ALTERNATIVE ADJUSTMENTS FOR NONRESPONSE IN THE NATIONAL HOSPITAL DISCHARGE SURVEY

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1. Introduction

A typical imputation adjustment in any survey is made by a multiplier ratio, the numerator of which is data known for all sample cases and the denominator of which is the same data for all responding sample cases. The choice of such ratios for imputation can affect the variability of the estimator and the level of response bias. The best choice of adjustment ratio depends upon the characteristics being measured in the survey and the auxillary information available for the sampled units.

In this paper we consider four alternative ratios that could be used to adjust for hospital nonresponse in the National Hospital Discharge Survey (NHDS). These ratios use hospital bed sizes at two different times, annual hospital discharge volumes, and simple hospital counts. Because of interest in the effect which use of old bed sizes in the adjustment ratio may have had on NHDS estimates published over the years, attention is focused on the relative magnitudes of estimates that result when the different adjustment ratios are used. Contrary to expectations, differences in the estimates were insignificant.

The alternative adjustment methods are discussed more fully in the following together with methodology for the study. Results of the study are discussed in the last section.

2. National Hospital Discharge Survey Design

The NHDS sample is a two-stage stratified random sample. The universe for the first stage consists of short stay special and general hospitals having 6 or more beds for inpatient use and an average length of stay of less than 30 days. Federal hospitals and units of institutions are excluded. The sampling frame used for the survey is the list of hospitals in the National Master Facility (NMFI) which satisfy the universe definition. The second stage of NHDS sample consists of systematic random samples of discharges selected from lists maintained by each sampled hospital.

The procedure used to produce estimates from NHDS data has three principal components: inflation by reciprocals of the probabilities of selection, adjustment for non-response, and ratio adjustment to fixed totals. National and regional estimates are thus produced for discharged patients, days of inpatient care, conditions diagnosed, and surgical procedures performed.

The remainder of this paper will be focused on the adjustment made for hospital non-response in the NHDS estimates. To appreciate the impact which this adjustment has on the NHDS estimates we note the response rates shown in Table 1 for 1977, the data year used in this study. Nationally, 86 percent of the 941 sampled hospitals responded while the response rates for the geographic regions varied from 81 to 93 percent. Because of the varying regional response rates, there is interest in how the adjustments for nonresponse affect the regional as well as the National estimates.

3. Methods of Adjusting for Nonresponse

The present method of adjusting for hospital non-response calls for using the bed sizes (number of beds maintained for inpatient use) which are recorded in the NMFI for individual sample hospitals. That is, within each sampling stratum the adjustment consists of a ratio, the numerator of which is the sum of beds in the sampled hospitals and the denominator of which is the sum of beds in the responding hospitals. Intuitively, if beds are to be used in the adjustment process, bed sizes for the current year should be the ones used since they are probably more correlated with discharges, days of care, and so forth, which are estimated in the NHDS than are the bed sizes for any other year. Hence, in this study, the non-response adjustment method which employs the 1977 bed sizes is used as the standard against which the other methods considered here are compared.

The second method of non-response adjustment considered is the one currently used. It employs the bed sizes recorded in the NMFI for hospitals at the time when each was selected to the NHDS sample. Hereafter, these bed sizes will be referred to as the "original" bed sizes. The NHDS sample for 1977 included hospitals selected from the 1965, 1969, 1973, and 1975 NMFI's with the bulk of them being selected in 1965. That means in 1977, the original bed sizes ranged in age from 2 to 12 years with most of them being 12 years old. Because dramatic changes have occurred in the bed sizes for some sampled hospitals over time, there was concern about the effect which use of the outdated bed sizes for non-response adjustment may have had on the NHDS estimates. Indeed this concern lead to this study when it was discovered that bed sizes were not updated annually in the adjustment ratio. If big differences existed between two sets of estimates produced for the same data year (say, 1977), one set by using the original bed sizes and the other set by using the current beds, then the estimates published for prior years would be suspect, too. Also, trend statistics would be affected, especially those transcending the first year in which original bed sizes are replaced with current bed sizes.

As long as we were studying the effects on NHDS estimates which result from use of the different bed sizes in the non-response adjustment ratio, we also considered use of discharge volumes and hospital counts in that ratio as a third and fourth method, respectively. The annual discharge volumes have been recorded in the NMFI each year since 1967 for individual hospitals so that these volumes are now also available for all sample hospitals. The use of discharge volumes is

attractive since, intiutively, they are more correlated with discharges, and days of care, which are estimated in NHDS, than are bed sizes.

The use of hospital counts in the non-response adjustment is the simple inflation method for NHDS. The numerator of the adjustment ratio consists of the total number of sampled hospitals while the denominator is the number of those hospitals responding to NHDS. Simple inflation is the best adjustment that can be made when no information about sample units is available from sources independent of the survey or when there is no correlation between the available information and the parameters being estimated. Theoretically in the adjustment process, the use of data correlated with the parameters being estimated reduces estimate variation due to non-response. Simple inflation is included in this study since bed sizes and discharges are not necessarily correlated with some of the parameters estimated in the NHDS.

Data collected in the 1977 NHDS was used to compute four sets of selected NHDS estimates, one set for each of the adjustment methods. Everything was kept constant when computing these sets except the ratio used to adjust for hospital non-response. The bed sizes recorded in the 1977 NMFI were used as the current bed sizes here, since 1977 NHDS data was used in the study.

The parameters chosen for estimation in this study include the totals for discharges, days of inpatient care, and all listed operations since these represent the basic types of variables presented in NHDS statistics. Four individual operations were also included in the study to represent parameters of smaller magnitudes than the totals.

The estimates which result when 1977 bed sizes are used in the non-response adjustment ratio are shown in column (1) of Table 2. The difference between these estimates and the corresponding estimates which employ the alternate adjustment ratios are expressed in columns (2) - (4) as percents of the estimates in column (1). A negative sign in columns (2) - (4) means that the associated estimate is less than the corresponding estimate which resulted from use of the 1977 beds in the non-response adjustment ratio.

5. Comparison of Methods

In Table 2, 3.6% appears to be the maximum percent difference between the estimates where 1977 bed sizes are used for adjustment and the corresponding estimates where alternate adjustment methods are used. Such small differences are not considered significant. The majority of the percent differences, including all those for National estimates, are about one percent or less.

While only seven parameters are used, here, out of many possible in NHDS, the basic types of NHDS variables and a range of estimated magnitudes are represented among the seven. On that basis and because of the consistently small differences between corresponding estimates based on the four adjustment methods for all seven of these parameters, it is reasonable to believe that in general, the four methods considered here for making non-response adjustments will not produce large differences between estimates for other parameters in NHDS.

The fact that the differences are small is comforting since that means the use of outdated bed sizes did not have a great effect on the NHDS estimates in 1977. In addition, since bed sizes are more likely to change as time passes and, hence, original bed sizes are more likely to be outdated as time passes, it is also reasonable to believe that estimates produced for years prior to 1977 were not greatly affected by use of outdated bed sizes instead of current beds in the adjustment for hospital non-response.

In addition to the small differences, a couple of other patterns may be noted in Table 2. The smallest percent differences shown for each region and parameter are associated with the use of discharge volumes. This could be expected since bed size and discharge volumes are intuitively correlated.

It is also obvious that the largest percent differences for each parameter tend to occur in the West and the next largest most frequently occur for the Northeast within adjustment methods. No explanation for this observation is apparent but it is noted that both the sample sizes and the estimates happen to be smallest in the West and those for the Northeast are the next smallest.

The small differences among corresponding estimates also indicate that the original beds could be replaced by discharge volumes and hospital counts as well as by current bed sizes without causing a great impact on the resulting statistics. It is especially noted that simple inflation did as well as the more sophisticated methods of adjustment for nonresponse as far as the magnitudes of the 1977 estimates are concerned. This suggests that the extra resources required when using bed sizes and discharge volumes may not be warranted in the NHDS estimates.

When there is no difference between magnitudes of estimates for the alternate non-response adjustment methods, the method of choice for future NHDS estimates is ideally that which yields the smallest variances or that method which uses data that is most highly correlated with the parameters being estimated since theoretically the higher correlation would reduce variances. However, limited resources did not permit computations of either variances or correlations needed for comparisons by the time of this writing.

6. Summary

Current bed sizes, current discharge volumes, original bed sizes, and simple hospital counts may each be used in a multiplier ratio which adjusts NHDS estimates for hospital non-response without greatly affecting the magnitude of the resulting estimates. The reliability of the estimates resulting from use of the different adjustment ratios, however, could not be included in the current paper. Thus none of the four methods considered for making non-response adjustment can be claimed here to be better than the others for future NHDS estimates.

References

Simmons, Walt R. (1970). "National Center for Health Statistics: Development of the Design of the NCHS Hospital Discharge Survey." Vital and Health Statistics. PHS No. 1000-Series 2-No. 39. Public Health Service. Washington, U.S. Government Printing Office.

Table 1. Number of Sample Hospitals in HDS and Percent Responding During 1977 by Region

REGION	SAMPLE HOSPITALS	PERCENT RESPONDING
TOTAL	491	86%
NORTHEAST	121	93%
NORTH CENTRAL	143	84%
SOUTH	155	81%
WEST	72	90%

Table 2. Selected NHDS Estimates for 1977 and Percent Differences Between Estimates Resulting from Alternate Non-response Adjustment Methods

Parameter Estimated	Region	Method Used to Adjust for Non-response			
		1977 Beds (1)	Original Beds (2)	1977 Discharges (3)	Simple Inflation (4)
		Estimate in Thousands	Percent Differences		
Total Discharges	United States	35,479	0.61	0.26	0.67
	Northeast	7,580	2.15	0.06	1.12
	North Central	10,593	1.23	0.53	0.99
	South	11,165	0.87	0.74	0.42
	West	6,141	-2.85	1.01	-3.45
Total Days of Care	United States	258,451	0.75	0.26	0.29
	Northeast	65,275	2.04	0.16	1.08
	North Central	79,627	1.15	0.43	0.95
	South	76,704	0.85	0.90	0.57
	West	36,846	-2.58	0.86	-3.14
Total of all Listed Operations	United States	20,905	0.54	0.09	0.24
	Northeast	4,632	2.16	1.02	0.13
	North Central	6,351	1.16	-0.53	1.02
	South	5,972	0.69	0.21	0.86
	West	3,951	-2.59	0.89	-3.16
Dilation and Curettage of Uterus	United States	979	0.96	-0.05	0.43
	Northeast	296	2.27	0.02	1.25
	North Central	294	1.41	-0.57	1.03
	South	269	0.67	-0.24	0.73
	West	120	-2.69	1.46	-3.67
Biopsy	United States	1,154	0.51	0.10	0.31
	Northeast	307	2.03	0.16	1.22
	North Central	362	0.73	-0.44	0.83
	South	293	0.52	0.21	0.94
	West	193	-2.32	0.86	-3.09
Oophorectomy	United States	452	0.67	0.01	0.26
	Northeast	89	2.02	0.09	1.19
	North Central	123	1.57	-0.50	1.25
	South	159	0.83	-0.28	0.61
	West	80	-2.54	1.23	-2.99
Appendectomy	United States	340	0.44	0.23	-0.16
	Northeast	67	2.64	-0.32	1.37
	North Central	99	1.27	-0.51	0.59
	South	108	0.56	0.61	0.44
	West	69	-2.98	1.21	-3.61