NONRESPONSE IN A SURVEY OF NURSING HOMES AND FACILITIES FOR MENTALLY RETARDED PERSONS: FINDINGS FROM THE NATIONAL MEDICAL EXPENDITURE SURVEY, INSTITUTIONAL POPULATION COMPONENT

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INTRODUCTION

The Institutional Population Component (IPC) of the 1987 National Medical Expenditure Survey (NMES) was established to provide an assessment of the health care utilization, costs, sources of payment, and health status of the U.S. institutionalized population in nursing and personal care homes (NH), and in facilities for the mentally retarded (MR). This paper will focus on nonresponse, at the facility level, as a possible source of bias in the IPC sample.

The 1986 Inventory of Long-Term Care Places (ILTCP), which served as the sampling frame for the IPC sample, provides a unique opportunity to compare IPC responding and nonresponding facilities. Because the ILTCP contains key data on facility characteristics, it will be possible to analyze response patterns for both responding and nonresponding facilities. Given knowledge of the characteristics of nonresponding facilities, key determinants of the probability of response will be measured and the direction of the bias resulting from nonresponse examined.

MATERIALS AND METHODS

Data in this paper are based on the 1987 NMES Institutional Population Component survey (IPC) and the 1986 Inventory of Long-Term Care Places (ILTCP). The later served as the sampling frame for the IPC survey.

The NMES IPC is a year long panel survey that was designed to provided data for a major research effort at the National Center for Health Services Research and Health Care Technology Assessment (NCHSR), and was co-sponsored with the Health Care Financing Administration (HCFA). Data were collected by Westat, Inc., and the National Opinion Research Center (NORC).

The targeted IPC universe is all persons who spent one or more nights in a nursing or personal care home, or a facility for the mentally retarded during 1987. The IPC sample was designed to yield unbiased national and regional estimates at the facility level and for the overall institutional user population, according to type of institution: nursing and personal care homes, and facilities for mentally retarded persons.

Designed as a stratified, three stage-probalility design, individual facilities were selected in the first two stages. Current residents (residents on January 1, 1987) and admissions (persons admitted between January 1, and December 31, 1987) were sampled, within sampled and cooperating facilities, at the third stage. Three explicit sampling strata were used to select the facility sample: nursing and personal care homes; facilities certified under Medicaid as Intermediate Care Facilities for the Mentally Retarded (ICF-MR) with 3-15 beds; and other facilities for mentally retarded persons. Implicit stratification variables were Census region, certification status, type of ownership, number of beds, number of admissions, state, and ZIP code. Within strata, facilities were selected in the first stage with probability proportional to size (pps), and further classified into four distinct cost strata[1], depending upon each facility's proximity to enough other facilities to form a full workload for an interviewer. The second stage facility sample was then selected according to an optimal allocation scheme to minimize variance for fixed cost. Persons within facilities were selected at rates that were inversely related to the selection probability of the facilities (Cohen, Flyer, and Potter, 1987).

In the first phase of IPC data collection, data on characteristics of the facility (including eligibility information) were collected from the facility administrator (or designee) using the Facility Questionnaire (FQ). Upon completion of the FQ, interviewers selected a sample of current residents from each responding in-scope facility and administered a Baseline Questionnaire. The Baseline Questionnaire collected person level information on health status, resident history and demographic data from facility staff persons responsible for providing care to sampled persons. Subsequent phases of the survey collected calendar year data for 1987 on the use and expenditures for health services by institutionalized persons. Reported here are the survey response results for the Facility Questionnaire.

The 1986 ILTCP served as the sampling frame for the IPC, and provided data for stratification. The ILTCP is the most up-to-date comprehensive listing of nursing and personal care homes, and facilities for mentally retarded persons in the 50 States and the District of Columbia. The ILTCP data collection was co-sponsored by NCHSR, HCFA, and the National Center for Health Statistics (NCHS), and conducted by the Bureau of the Census as a mail survey with telephone and personal follow-up to nonrespondents. Details on the construction of the IPC sampling frame and the design of the ILTCP are presented elsewhere (Potter, Cohen and Mueller, 1987).

The ILTCP response rate was high at 97%. Facilities with total nonresponse to the ILTCP were included in the NMES IPC sampling frame to allow each facility a probability of selection. These facilities are also included in this analysis. Item specific data for the total nonrespondents are handled in a manner similar to item nonrespondents. The mean item response rate for key ILTCP facility characteristics was 96% (Potter, Cohen and Mueller, 1987). Data from the 1982 National Master Facility Inventory (NMFI; Sirrocco, 1985) and the 1982 National Census of Residential Facilities (NCRF; Hauber, et al., 1984) -- the predecessors to the ILTCP -- were used to replace missing ILTCP data on facility type, bed size, certification status, and ownership. After secondary source replacement, bed size information was imputed for 2.2% of the

facilities, using a median value imputation procedure within five bed size classes and stratifying for facility type, ownership, and certification status. There was no missing data with respect to Census region, state, and the subsampling cost strata. These key sampling frame variables, and a variable to control for IPC field region[2], are used in this analysis to characterize the NMES IPC facility respondents and nonrespondents.

Both stratified analysis and logistic regression analysis were used to assess the difference between responding and nonresponding facilities. The logistic regression model, in the form of:

$$\log \frac{P}{1 - P} = \beta_0 + \beta_1 x_1 + \ldots + \beta_k x_k$$

(Cox, 1970), was used to assess the simultaneous effects of potential confounding and effect modification by qualitative and categorically defined quantitative variables, and to obtain marginal probability estimates associated with being a responding facility. This preliminary analysis proceeds in two stages, by facility type.

First, stratified analyses were used to screen variables prior to inclusion in the model. The chi-square test statistic was used to assess the homogeneity of responding and nonresponding facilities with respect to key facility characteristics. Stratified analyses were run unweighted using the SAS computer package (SAS, 1985).

Second, an ordinary backwards stepwise logistic regression procedure was used to further screen variables for inclusion in the model. This was run as a SAS utility procedure using the BMDP LR program (Engelman, 1985). T-statistics for significance were used to determine which parameters were to be deleted from the model and which parameter cells were to be collapsed to improve fit. Goodness-of-fit was assessed using the Hosmer and the Brown chi-square statistics, and a Wald statistic (Hosmer and Lemeshow, 1980; Prentice, 1976; Landis, et al., 1976). The latter was based on the information matrix from the maximum-likehood calculations derived from the SAS categorical data modeling procedure CATMOD (SAS, 1985).

RESULTS

The original IPC sample consisted of 1,714 facilities: 815 nursing homes and 899 facilities for mentally retarded persons (Cohen, Flyer and Potter, 1987). Table 1 shows the results of the Facility Questionnaire data collection efforts for the sample. Excluded from the sample were facilities found to be closed (35), facilities identified as duplicates of other sampled facilities (24), and facilities found to be ineligible for the IPC based upon data collected in the Facility Questionnaire (74). To be eligible, the following definitions were adopted and incorporated into the design of the FQ instrument:

Nursing and personal care homes were defined as (1) a place or unit certified as a Skilled Nursing Facility (SNF) by Medicare or Medicaid, or (2) a place certified as an Intermediate Care Facility (ICF) by Medicaid, or (3) a place or unit with three or more beds for clients, where clients resided, that provides personal care -- help with Activities of Daily Living (ADL) or Instrumental Activities of Daily Living (IADL)[3], that is not a licensed hospital, that does not serve primarily or exclusively persons with specific physical, mental or emotional conditions (i.e., is not a categorical institution for alcoholics, etc.) and that, if a unit of a larger institution, can identify eligible residents separately from those of the institution as a whole.

Facilities for mentally retarded persons were defined as (1) a place or unit certified as an Intermediate Care Facility for the Mentally Retarded (ICF-MR) by Medicaid, or (2) a place or unit with three or more beds for clients who reside there, and that provides to mentally retarded persons either personal care (ADL or IADL)[3] or protective oversight -- 24-hour-a-day, seven days-a-week supervision, that is not a licensed hospital except a hospital for the mentally retarded, and that is not a family providing services exclusively to a relative or relatives.

By the above definitions all SNF- or ICF-certified units of licensed hospitals were eligible. In such cases, and in the case of retirement homes, only the long-term care unit of the facility was eligible. In the case of the MR unit within a hospital, only the MR unit of the hospital was eligible.

The overwhelming majority of IPC ineligible facilities reported serving the mentally ill and not the mentally retarded. Six responding facilities were excluded because the number of beds set up and staffed for use was fewer than three.

The final IPC sample of eligible facilities consisted of 1,501 responding facilities and 80 nonresponding facilities, for an overall IPC FQ response rate of 95% (Table 1). No differences in response rate were observed by facility type.

Comparison of Facility Characteristics - Table 2 shows the distribution of responding and nonresponding eligible facilities by key facility characteristics. A significant association was observed between ownership and responding status, with for profit facilities accounting for 75% of the nonresponding facilities but only 56% of the responding facilities. A significant association was also observed between response and subsampling cost strata -- facilities close enough to other facilities to form a full interviewer workload comprised 83% of the nonresponders, but only 73% of the responders. Other geographic location variables found to be associated with facility response were field region and location in New York (NY) or California (CA). No significant differences were observed for facility type, bed size, Census region, and certification status (i.e., SNF Medicare or Medicaid, ICF Medicaid, ICF-MR Medicaid, and no certification).

The distribution of key characteristics by facility type and responding status is shown in Table 3. Ownership was significantly associated with facility response among nursing homes (70% of the responders verses 93% of the nonresponders were for profit) as was SNF certification status. The later appeared to be associated with response, with 71% of the responders having SNF Medicaid or Medicare certification compared to only 56% of the nonrespondents. Suggested differences were also noted among nursing homes (NH) that lacked any certification, and by Census region; however, the data were sparse and not tested statistically.

Among facilities for the mentally retarded (MR), Census region and location in New York or California were found to be significantly associated with MR facility response. Among responding facilities, those in NY or CA accounted for 22% of all MR, but among nonresponders they accounted for 54%. Other variables -- cost strata, bed size, ICF certification status, and field region -- also suggested differences by responding status but these were not statistically significant.

Models to Predict Facility Response - A summary of the operational definitions of the dependent and independent variables included in the saturated backward stepwise logistic regression models is provided in Table 4. The saturated model was run three times: (1) for all eligible facilities, (2) eligible NH, and (3) eligible MR. All variables used for the stratified analysis were included in the saturated models since all, except ICF-MR certification status and the MR sampling strata variable, showed some differences in facility response. Although not all differences were statistically significant, the effect of potential confounding variables could not be assessed by stratified analysis alone and, thus, were included in the models.

The original saturated models included three levels of ownership and four levels of cost strata, but T-tests of differences between coefficients found no significant difference between nonprofit and Government ownership, or between the three categories of partial workload cost strata. Thus, these variables were recoded and the saturated models rerun.

The final the logistic regression models for estimating the probability of being a responding facility are shown in Tables 5-7. Among all eligible facilities, nonprofit facilities were significantly more likely to be responders than for-profit institutions, and this increased the marginal probability of response by 4%[4]. Similarly, facilities located far enough from other facilities to form only a partial interviewer workload or require overnight travel (partial cost strata) were significantly more likely to be responders than facilities located close enough to other facilities to form a full interviewer workload. The former increased the probability of response by almost 4%. Conversely, facilities with ICF certification or those located in NY or CA were significantly more likely to be nonresponding facilities than their counterparts (Table 5).

Among nursing homes, similar results were observed for ownership; however, the marginal probability of being a responding nonprofit facility doubled from 4% among all facilities to 8% among NH, when compared to for profit places. SNF certification status was also found to significantly increase the probability of NH response showing similar results to what was observed for the stratified analysis. While bed size and partial workload cost strata did improve the overall fit of the NH model, these variables were not significant predictors of response.

Among facilities for the mentally retarded, those with 16-149 beds were significantly more likely to be nonresponders compared to very small facilities (3-15 beds). Facilities with more than 149 beds were not significantly different from very small facilities, suggesting that the very small and large facilities are more likely to be MR responders than mid-sized facilities. In fact, MR facilities with 16-49 beds decreased the probability of response by almost 7% over that of the smaller facilities (Table 7).

Also shown to be significant predictors of MR nonresponse were ICF certification and location in NY or CA. The later decreased the probability of response by almost 8% over facilities in states other than NY or CA.

DISCUSSION

Past research has demonstrated that survey nonresponse is an important problem for statisticians and survey researchers (Cornfield, 1942). Nonresponse can seriously bias survey estimates and distort inferences, and the topic is well covered in sampling texts (Cochran, 1963; Kish, 1965).

Typically, statisticians use response rates as proxy measures of nonresponse bias because they lack the necessary data to calculate the nonresponse mean and thus determine the relative bias associated with survey nonresponse[5]. Data from the National Medical Expenditure Survey, Institutional Population Component survey provides a unique opportunity to evaluate the effects of nonresponse bias since data on nonrespondents were available.

The IPC sample was designed to yield unbiased national and regional estimates at the facility level and for the overall institutional user population according to type of institution: nursing and personal care homes, and facilities for the mentally retarded. The focus of this paper was on nonresponse at the facility level as a possible source of bias in the IPC sample. Data from the IPC sampling frame were used to characterize facility respondents and nonrespondents, and to model the probability of being a responding facility. Three models were developed, one each for: all eligible facilities, NH only, and MR only.

Among all eligible facilities, and among NH only, nonprofit institutions were significantly more likely to be responders than for-profits. But among NH, the marginally probability associated with response was double that of nonprofits in the all facility model, suggesting that the relationship between ownership and facility response is driven by the NH component in the all-facility model. This is further supported by the fact that ownership failed to be included in

the final MR model. This finding -- that ownership is associated with NH response -- replicates what was found in the 1985 National Nursing Home Survey (NNHS) expense data (Hing, 1987). However, the NNHS analysis failed to control for potential confounding variables that were controlled for in this analysis.

Among all facilities and among facilities for the mentally retarded, those located in New York or California significantly decreased the probability of being a responding facility. No association between facility response and NY/CA was observed among nursing homes. This, and the marginal probabilities associated with response in the MR and all-facility models, points to an association of nonresponse among MR only. No explanation is offered for this finding at this time. If the finding were for both facility types, one might suggest that the nonresponse was typical of field problems generally associated with household surveys in the metropolitan areas of NY City and LA. Since no association was found for NH, this can not be assumed.

Among all facilities, the subsampling cost strata variable was found to be significantly associated with response -- facilities located far enough from other facilities to form only a partial interviewer workload or require overnight travel were significantly more likely to be responders than facilities located close enough to other facilities to form a full interviewer workload. Two possible explanations are offered for this finding. First, interviewers working in areas where the number of facilities was insufficient to form a full workload may be economically motivated to improve response rates, since their workload is already small. Secondly, the full interviewer workload cost strata may be a proxy measure for large metropolitan areas, and therefore, a measure of urbanization effects on response rates. An effect that has been documented in the literature (Steeh, 1981).

The finding that cost strata is associated with response appears to be a finding for all facility types (NH and MR). The variable was included in the NH model, but was not a significant predictor. While it was excluded from the MR model, the size of the MR sample, when combined with the NH sample in the all-facility model, was sufficient to reveal a significant finding. This suggests that a lack of power may be responsible for the lack of association among the individual facility types, when analyzed as independent models.

Taken together, the findings for the variable cost strata and NY/CA state suggests that their contribution to the bias of the geographic location variables is not entirely understood at this time. Both variables may be proxy measures for urbanization's effects on response. Unfortunately, the information with which to create an urban/rural variable was not available for this analysis Future analyses are planned and this variable could be included at that time.

The field region variable was included in the saturated model not because it was thought to be a proxy measure for contiguous geographic areas -- a review of the states by field region (Table 4) shows that the these regions frequently include states not contiguous to each other -- but rather, to control for field supervisor effects on response. In this light, it is reassuring that no significant differences on response were observed. The data further suggest that any association for field region, relative to geographic location was teased out of the data with the cost strata and the state variables, even if their relationship to the bias is not completely understood at this time.

Certification was found to contribute significantly to the probability of response. However, the results are not conclusive. ICF certification was found to significantly decrease the probability of being a responding MR -- decreasing the probability of response by over 5% -- while SNF certification significantly increased the probability of response among NH. ICF status was excluded from the final NH model, as was SNF excluded from the final MR model. The finding that SNF certification is positively associated with NH response was also reported for the 1985 NNHS; however, Hing (1987) also reported that ICF status was positively associated with NH response. This later finding was not replicated with these analyses, perhaps because the NNHS analysis failed to control for potential confounding variables. Another possible explanation is that no interaction term for SNF and ICF was included in the model. Long-term care facilities can be both SNF and ICF, one or the other, or neither, and these analyses failed to adequately control for possible interaction effects.

The finding that mid-size MR are more likely to be responders than very small or large MR facilities is surprising and the reason not clearly understood. Perhaps the inclusion of interaction terms in the model might explain the finding. It is reassuring though, that large MR facilities fail to be significant predictors of response, as over half of the mentally retarded population (52%) has been reported to reside in institutions with 150 or more beds (Hauber et al., 1984).

Primary sampling strata -- NH, MR with ICF-MR certification and 3-15 beds, and other MR -- was not associated with response in the all-facility model or in the MR model. These data suggest it is not facility type per say that drives the probability of response, but rather, the underlying characteristics of these facilities.

In conclusion, nonprofit ownership and SNF certification were positively associated with NH response, and ICF status and bed size were negatively associated with MR response. These findings are of concern but not serious concern. Nonresponse weighting adjustments have been made to the NMES IPC data using ownership, certification status, and bed size as weighting classes. What these data do suggest is that the collapsing of certification across SNF and ICF, and the collapsing of bed size classes may be inappropriate to adjust for nonresponse bias.

Of all the findings the two of most concern are the findings that location in NY or CA is negatively associated with MR response, and that partial workload cost strata is positively associated with response among all facility types (NH or MR). These variables, have not yet, been

incorporated into weights adjustments for total nonresponse. This addition to the weighting class specifications that adjust for nonresponse may yield an additional reduction in nonresponse bias. For example, the relative bias of the sample mean associated with NY/CA among facilities for the mentally retarded was calculated as -6.7%[5]. That is, the sample estimate of the population mean may bias the true estimate downward by 6.7%. The NMES IPC was designed as an expenditure survey, with one of it's objectives a national estimate of Medicaid expenditures for the MR population -- Medicaid is a significant source of financing for this population. Since reimbursement rates for Medicaid are determined at the state level, a contribution to the total survey error by location in NY or CA is a real concern and subsequent nonresponse adjustments to the data need to take this into account.

This analysis of NMES IPC nonresponse was conducted as an unweighted analysis. While useful in it's own right, the analysis underestimates the variance associated with the coefficient estimates since the survey is of a complex survey design, rather than simple random sampling. However, the findings for ownership, bed size (16-49 beds), location in NY or CA, and possibly cost strata, are not expected to change when the models are rerun using complex survey design software (such as the SAS RTILOGIT procedure developed by RTI; Shah et al., 1977; Lavange et al., 1986). The p values associated with these variables, excluding cost strata, were all less than .01 (the p value for cost strata was .016), and thus are expected to remain significant even after rerunning the weighted models. The findings of SNF certification and 50-149 bed size, and most probably ICF status, may no longer be applicable when the data are rerun as weighted models with more appropriate variance estimation techniques, since their p values were in the range of .03 - .05 (Cox and Cohen, 1985).

Not available for these analyses were the record of calls (specific data on the reason a facility refused to participate), an urban/rural indicator, and non-key sampling variables from the IPC sampling frame (e.g., routine provision of nursing services). These, interaction terms, and the use of appropriate software to estimate the weighted logistic coefficient will be incorporated into the final analysis of these data.

NOTES

[1]Four distinct cost strata were defined for the IPC sample using data obtained from an experimental sample draw of facilities. The experiment analysis suggested that facilities could be reasonably classified as belonging to one of four types based upon travel costs associated with interviewing over the course of the survey (Cohen, Flyer and Potter, 1987). In essence, facilities were classified based upon their geographical proximity to other facilities. The four cost strata defined were: (1) full workload for an interviewer (minimum 130 hours) in a single site, (2) partial workload for an interviewer at a site that is distant from an interviewer's home, (3) single facility within driving distance from an interviewer's home, and (4) single facility requiring air travel.

[2]For purposes of IPC data collection, the country was divided into seven geographic or field regions. Each field region consisted of between 2 and 13 states depending upon the number of sampled facilities per state. The states composing a field region were loosely grouped by geography, but, by no means did a field region form a contiguous geographic area. However, each field region was supervised by a single field supervisor and all interviewers working in a region reported to that supervisor. Thus, the field region variable is a measure of field supervisor effects. See Table 4 for a state by state breakdown of the seven field regions.

[3]For purposes of determining facility eligibility, a facility provided personal care if at least one of the following were routinely provided: nursing or medical care; supervision over residents who administer their own medications; or help with bathing, dressing, correspondence or shopping, walking or getting about, eating, or communication (such as hearing, speaking, sign language, or writing).

[4]Marginal probabilities were computed as:

$$P_1 = B_1 \times [P \times (1 - P)]$$

where: P_1 = the marginal probability of the independent variable x_1, B_1 = the logistic coefficient of the independent variable x_1, and P = the mean of the 0/1 dependent variable.

[5]The relationship between nonresponse and the sample mean can be defined as:

$$\bar{Y} = W_1\bar{Y}_1 + W_2\bar{Y}_2$$

where W_1 and W_2 are the proportion of respondents and nonrespondents. Such that, the relative bias is:

$$RB(\bar{Y}_1) = W_2 \frac{(\bar{Y}_1) - (\bar{Y}_2)}{\bar{Y}}$$

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