

Nonresponse Bias in Expense Data from the 1985 National Nursing Home Survey

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The National Nursing Home Survey (NNHS) is a nationwide sample survey of nursing homes, their residents, discharges, and staff. The first NNHS was conducted in 1973-74 and the second was conducted in 1977. The most recent NNHS was conducted from August 1985 to January 1986. As part of the survey, information on the nursing homes' costs of providing care during the previous calendar year was collected through a self-administered form called the Expense Questionnaire (EQ). In the 1985 NNHS, the response rate for this questionnaire was 68 percent (Table 1). This represents a 33 and 20 percent reduction in response rate since the 1973-74 and 1977 NNHS, respectively. Although the expense data from the earlier NNHSs experienced nonresponse, the magnitude is much greater in the 1985 NNHS. To assess the characteristics of bias resulting from nonresponse, this paper is divided into three sections. First, EQ response rates are examined to identify characteristics of homes that responded versus characteristics of homes that did not. Second, to assess the representativeness of reported costs, variables found to be correlated with nursing home costs in past NNHSs were compared for homes that responded to homes that did not. Finally, this paper describes how the estimator for cost was adjusted to compensate for differential nonresponse by ownership group. The paper describes how this approach was useful in reducing nonresponse bias when compared with an estimator that lacked such an adjustment.

Source of Data

Data in this paper are based on the 1985 NNHS. Facilities included in the 1985 NNHS were nursing and related-care homes in the conterminous United States that had three or more beds set up and staffed for use by residents and that routinely provided nursing and personal care services. A facility could be free standing or could be a nursing care unit of a hospital, retirement center, or similar institution as long as the unit maintained financial and employee records separate from the parent institution. Places providing only room and board were excluded, as were places serving only persons with specific health problems (for example, mental retardation or alcoholism).

The sample frame for the 1985 NNHS consisted of the following components:

- The 1982 NMFI, a census of nursing and related-care homes conducted by the National Center for Health Statistics.
- Homes identified in the 1982 Complement Survey of the NMFI as "missing" from the 1982 NMFI.
- Nursing homes opened for business from 1982 through June 1984.
- Hospital-based nursing homes identified in records of the Health Care Financing Administration (HCFA).

The resulting frame contained 20,479 nursing homes.

The sample of the 1985 NNHS was a stratified two-stage probability design. The first stage was a selection of 1,220 nursing homes. The second stage was a selection of residents, discharges, and staff.

Twenty sampling strata of facilities were formed in the 1985 sampling frame based on certification status, Complement Survey status (added, or not added, to the sampling frame from the Complement Survey), and

bedsize (3-14 beds, 15-24 beds, 25-49 beds, 50-99 beds, 100-199 beds, 200-399 beds, 400-599 beds, 600 or more beds, and unknown). A home was considered certified if, according to the data in the sampling frame, it was certified as either a skilled nursing facility or an intermediate care facility under Titles XVIII and XIX of the Social Security Act for Medicare and Medicaid. Within each sampling stratum, facilities were then ordered by ownership, census region, metropolitan status, State, county, and zip code. The stratified sample of facilities was then selected systematically with overall probability proportional to the reported bedsize adjusted by the facility's probability of being in the sampling frame.

Data on characteristics of the facility were collected on the Facility Questionnaire (FQ) by interviewing the administrator. With the permission of the administrator, expense data were collected by leaving the self-administered EQ with the facility's accountant or bookkeeper. A recent financial statement, if available, was acceptable as a replacement for the completed EQ. Overall, 46 percent of homes responding to the EQ submitted financial statements. (Data from the financial statements were edited and prepared for keying by a NNHS accountant). The overall response rate for nursing homes in the 1985 NNHS was 93 percent. Of these responding facilities, 68 percent responded to the EQ.

Data used in this paper, are from both the FQ and the EQ.

Response Rates

Table 2 shows the response rates for the EQ by selected facility characteristics. One of the most striking differences shown in this table is the substantially lower response rate in proprietary facilities (58 percent) compared to voluntary nonprofit facilities (89 percent) and government-operated homes (94 percent). This discrepancy may be due to the greater accessibility of financial data among voluntary nonprofit and government-operated facilities. For example, these homes were more likely to submit financial statements (58 percent of voluntary nonprofit and 52 percent of government homes submitted financial statements) than to complete the EQ. In contrast, proprietary homes were more likely to complete the EQ (60 percent) than to submit a financial statement.¹ The time required to complete the EQ (as well as other factors) may have influenced the lower response rate of proprietary homes.

Table 2 also shows that homes certified by the Medicare or Medicaid programs to provide skilled or intermediate care services were more likely to respond (63 to 74 percent) than homes not certified by either of these programs (60 percent). (Medicare certifies only skilled nursing homes).

Response to the EQ increased with size of the facility; from 61 percent of homes with less than 50 beds to 73 percent of homes with 200 beds or more. When regional variables were examined, response was higher in the North Central region (71 percent compared to 64 to 68 percent in the remaining regions) but did not vary by metropolitan status. The higher response rate in the North Central region may be related to the availability of financial statements. The North Central region was the only region where

financial statements were submitted more often (53 percent) than completed EQs were.^{1/} In addition, the national proportion of nonprofit and government homes (33 percent) was higher in the North Central region than in the South and West regions. (The proportion of nonprofit and government homes in the Northeast (27 percent) was not statistically different from that in the North Central region) - Table 3.

Table 2 also shows that response rates varied by type of home in the sampling frame. Hospital-based homes identified from HCFA records were most likely to respond to the EQ (91 percent) while homes identified from the Complement Survey were least likely to respond (48 percent).

Response rates also varied by affiliation, with chain operated nursing homes less likely to respond (62 percent) than independently operated nursing homes (70 percent) and government homes (94 percent). This finding may be related to the larger proportion of proprietary homes among chain homes (85 percent) in the nation compared to independently operated nursing homes (64 percent) - Table 3.

Comparison of Facility Characteristics

Table 4 shows average bedsize, annual occupancy rate (for 1984) and number of full-time equivalent employees per 100 beds by response status to the EQ and selected facility characteristics. According to previous NNHSs, bedsize, occupancy rate, and number of full-time equivalent employees are correlated with nursing home costs.^{2/3/} By comparing these characteristics for homes that responded to the EQ with homes that did not respond, the direction of bias resulting from nonresponse can be examined.

In previous NNHSs, nursing home costs tended to increase with increasing size of the home. Table 4 shows that, on the average, homes responding to the EQ were larger (94 beds) than homes that did not respond (71 beds). The tendency of EQ responding homes to be larger than EQ nonresponding homes responding is consistent for most of the characteristics presented. For example, EQ responding homes in the Northeast region (102.2 beds) were 70 percent larger, on the average, than nonresponding homes in the same region (60.1 beds). Similarly, independently operated nursing homes that responded to the EQ were 64 percent larger, on the average, than independently operated homes that did not respond to the EQ. Because the cost data reported by the EQ responding homes tends to represent larger homes, the cost data are biased upward.

The number of full-time equivalent staff per 100 beds was also found to be highly correlated with nursing home costs in previous NNHSs. As the availability of staffing increased, nursing home costs tended to also increase. Table 4 shows that, with a few exceptions, homes responding to the EQ also tended to have more staff available per bed than homes that did not respond. Thus, the data again point to over-representation of higher cost homes among respondents to the EQ.

In the 1973-74 NNHS, occupancy rate had a negative relationship with average cost per resident day.^{2/} In other words, as average costs increased, the occupancy rate tended to decrease. Table 4 shows that overall, the occupancy rate was only slightly higher for respondents to the EQ than for nonrespondents. There was much variation in this variable, but in general, nonrespondents to the EQ were less fully occupied in 1984 than respondents were. This would imply that based on the 1973-74 findings, that nonrespondents to the EQ have higher costs. Since this contradicts the previous findings that EQ responding homes tend to have higher costs than EQ nonresponding homes, the

association between occupancy rate and costs found in the 1973-74 NNHS, may not apply in 1985. Further investigation of this issue is needed.

Attempts to Reduce Nonresponse Bias

The preceding analysis suggests that expense data from respondents in the 1985 NNHS under-represents smaller lower cost homes and proprietary homes. The extent of this bias may be approximated using the total number of beds as a surrogate for total costs (since this variable is highly correlated with cost). Table 5 shows the estimated number of beds using the full sample of NNHS responding homes and the estimated number of beds for homes responding to the EQ. The difference between these two estimates are chiefly due to nonresponse bias. The overall difference is 7,500 or 0.5 percent of total beds for the full sample. As expected from the previous analysis, total beds in the EQ sample were underestimated for proprietary nursing homes by 15 percent and beds in the EQ sample for voluntary nonprofit and government homes were each overestimated by 32 percent. This difference by ownership appears to be a major source of nonresponse bias since the percent of the absolute bias to total beds for all other categories ranged from 0 to 24 percent (Table 6). The most notable other categorically in Table 5 with nonresponse bias was correlated with ownership; beds in hospital-based homes in the EQ sample were overestimated by 24 percent. Because 91 percent of hospital-based homes are either voluntary nonprofit, or government-operated, this overestimation was expected.

To adjust total costs estimates for the differential response rates by ownership, the weight for the expense data was adjusted for nonresponse by ownership. That is, EQ homes were divided into two ownership groups: (1) proprietary homes and (2) nonproprietary homes (voluntary nonprofit homes and government homes). Within each ownership group, separate nonresponse adjustment factors and bedsize ratio adjustment factors were applied to the weight within primary stratum.^{4/} The effect of these post-stratified adjustments was to make the EQ estimates more representative of nursing home costs by ownership type, as well as correct for under and overestimation of costs by ownership groups.

Table 5 shows the results of post-stratifying the expense weight by ownership. The adjusted EQ beds estimated with this weight overall differs from beds estimated from the full sample by 1,600, representing an overestimate of 0.1 percent. This estimator reduced the magnitude of the nonresponse bias by 80 percent. Unfortunately, the overall bias changed in direction from an underestimate of total beds to an overestimate of total beds. Thus, using the adjusted expense weight, the estimate of total nursing home costs is likely to be overestimated.

Table 6 shows that the magnitude of the bias in total beds by ownership was drastically reduced using the adjusted EQ weight. Total beds for proprietary and government homes were each underestimated by 2 percent using the adjusted EQ weight, compared to a 15 percent underestimate of proprietary homes and a 32 percent overestimate of government homes, when the unadjusted weight was used. Beds for voluntary nonprofit homes are still overestimated by 6 percent. This however, is much less than the 32 percent overestimate using the unadjusted weight. In general, the percent of adjusted beds bias to total beds is lower in magnitude than the nonresponse bias, but the new estimator does not yield better estimates in all cases. For example, the percent of bias to total beds for

homes with less than 50 beds decreased from 11 to 5 percent using the adjusted weight. The adjusted estimate of beds for not certified homes and Complement Survey homes, however, increased in percent bias of total beds. The reasons for this needs further investigation.

The preceding discussion has shown that adjusting the expense weight for nonresponse by ownership reduced nonresponse bias by 80 percent overall. The resulting cost estimates will thus be closer to the true cost of providing care in nursing homes. The adjustment however, will result in a slight overestimate of total cost for many characteristics.

The standard errors of total beds, shown in Table 6, can be used to approximate the ratio of the adjusted beds bias to the standard error. This provides an indicator of the relative importance of bias to the sampling error. Most of the adjusted beds biases shown in Table 5 are less than the corresponding standard errors, but in a few cases the adjusted bed bias is as large or larger than the standard error. Thus, although the post-stratified nonresponse adjustment by ownership improves the estimate of total cost, there is still room for further improvements.

References

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Table 1. Expense Questionnaire response rates: National Nursing Home Survey, 1973-74, 1977, and 1985

	Survey Year		
	1973-74	1977	1985
Number of homes eligible to have Expense Questionnaire ^{1/}	1,778	1,451	1,079
Number of Expense Questionnaire responding homes.....	1,569	1,226	732
Response rate.....	88.2	84.5	67.8

^{1/}The Expense Questionnaire was administered only to homes that had been in business 2 years or more in the 1973-74 NNHS. All homes included in the 1977 and 1985 NNHS were administered the Expense Questionnaire.

Table 2. Expense Questionnaire response rates by selected facility characteristics: 1985 National Nursing Home Survey

Facility characteristic	Expense questionnaire response status			Percent distribution		
	All eligible sample homes	Responding	Non-responding	Expense questionnaire response status		
				All eligible sample homes	Responding	Non-responding
Total.....	1,079	732	347	100.0	67.8	32.2
Ownership						
Proprietary.....	752	436	316	100.0	58.0	42.0
Voluntary nonprofit.....	242	216	26	100.0	89.3	10.7
Government.....	85	80	5	100.0	94.1	5.9
Certification						
Skilled nursing facility only.....	208	130	78	100.0	63.4	36.6
Skilled nursing facility and intermediate care facility.....	502	366	137	100.0	72.8	27.2
Intermediate care facility only.....	287	186	101	100.0	64.8	35.2
Not certified.....	84	50	34	100.0	59.5	40.5
Bed size						
Less than 50 beds....	89	54	35	100.0	60.7	39.3
50-99 Beds.....	288	186	100	100.0	65.0	35.0
100-199 Beds.....	475	324	151	100.0	68.2	31.8
200 Beds or more....	229	168	61	100.0	73.4	26.6
Census Region						
Northeast.....	238	162	76	100.0	68.1	31.9
North Central.....	361	258	105	100.0	70.9	29.1
South.....	328	211	115	100.0	64.7	35.3
West.....	154	103	51	100.0	66.9	33.1
Metropolitan status						
MSA.....	737	495	242	100.0	67.2	32.8
Non-MSA.....	342	237	105	100.0	69.3	30.7
Type of nursing home						
Newly opened home... Complement Survey	33	22	11	100.0	66.7	33.3
home.....	27	13	14	100.0	48.1	51.9
hospital-based home... NPI home.....	35	32	3	100.0	91.4	8.6
	984	665	319	100.0	67.6	32.4
Affiliation						
Chain.....	547	339	208	100.0	62.0	38.0
Independent.....	441	310	131	100.0	70.3	29.7
Government.....	85	80	5	100.0	94.1	5.9
Unknown.....	6	3	3	100.0	50.0	50.0

Table 3. Percent distribution of nursing homes by ownership according to selected facility characteristics: United States, 1985

Facility characteristic	Total	Ownership		
		Proprietary	Voluntary nonprofit	Government
Total	100.0	69.7	22.4	7.9
Certification				
Skilled nursing facility only	100.0	75.6	16.6	7.8
Skilled nursing facility and intermediate care facility	100.0	65.8	25.4	8.7
Intermediate care facility only	100.0	72.8	20.9	6.3
Not certified	100.0	67.9	23.8	8.3
Bed size				
Less than 50 beds	100.0	70.8	23.6	5.6
50-99 Beds	100.0	71.0	23.8	5.2
100-199 Beds	100.0	77.3	18.1	4.6
200 Beds or more	100.0	52.0	29.3	18.8
Census Region				
Northeast	100.0	60.1	27.7	12.2
North Central	100.0	61.5	29.1	9.4
South	100.0	81.9	15.0	3.1
West	100.0	77.9	14.3	7.8
Metropolitan status				
MSA	100.0	70.3	23.2	6.5
Non-MSA	100.0	68.4	20.8	10.8
Type of nursing home				
Newly opened home	100.0	69.7	27.3	3.0
Complement Survey home	100.0	63.0	37.0	
Hospital-based home	100.0	14.3	45.7	40.0
NMFI home	100.0	71.8	21.0	7.1
Affiliation				
Chain	100.0	85.2	14.8	
Independent	100.0	63.7	36.3	
Government	100.0			100.0
Unknown	100.0	83.3	16.7	

- Data not available.

Table 4. Average beds per home, annual occupancy rate, and full-time equivalent employees per 100 beds by EO response status and facility characteristics

Facility characteristic	Beds per nursing home			Annual occupancy rate ^{1/}			Full-time equivalent staff per 100 beds ^{2/}		
	Expense questionnaire response status								
	All eligible sample homes	Responding	Non-responding	All eligible sample homes	Responding	Non-responding	All eligible sample homes	Responding	Non-responding
Total	85.2	93.8	71.2	91.6	92.7	89.2	71.4	74.4	65.0
Ownership									
Proprietary	78.4	84.7	71.2	91.7	93.9	88.8	65.4	66.5	63.9
Voluntary nonprofit	98.7	105.0	81.6	91.0	91.3	88.8	83.8	84.4	77.8
Government	130.1	129.4	139.1	91.7	90.2	111.3	87.6	88.8	73.6
Certification									
Skilled nursing facility only	88.0	95.2	77.6	95.6	97.4	92.5	80.4	84.4	73.3
Skilled nursing facility and intermediate care facility	127.8	130.2	122.1	90.1	91.5	86.4	76.8	78.6	72.1
Intermediate care facility only	77.9	75.9	82.0	94.9	97.2	90.6	64.1	67.1	58.4
Not certified	39.3	53.8	27.0	83.0	79.5	89.0	51.2	55.5	43.8
Bed size									
Less than 50 beds	23.9	28.7	19.2	84.1	96.3	90.9	61.1	65.5	54.8
50-99 Beds	71.7	70.7	73.9	93.0	93.0	90.0	71.5	72.7	69.2
100-199 Beds	131.1	132.0	129.3	90.0	91.9	86.0	69.8	72.3	64.4
200 Beds or more	275.2	284.5	251.5	91.8	92.5	89.8	79.5	84.1	66.6
Census Region									
Northeast	84.4	102.2	60.1	92.8	92.9	92.8	77.1	81.8	66.3
North Central	95.4	91.4	106.3	91.1	92.3	88.5	71.5	73.2	67.4
South	79.6	91.5	64.1	90.9	93.6	85.9	66.3	69.4	60.5
West	76.6	91.9	61.4	92.0	91.5	93.0	72.8	75.3	68.0
Metropolitan status									
MSA	95.8	105.0	80.2	92.0	93.0	89.7	73.4	76.6	66.5
Non-MSA	68.9	75.9	57.7	90.8	92.0	88.2	67.2	69.7	61.8
Type of nursing home									
Newly opened home	101.7	94.8	113.9	85.9	89.1	81.1	72.1	77.4	64.4
Complement Survey home	21.9	57.7	14.7	83.8	79.8	87.0	36.9	36.6	37.2
Hospital-based home	108.4	104.3	130.2	92.3	92.3	92.5	99.5	99.3	101.1
NMFI home	88.7	94.0	79.1	92.0	93.1	89.9	71.0	73.5	65.6
Affiliation									
Chain	101.5	103.4	98.5	90.2	90.7	89.5	69.7	69.4	67.5
Independent	87.8	80.8	49.2	93.4	95.4	88.5	71.6	75.0	60.9
Government	130.1	129.4	139.1	91.7	90.2	111.3	87.6	88.8	73.6
Unknown	88.7	91.9	82.3	76.3	89.8	83.6	64.9	67.9	62.2

^{1/} Occupancy rate is for calendar year 1984.

^{2/} Full-time equivalent employees were calculated by dividing part-time hours by 35 and adding the results to full-time employees.

Table 5. Number of total nursing home beds estimated for all eligible sample homes and EQ homes, estimated non-response bias, adjusted EQ beds, and adjusted bias

Facility characteristic	Estimated number of nursing home beds		Estimated non-response bias in total beds	EQ beds post-stratified by ownership	Adjusted beds bias
	All eligible sample homes	EQ homes			
Total	1,624,170	1,616,615	7,554	1,625,813	-1,644
Ownership					
Proprietary	1,121,503	953,975	167,528	1,103,115	18,388
Voluntary nonprofit	370,733	488,524	-117,790	393,551	-22,817
Government	131,934	174,116	-42,183	129,148	2,785
Certification					
Skilled nursing facility only	307,875	292,009	15,866	303,329	4,547
Skilled nursing facility and intermediate care facility	724,004	749,784	-25,779	747,292	-23,288
Intermediate care facility only	409,383	394,710	14,674	408,422	962
Not certified	182,907	180,113	2,794	166,771	16,136
Bed size					
Less than 50 beds	151,099	135,150	15,949	143,952	7,147
50-99 Beds	444,256	456,911	-12,654	456,459	-12,203
100-199 Beds	702,144	695,152	6,993	712,736	-10,592
200 Beds or more	326,670	329,403	-2,733	312,666	14,005
Census Region					
Northeast	371,085	386,312	-15,227	369,606	1,479
North Central	531,707	542,197	-10,490	529,105	2,603
South	488,250	461,861	26,389	488,833	-583
West	233,127	226,245	6,882	238,270	-5,143
Metropolitan status					
MSA	1,107,373	1,107,342	30	1,120,357	-12,984
Non-MSA	516,797	509,273	7,524	505,456	11,340
Type of nursing home					
Newly opened home	85,996	72,265	13,731	97,770	-11,774
Complement Survey home	28,667	28,667	0	25,070	3,597
Hospital-based home	54,608	67,761	-13,153	51,152	3,456
NMFI home	1,454,899	1,447,922	6,977	1,451,822	3,077
Affiliation					
Chain	799,967	724,513	75,454	785,108	14,859
Independent	680,670	708,958	-28,288	700,916	-20,246
Government	131,934	174,116	-42,183	129,148	2,785
Unknown	11,599	9,028	2,571	10,641	958

Table 6. Standard errors of total nursing home beds, percent of nonresponse bias to total beds and percent of adjusted beds bias to total beds by selected facility characteristics: 1985 National Nursing Home Survey

Selected facility characteristics	Standard errors of total beds	Percent of nonresponse bias to total beds	Percent of adjusted beds bias to total beds
Total	19,652	0.5%	-0.1%
Ownership			
Proprietary	24,897	14.9	1.6
Voluntary nonprofit	26,433	-31.8	-6.2
Government	14,434	-32.0	2.1
Certification			
Skilled nursing facility only	19,242	5.2	1.5
Skilled nursing facility and intermediate care facility	23,458	-3.6	-3.2
Intermediate care facility only	21,697	3.6	0.2
Not certified	17,266	1.5	8.8
Bedsize			
Less than 50 beds	12,919	10.6	4.7
50-99 beds	14,394	-2.8	-2.7
100-199 beds	16,290	1.0	-1.5
200 beds or more	12,315	-0.8	4.3
Census region			
Northeast	18,257	-4.1	0.4
North Central	30,258	-2.0	0.5
South	30,507	5.4	-0.1
West	15,666	3.0	-2.2
Metropolitan status			
MSA	18,050	0.0	-1.2
Non-MSA	24,548	1.5	1.0
Type of nursing home in sampling frame			
Newly opened home	11,979	16.0	-13.7
Complement Survey home	6,235	-	12.5
Hospital-based home	7,285	-24.1	6.3
NMFI home	19,496	0.5	0.2
Affiliation			
Chain	21,679	9.4	1.9
Independent	26,070	-4.2	-3.0
Government	14,434	-32.0	2.1
Unknown	3,061	22.2	8.3