)	6.00	(0.21)		
5+ people	10.23	(0.41)	10.97	(0.39)	0.90	(0.13)		
7. Education level	Chi-sa	uare = 22	3.24. n <	.0001				
No school	0.50	(0.10)	0.50	(0.11)	0.51	(0.23)		
Elementary	8.40	(0.38)	9.12	(0.43)	5.15	(0.71)		
Some high school	10.98	(0.23)	11.86	(0.49)	7.00	(0.82)		
H S graduate or GED	26.58	(0.10)	27.15	(0.17)	24.00	(1.37)		
Some college	23.86	(0.50)	27.13	(0.67)	21.00 24.00	(1.37)		
College	14.06	(0.30)	14 25	(0.51)	13.18	(1.07)		
Graduate School	7 35	(0.47) (0.36)	7 55	(0.33)	6.49	(1.07)		
Unknown	8.27	(0.30)	5 75	(0.40)	10.49	(0.79)		
Ulikilowii	0.27	(0.50)	5.15	(0.55)	17.07	(1.20)		
8. Region	Chi-sa	uare = 52	.13, p <	.0001				
Northeast	18.22	(0.53)	16.60	(0.56)	25.54	(1.40)		
Midwest	22.21	(0.57)	22.30	(0.63)	21.83	(1.33)		
South	35.82	(0.66)	37.41	(0.73)	28.63	(1.45)		
West	23.74	(0.58)	23.69	(0.64)	24.00	(1.37)		

# Table 1: Demographic and Socioeconomic Profiles of Dwelling Unit Respondents and Non-respondents:Round 1, 2000 MEPS Household Component.

Table	1	continued
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	Overa	Overall $n = 5,357$		Responding $n = 4,386$		sponding			
	n = 5					971			
Measure		Percent	(Standar	rd Error)					
9. Family income of primary reporting unit	.0001								
< 10K	25.22	(0.59)	26.99	(0.67)	17.20	(1.21)			
10-19K	16.45	(0.51)	16.99	(0.57)	14.01	(1.11)			
20-34K	36.40	(0.66)	36.23	(0.73)	37.18	(1.55)			
35K+	13.63	(0.47)	12.61	(0.50)	18.23	(1.24)			
Unknown	8.31	(0.38)	7.18	(0.39)	13.39	(1.09)			
10. MSA size	Chi-sq1								
500K+	62.03	(0.66)	60.97	(0.74)	66.84	(1.51)			
< 500K	18.46	(0.53)	18.31	(0.58)	19.16	(1.26)			
Non-MSA	19.51	(0.54)	20.73	(0.61)	14.01	(1.11)			
11. MSA status	Chi-sqi	<i>Chi-square</i> = 27.38, <i>p</i> < .0001							
In MSA, in central city	31.94	(0.64)	32.06	(0.70)	31.41	(1.49)			
In MSA, not in central city	48.55	(0.68)	47.22	(0.75)	54.58	(1.60)			
Not in MSA	19.51	(0.54)	20.73	(0.61)	14.01	(1.11)			
12. Health status	Chi-sq1	uare = 14	.39, p =	.0008					
Excellent, very good, or good	81.97	(0.53)	81.03	(0.59)	86.20	(1.11)			
Fair or poor	12.96	(0.46)	13.61	(0.52)	9.99	(0.96)			
Unknown	5.08	(0.30)	5.36	(0.34)	3.81	(0.61)			
13. Telephone status	Chi-sqi	uare = 21	7.95, p <	< .0001					
Has phone and gave number	84.38	(0.50)	87.03	(0.51)	72.40	(1.43)			
Has phone, did not give number	5.38	(0.31)	4.13	(0.30)	11.02	(1.00)			
No phone or no information	4.20	(0.27)	4.54	(0.31)	2.68	(0.52)			
Otherwise	6.05	(0.33)	4.31	(0.31)	13.90	(1.11)			
14. There are people in the DU needing help <i>Chi</i>	square = 0.	06, p = .8	8031						
Yes	1.53	(0.17)	1.55	(0.19)	1.44	(0.38)			
Otherwise	98.47	(0.17)	98.45	(0.19)	98.56	(0.38)			
15. Work and activity status	Chi-sqi	uare = 72	2.02, p <	.0001					
Working	57.85	(0.67)	58.96	(0.74)	52.83	(1.60)			
Keep house	6.51	(0.34)	6.77	(0.38)	5.36	(0.72)			
School	1.12	(0.14)	1.07	(0.16)	1.34	(0.37)			
Retired	16.00	(0.50)	16.26	(0.56)	14.83	(1.14)			
Unable to work	4.78	(0.29)	5.04	(0.33)	3.60	(0.60)			
Otherwise	13.74	(0.47)	11.90	(0.49)	22.04	(1.33)			
16. Urban/rural residence	Chi-sqi	uare = 8.1	79, $p = .0$	0030					
Urban	74.52	(0.60)	73.69	(0.66)	78.27	(1.32)			
Rural	25.48	(0.60)	26.31	(0.66)	21.73	(1.32)			
17. Type of PSU	Chi-sai	uare = 19	0.15, p <	.0001					
Self-representing	66.83	(0.64)	65.50	(0.72)	72.81	(1.43)			
Non-self-representing	33.17	(0.64)	34.50	(0.72)	27.19	(1.43)			
18. Flag for families, income is known	Chi-sai	uare = 40	0.20, p <	.0001					
Income unknown	8.31	(0.38)	7.18	(0.39)	13.39	(1.09)			
Otherwise	91.69	(0.38)	92.82	(0.39)	86.61	(1.09)			

Source: Center for Financing, Access, and Cost Trends; Agency for Healthcare Research and Quality: Medical Expenditure Panel Survey, 2000.

	Over	Overall		Responding		sponding		
	n = 5,065		n = 4,220		n =	845		
Measure	Percent (Standard Error)							
1. Type of home	<i>Chi-square</i> = $14.41$ , <i>p</i> = .0007							
House/apt/flat/condo	92.83	(0.36)	92.32	(0.41)	95.38	(0.72)		
Other type of dwelling	7.09	(0.36)	7.63	(0.41)	4.38	(0.70)		
Missing	0.08	(0.04)	0.05	(0.03)	0.24	(0.17)		
2. Time without a telephone	<i>Chi-square</i> = 8.55, <i>p</i> < .0358							
Less than 3 weeks 1.18	6 (0.15)	1.23	(0.17)	0.95	(0.33)			
3 or more weeks	4.72	(0.30)	5.05	(0.34)	3.08	(0.59)		
No service interruption	93.72	(0.34)	93.29	(0.39)	95.86	(0.69)		
Missing	0.38	(0.09)	0.43	(0.10)	0.12	(0.12)		
3. Interview language	Chi-sq	<i>Chi-square</i> = 36.25, <i>p</i> < .0001						
English only	82.27	(0.54)	82.84	(0.58)	79.41	(1.39)		
Not English only	5.92	(0.33)	6.42	(0.38)	3.43	(0.63)		
Missing	11.81	(0.45)	10.73	(0.48)	17.16	(1.30)		
4. U.S. citizen status	Chi-sq	uare = 34	<sup>1</sup> .67, p <	.0001				
U.S. citizen	90.15	(0.42)	90.05	(0.46)	90.65	(1.00)		
Not U.S. citizen	8.77	(0.40)	9.22	(0.45)	6.51	(0.85)		
Missing	1.09	(0.15)	0.73	(0.13)	2.84	(0.57)		
5. Family medical expenses amount	<i>Chi-square</i> = 51.52, <i>p</i> < .0001							
Zero	11.04	(0.44)	10.64	(0.47)	13.02	(1.16)		
Less than \$500	47.56	(0.70)	48.08	(0.77)	44.97	(1.71)		
\$500 to \$1,999	25.41	(0.61)	25.92	(0.67)	22.84	(1.44)		
\$2,000 or more	10.80	(0.44)	11.09	(0.48)	9.35	(1.00)		
Missing	5.19	(0.31)	4.27	(0.31)	9.82	(1.02)		
6. Homeowner status	<i>Chi-square</i> = 62.93, <i>p</i> < .0001							
Owned or being bought	63.04	(0.68)	63.06	(0.74)	62.96	(1.66)		
Rented or other	34.89	(0.67)	35.57	(0.74)	31.48	(1.60)		
Missing	2.07	(0.20)	1.37	(0.18)	5.56	(0.79)		
7. Born in U.S.	<i>Chi-square</i> = 43.57, <i>p</i> < .0001							
Born in U.S.	82.53	(0.53)	82.35	(0.59)	83.43	(1.28)		
Not born in U.S.	16.82	(0.53)	17.32	(0.58)	14.32	(1.21)		
Missing	0.65	(0.11)	0.33	(0.09)	2.25	(0.51)		
8. Reason did not work last week	Chi-sq	uare = 2	58, $p = 0$	.4617				
Health reasons or disabled	7.29	(0.37)	7.51	(0.41)	6.15	(0.83)		
School, retired, layoff, other	28.19	(0.63)	28.18	(0.69)	28.28	(1.55)		
Working or under 18 years old	64.46	(0.67)	64.24	(0.74)	65.56	(1.63)		
Missing	0.06	(0.03)	0.07	(0.04)	0.00	(0.00)		

Table 2: Demographic and Socioeconomic Profiles of Dwelling Unit Respondents and Non-respondents to theLinked 1999 NHIS and 2000 MEPS Surveys.

	Overall n = 5,065		Responding n = 4,220		Non-responding $n = 845$			
Maaaaaa								
Nieasure	Percent (Standard Effor)							
9. Number of nights in the hospital last year Chi-	square = 16	6.85, p =	0.0008					
Zero nights	89.69	(0.43)	88.98	(0.48)	93.25	(0.86)		
1 to 7 nights	7.74	(0.38)	8.13	(0.42)	5.80	(0.80)		
8 or more nights	2.49	(0.22)	2.80	(0.25)	0.95	(0.33)		
Missing	0.08	(0.04)	0.09	(0.05)	0.00	(0.00)		
10. Health care coverage status	<i>Chi-square</i> = 37.88, <i>p</i> < .0001							
Health care coverage	85.29	(0.50)	84.81	(0.55)	87.69	(1.13)		
No health care coverage	14.27	(0.49)	14.98	(0.55)	10.77	(1.07)		
Missing	0.43	(0.09)	0.21	(0.07)	1.54	(0.42)		

# Table 2 continued

*Note: some of the cells in this table have an expected value less than 5. Thus, the value of the chi-square test may be limited.* 

Source: Center for Financing, Access, and Cost Trends; Agency for Healthcare Research and Quality: Medical Expenditure Panel Survey, 2000.