MISSING DATA ON MEDICAL EXPENDITURE SURVEYS: MATCHING HOUSEHOLD AND PROVIDER REPORTS

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I THE PROBLEM: MISSING DATA ON HEALTH EXPENDITURE SURVEYS

Collecting accurate data about the cost of and sources of payment for medical care represents a formidable challenge to health survey researchers. Medical records are limited as a source of information because they do not give a complete picture of a family's use of services, nor do they provide complete information on source of payment for care, as many persons receive reimbursement from health insurance for out-of-pocket payment of physician charges. Survey interviews in households are a better source of information for these items, but many household respondents cannot report use of services or charges accurately. Medicaid beneficiaries find it particularly difficult to report charges as they often do not receive a bill for medical services. Some non-Medicaid respondents also have trouble reporting these charges. They may not be able to recall the charges associated with doctor visits occurring two or three months before the interview, and may not even remember the visits. On the other hand, charges associated with recent medical events may not be known because the respondent has not yet been billed.

The 1977 National Medical Care Expenditure Survey (NMCES) was designed to produce national estimates of expenditures for both inpatient and outpatient care. Approximately 40,000 individuals representing 13,500 households were surveyed five times in the course of one year about their health care. A supplementary survey of medical providers was also conducted to fill in missing data from the household survey. This study summarizes the problem of matching household data with data from medical providers encountered with the NMCES, and then describes the results of an experiment conducted as part of the 1986 Evaluation of NCHS Population-based Surveys, Medical Expenditure Survey. The experiment was designed to explore strategies for improving match rates.

II MATCHING HOUSEHOLD AND MEDICAID PROVIDER DATA

Non-Medicaid respondents to the 1977 NMCES household survey were usually able to report a visit charge. Overall, less than 20% of their doctor visit charges were missing. Medicaid respondents, however, reported charges for only about 23% of their visits. For both Medicaid and non-Medicaid respondents, moreover, certain types of visits -- emergency room care and home health services, for example -- had higher levels of missing data than other visit types.

In an attempt to fill in some of this missing data, NMCES included a Medical Provider Survey (MPS). Medical providers reported by 32% of the persons participating in the household survey were selected for this verification component. The usefulness of MPS data was limited by two levels of nonresponse: about 15% of the identified physicians could not be contacted because their patients did not sign permission forms, and another 15% of the physicians chose not to participate. When both household and provider reports were obtained, determining which MPS visit reports matched (described the same visit as) household reports proved time-consuming and expensive.

The first step in the NMCES matching process was the development of a "truth set" by having a panel of expert coders hand-match data from 400 household respondents and their providers. Machine algorithms were then developed to replicate the match decisions of the expert panel as nearly as possible. This process was only moderately successful. The algorithm failed to match 34% of household visits matched by the expert panel (Kasper 1984) and the algorithm matched many events left unmatched by the panel (Cooley 1981). The algorithm was then applied to the full data set. Missing data in the household survey was replaced with data from the Medical Provider Survey whenever there was a match. Visits reported by medical providers that were not matched to a household-reported visit were not used in the imputation process.

Only about 47% of physician visits reported by household respondents could be linked to an MPS report for those households selected for verification. For matched visits in which both the physician and household respondent reported charges, the household-reported charge took precedence if there was disagreement. Thus, MPS data were used to impute only a small proportion of physician-event charges.

Design of the NMES Experiment

The 1987 National Medical Expenditure Survey (NMES) was the third in the series of medical expenditure surveys, of which NMCES was the first. The NMES was preceded by a pilot study (the Evaluation of NCHS Population-based Surveys, Medical Expenditure Survey) to evaluate several potential methodological innovations. Like the 1977 NMCES survey, both the 1987 NMES and its pilot were to include a Medical Provider Survey.

The planned MPS component of the NMES was redesigned to focus specifically on kinds of respondents who had difficulty reporting expenditures and kinds of medical events for which expenditures were generally not well-reported in 1977. The MPS sample would therefore focus primarily on care in institutional settings, home health care, and physician visits by persons covered by Medicaid.

The MPS component of the 1986 NMES pilot was designed to examine a number of methodological issues concerning the match of medical provider reports with household reports, including the following:

- Are higher match rates achieved by furnishing the physician with the dates of care as reported by the household respondent?
- What is the marginal gain of expert hand-matching over simple matching rules that could be implemented by machine?
- What is the maximum attainable match rate? Can missing data problems be corrected only through exact matching or is statistical matching also desirable in an optimal imputation procedure?

The NMES pilot began with a household survey of 560 dwelling units located in eight primary sampling units across the country. Two rounds of interviewing were conducted with household respondents to collect information on use of and expenses for medical care services for a six-month period. The survey sample heavily over-represented Blacks, Hispanics, and the elderly. The design of the household survey is described in Mathiowetz and Ward (1987). Results of methodological experiments conducted as part of the household component are discussed in Berk et al., (1987) and Mathiowetz and Ward (1987).

At the conclusion of the household survey, respondents were asked to sign permission forms authorizing their medical providers to provide supplementary data about the care received. The sample of providers thus identified was divided into three experimental groups to test the differential effects of

(a) conducting the interviews by mail or over the telephone and (b) informing the medical providers of the visit dates reported by household respondents or not informing them. All medical providers received a mailing that included a letter describing the survey and copies of permission forms signed by their patients. For Group 1, the mailing included the household-reported dates of visits. This group was then interviewed by telephone. Group 2 was also interviewed over the phone but was not given the dates of visits. Group 3 received the household-reported dates in the mailing along with the survey questionnaires for self-administration. Because the earlier study had used both mail and telephone modes and had not given household-reported visit dates to providers, the fourth cell, a mail survey with dates not given, was not included in the NMES pilot study experiment. We should note that the NMES pilot MPS was limited to visits for ambulatory care, and that hospitals and HMO's were under-represented in the sample for operational reasons.

Although several studies have used surveys of physicians to verify household reporting (i.e., Cannell and Fowler 1962; Andersen, et al. 1979), these studies did not provide physicians with information about what the household respondent had reported. Very early studies, however, did provide the physician with household-reported data. This procedure was used in the 1935-1936 National Health Survey, which attempted to verify diagnosis. Anecdotal evidence from that study led researchers to believe that physicians were taking the "path of least resistance" by checking the family diagnosis as correct (Trussel and Elinson 1959). In order to systematically study this potential source of bias, a controlled experiment was conducted in their 1957 Hunterdon County study. Matching in this study was based on the relationship between physician and patient diagnosis, as well as the tendency of either the physician or patient to report conditions not reported by the other. The findings indicated that physicians informed of household reports were more likely to verify diagnosis and that physicians who were not informed were much more likely to report conditions not mentioned by the patient. Due in part to these findings, verification studies during the last 30 years have tried to avoid physician "yea-saying" by asking for a completely independent report in which the physician is not given information obtained from the patient.

The analytical design of the 1987 NMES, however, made it practical to again consider the merits of providing the physician with patient reports. As a result of studies based on the 1977 NMCES (Cox and McGrath 1981) it was determined that the correlation between household- and physician-reported diagnosis was so low that the MPS should no longer be used as device to correct household-reported diagnosis. Instead, the MPS should focus on use and expenditures. Since physicians were asked to provide detailed data about each visit, there was little concern that the provider would "verify" a visit of which he had no record since this would require fabricating responses to an accompanying set of questions as well. There was, however, interest in determining whether physicians who were given visit dates would be less careful about checking their records further and therefore report fewer "unverified visits" than doctors not given such information. If giving physicians the dates of visits increased match rates without decreasing the likelihood of reporting new visits, the procedure would appear to offer promise as a mechanism for improving data quality.

Findings

A simple tabulation of the numbers of visits reported by household respondents as compared with the number reported by medical providers showed some results of interest. For purposes of these analyses, an observation was considered to be one patient (household survey participant) and one medical provider reported by the household survey respondent as having seen that patient; this observational unit is a "patient-provider pair." Overall, for 45% of patient-provider pairs, the household respondent and medical provider reported the same number of visits; for 30% of the pairs, the medical provider reported more visits; and for 25% of the pairs, the household respondent reported more visits. However, the total number of visits reported by household respondents was about 6% greater than the total number reported by medical providers. (This discrepancy can be entirely accounted for by pairs in the tails of the distribution. If the frequency distribution of the difference in the number of visits reported per pair by each source were truncated at a difference of ten on each side, the totals would be virtually identical.)

Examining the different levels of reporting by experimental treatment groups reveals that providing household-reported visit dates seems to improve (or at least increase) the reporting of visits by medical providers, contradicting the tendency toward "yea-saying" by medical providers when reporting medical conditions. Table 1 indicates that medical providers reported only 2% fewer visits than household respondents in the "telephone/dates given" treatment, 6% fewer in the "mail/dates given" treatment, and 10% fewer in the "telephone/ dates not given" treatment. Further, the household respondent reported more visits than the medical provider in only 19% of the patient-provider pairs for the "telephone/dates given" treatment as opposed to 28% in the other groups. The difference falls just short of being statistically significant at the .05 level ($Z = 1.94$), and suggests that giving the household-reported dates of visit may improve reporting by medical providers.

The analysis proceeded by matching household-reported and provider-reported visits; the initial match used "simple rules" that could be easily replicated by machine. First, all visits on which both the provider and household respondent reported the same date were considered to be "matched." If a household-reported visit did not match a provider-reported visit exactly, it was matched to the provider visit with the closest date, providing the two reported dates were within 14 days of each other. If the household respondent reported the month of a visit but did not know the date, the visit could be matched to a provider visit within the same month. Visits reported for a particular survey participant to a particular provider could only be matched to visits by that person reported as being to that provider.

The results indicate that, with a telephone verification survey, there is a small improvement in simple match rate when the provider is given the dates of visits reported by household respondents (Table 2). However, this difference is not statistically significant at the .05 level. There was no difference between the match rates obtained in telephone and mail verification surveys when dates were given.

We then applied complex match rules based on the subjective evaluation of an expert coder. In addition to date of visit, the reason for visit provided by the household respondent and the diagnosis reported by the medical provider were also considered. Additionally, visits could be matched if they agreed on the day of the month even if the month itself was different. The overall reporting pattern was also considered so that, for example, a string of equally spaced visits on the household side might be matched to a similar string even if the groupings of visits were several weeks apart. Using these complex rules, a 70% match was obtained for the telephone survey with dates given, compared to 68% for the telephone survey in which the provider was not given visit dates. A 69% match rate was achieved in the mail survey.

Finally, we considered the maximum match rate possible, assuming that every medical provider visit could be matched with a corresponding household visit, with the only restriction being that the match had to be one-to-one, that is, "extra" visits reported by either the household or medical provider in a patient-provider pair could not be matched. Interestingly, the differences between treatment groups essentially disappear,

with an overall maximum match rate of 76%.

Discussion

The findings illustrate the limitations of the matching process. Our analysis is limited only to the subset of patient-provider pairs for which data was obtained from both household and provider interviews. In a household panel survey with verification, there are multiple levels of attrition, including nonparticipation in the household survey, refusal to sign permission forms for the verification survey, and non-response on the verification survey. Even on the subset that remains, however, the match rate using simple match rules on telephone survey data was about 60%, improving to 64% when the provider was given the visit dates to be verified. Moreover, improving this rate is a formidable task. The use of an expert coder can provide a hand-match rate of about 70% but these complex match rules probably cannot be implemented by a computer algorithm. A major component of the problem is the fact that often providers and respondents reported different numbers of visits, making some matches impossible. The maximum match rate attainable in this study was about 76% of household-reported visits, regardless of experimental treatment.

Conclusion

The findings indicate that furnishing the provider with household-reported dates can result in a small but worthwhile improvement in match at relatively little cost. This strategy does not result in "yea-saying," or under-reporting of visits not reported by the household respondent, when the objective is collecting information on the number of visits and charges for those visits. Using complex hand-matching rules also leads to a small improvement in match rates but the cost is high. Even when both methods are used together, match rates do not exceed 70%. Moreover, we have indicated that there is an upward bound on the match rate that can be achieved and that major improvements in matching beyond that reported in this study are unlikely.

Thus, there is a strong possibility that exact matching techniques are themselves biased when used as a strategy for reducing potential item nonresponse bias or standard errors of estimates from a medical expenditure survey.

We expect that the growth of public insurance programs and the aging of the population will mean that the problem of missing data will continue to challenge health survey researchers concerned with missing data. We have suggested that, while there are some potential innovative approaches to improving match rates for direct substitution of provider-reported data for missing household survey data, the problem remains formidable.

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Table 1. Comparison of Number of Visits Reported by Household and Medical Provider

	N (patient-provider pairs)	# visits reported by household	# visits reported by provider	Proportional difference in # of visits reported	Proportion of observations where: Provider reported < visits	Household & provider rep = # of visits	Household reported > visits
Treatment Category							
Telephone survey/ provider given household-reported visit dates	168	518	508	.02	.34	.47	.19
Telephone survey/ provider not given dates	166	522	471	.10	.26	.46	.28
Mail survey/ provider given dates	131	503	475	.06	.31	.41	.28

Table 2. Simple, Complex and Maximum Match Rates by Treatment Category

	# visits reported on household survey	% matched with simple match rules	% matched with complex match rules	maximum attainable match rate
Treatment Category				
Telephone survey/provider given household-reported visit dates	518	64	70	76
Telephone survey/provider not given dates	522	60	68	75
Mail survey/provider given dates	503	64	69	76