

USING THE NATIONAL HEALTH INTERVIEW SURVEY AS A SAMPLING FRAME FOR OTHER HEALTH-RELATED SURVEYS¹

Trena M. Ezzati-Rice, National Center for Health Statistics (NCHS); Steven B. Cohen, Agency for Health Care Policy and Research; Meena Khare, NCHS; and Christopher L. Moriarity, NCHS
Trena M. Ezzati-Rice, National Center for Health Statistics, 6525 Belcrest Road, Hyattsville, MD 20782

Key Words: Health surveys, survey integration, sample design

1. Introduction

The Department of Health and Human Services (DHHS) conducts a number of important population based health surveys. Data from these surveys are used to support broad analytic and program objectives and to evaluate the impact of various health care policies over time. Traditionally, the various DHHS surveys have been developed independently to meet defined data needs. As part of efforts to “reinvent government”, the DHHS is undertaking major planning and research efforts to restructure its health surveys in an effort to fill major data gaps, improve analytical utility, and develop a more systematic strategy for collection of data on key health and health care issues. The product of this effort is the DHHS survey integration plan. This plan developed in 1995 is designed to increase the analytic potential of DHHS’ data collection systems by encouraging integration of survey samples, survey design features, questionnaires, and data collection procedures.

A major part of this integration plan is the designation of the National Health Interview Survey (NHIS) as the sampling frame for a number of DHHS household surveys. This paper provides an overview of key elements of the DHHS survey integration plan, the linkage of three major DHHS surveys with the NHIS, and the integration of the NHIS and a telephone survey to provide key data at the state level. Selected methodological issues for the next redesign of the NHIS related to the integration of surveys in the future are also discussed.

2. Goals and Key Elements of DHHS Survey Integration

In 1995, DHHS submitted a plan to the Office of Management and Budget proposing to integrate and coordinate data collection systems within the Department. The survey integration plan had several major goals as previously reported by Hunter and Arnett (1996). These goals focus on enhancing and expanding the analytical capacity of DHHS surveys, addressing high priority data gaps, and developing a systematic strategic framework

for DHHS data collection activities. Selected key elements of this plan include:

- (1) Redesigning and automating the NHIS to serve as the sampling “nucleus” for various DHHS population surveys;
- (2) Implementing an ongoing, longitudinal panel survey on insurance and expenditures;
- (3) Implementing a continuous National Health and Nutrition Examination Survey with its sample linked to the NHIS;
- (4) Developing the capacity to produce State-level data;
- (5) Implementing joint field operations and common core questionnaire for surveys of health care providers;
- (6) Consolidating surveys of employers to gather employer health insurance information; and
- (7) Sharing of knowledge and resources in such areas as instrument design, sample design, estimation techniques, data access and privacy, and public data release.

Initially there were four surveys targeted for linkage to the NHIS: the National Survey of Family Growth, a new Medical Expenditure Panel Survey growing from the earlier National Medical Expenditure Surveys, the National Health and Nutrition Examination Survey, and the National Household Survey on Drug Abuse (NHSDA). Due to a number of methodological issues related to anonymity and confidentiality, the NHSDA was dropped from consideration of linkage with the NHIS in the short term.

3.1 Overview of the NHIS Sample Design

The NHIS, conducted by the National Center for Health Statistics (NCHS), is the Nation’s primary source of general purpose health information for the resident civilian noninstitutionalized population. In particular, the

¹The views expressed in this paper are those of the authors and no official endorsement by the Department of Health and Human Services, the Agency for Health Care Policy and Research or the National Center for Health Statistics is intended or should be inferred.

NHIS is an on-going survey that provides national estimates of health status indicators, health care utilization and access, chronic disease, acute conditions, and other health-related data. It also collects information on health insurance coverage status, income and program participation, and various socio-demographic characteristics.

The NHIS is based on a stratified multistage sampling plan. Since its inception in 1957 (National Center for Health Statistics, 1958), the NHIS sample has been redesigned following each Decennial Census of the population in order to both accommodate changes in survey requirements and take into account the changes in the population and its distribution. Thus, each NHIS sampling plan is followed for about 10 years. The specific parameters of the design have changed over time. For example, the 1973-84 NHIS design was based on 386 sample primary sample units (PSUs), the 1985-94 NHIS design on 198 sample PSUs, and the 1995-2004 NHIS on 358 sample PSUs (National Center for Health Statistics, 1975, 1985a, and 1989). The NHIS has been designed to produce estimates for the Nation and for each of the four Census Regions and within these regions by areas determined by metropolitan and nonmetropolitan status.

3.2 Key Features of the 1995-2004 NHIS Sample Design

The key design features of the NHIS sample design implemented in January 1995 are as follows:

1. *Use of an all area sampling frame.* The use of an all area-frame sample permits NCHS to release the addresses of the NHIS sample to its contractors for additional data collection; Census confidentiality constraints would not permit the release of addresses obtained through listings compiled for the preceding Decennial Census.
2. *Oversampling of Black and Hispanic persons.* This is accomplished with two features. First, a larger initial sample is selected than would be otherwise required. In this larger sample, all households with a Black or Hispanic person are retained in the survey, while only a subsample of other households is retained in the survey. The determination of a household's race/ethnicity status is accomplished through the administration of a brief screening interview. Second, addresses are selected at higher rates in areas with high concentrations of Black and Hispanic persons.
3. *State stratification and increase in the number of (PSUs).* State stratification together with an almost doubling of the number of PSUs in the NHIS sample over the previous design can facilitate state level sample expansions that allow for a combination of national and state level samples. The largest increase

in the number of sample PSUs occurred in those representing nonmetropolitan areas. To obtain this increase, the average number of households assigned to such PSUs was substantially reduced over earlier designs. For the NHIS, NCHS usually selected 2 sample PSUs from each nonself-representing first-stage stratum. Because of both the State stratification and the increase in the number of sample PSUs, in a few strata only a single nonself-representing PSU was selected.

The 1995-2004 NHIS design consists of 358 PSUs (which are counties or groups of contiguous counties), and approximately 42,000 responding households. The sample PSUs were stratified by geographic area (Census Region and State), metropolitan status, and sociodemographic measures (Judkins *et al.*, 1994). Within sample PSUs, a sample of blocks (segments) was selected after the blocks were stratified by measures of minority population density that allowed for an oversample of areas with high population concentrations of blacks and Hispanics. A nationally representative sample of approximately 71,000 addresses within sampled blocks was selected and targeted for further screening to facilitate an oversample of blacks and Hispanics.

The NHIS sample is partitioned into a number of subdesigns. The NHIS sample is first partitioned into subdesigns that are assigned for data collection each year from 1995 to 2004. Moreover, for survey administration, data collection, and processing, the NHIS annual sample is assigned to 4 calendar quarters. Within each quarter the sample is assigned to individual weeks. The NHIS sample assigned to each calendar quarter of the year is representative of the target population and the NHIS sample assigned to each week is also representative of the target population. However, estimates based on weekly samples tend to be unstable; for example, each sample PSU represented in a quarterly sample is not necessarily represented in the weekly sample. This assignment of subdesigns to specific data collection periods permits the NHIS sample to be used to estimate high frequency measures or for large population groups to be obtained from a short period of data collection. Other measures can be obtained by accumulating the NHIS sample for longer periods of time. The assignment of the NHIS sample to weekly and quarterly subsamples also has a number of operational and administrative benefits. With this assignment of the NHIS to weekly samples, the data collection can be handled on an ongoing basis with an experienced and stable field staff which enhances the quality of the resultant data.

Since 1985, the annual NHIS sample has also been partitioned into 4 nationally representative "panels", or subsamples, each of which has approximately the same number of sample households and conceptually similar statistical features. The panels have several potential uses. They provide a mechanism to make large cuts in the NHIS sample size in case insufficient funds are available for data collection. Further, the panels provide

a mechanism for the NHIS to provide nonoverlapping samples for re-use as sampling frames for other surveys.

4. Integration of Surveys Using the NHIS as the Sampling Frame

There are four potential levels of linkage to the NHIS:

- Respondent level: same respondents in both surveys
- Household (address) level: same households (addresses) - but possibly different respondents
- Segment level: same second-stage units - but different households within segments
- PSU level: same first-stage units (PSUs) - but different segments within PSUs.

The greatest benefit in terms of increased analytical capabilities comes from a linkage that involves overlap with the same respondents in both surveys. The three surveys discussed in this section use different linkage approaches. Each survey discussed begins with an overview of the goals and objectives of the survey; followed by a summary of the sample design and how linked to the NHIS, either currently or in the past; and, finally, a brief summary of the advantages and limitations of the linked design.

4.1 National Survey of Family Growth (NSFG)

The National Survey of Family Growth (NSFG), sponsored by NCHS and other U.S. Public Health Service agencies, is a survey of women 15-44 years of age focusing on women's reproductive history and the health of women and children. A critical feature of the NHIS design that allows reuse of the NHIS for other surveys such as the NSFG is that the NHIS is based on an area sampling frame. As discussed above in the overview of the NHIS sample design, this feature allows NCHS to release the addresses of NHIS respondents for additional data collection. Thus, the sample of women for the NSFG Cycles IV (1988) and V (1995) was selected from women who had previously been sampled for the NHIS.

Prior to the linkage of NSFG to NHIS, research (National Center for Health Statistics, Waksberg and Northrup, 1985b) and field trials (National Center for Health Statistics, Mathiowetz *et al.*, 1987) were done to explore the efficiency and feasibility of such a linkage. The NSFG Cycle IV was undertaken prior to the implementation of the DHHS Survey Integration Plan. Thus, Cycle IV of the NSFG was the first periodic household survey to use the NHIS as a sampling frame.

Women for the NSFG Cycle V sample were selected from all 198 PSUs of the 1985-1994 NHIS design. PSUs were located in nearly every State and included all of the

largest metropolitan areas in the United States. Sample women who had moved since the NHIS interview were traced to their new address, and an interviewer conducted the interview with the woman at the new address. Hispanic and non-Hispanic black women were selected with higher probability than other women so that more reliable statistics for Hispanic and non-Hispanic black women could be produced. All NHIS households containing Hispanic or non-Hispanic black women were included in the NSFG sample; one woman was selected randomly from an eligible household if more than one woman was eligible for the NSFG. Only some households of other race or ethnic identification were selected to be in the sample. Households were selected with probability proportional to the number of eligible women in the household (National Center for Health Statistics, Potter *et al.*, 1998).

The cost of the NHIS is increased because of the use of an area sampling frame. However, as discussed in National Center for Health Statistics, Waksberg *et al.* (1993), Cycle IV of the NSFG incurred a reduction in its cost because of the linkage to the NHIS. The cost savings were largely due to identification in the NHIS of households containing women aged 15-44 years; this eliminated the screening of households that would be necessary if an independent area sample had been used for the NSFG.

Additionally, linking the NSFG to the NHIS provided access to other information collected in the NHIS interview. For example, information on the race/ethnicity of NHIS respondents allowed for efficient oversampling of minority populations for the NSFG. Also, information from the NHIS interview for persons selected but not responding to the NSFG was used for nonresponse adjustments to the sampling weights for Cycle IV (National Center for Health Statistics, Judkins *et al.*, 1991) and for Cycle V (National Center for Health Statistics, Potter *et al.*, 1998) of the NSFG. Another advantage was the use of NHIS data on income to impute for missing income data in the NSFG.

Linkage of the NSFG to the NHIS does, however, impose certain restrictions on the NSFG design. For example, the size of the NSFG sample is limited by the size of the NHIS sample; the NSFG sample cannot exceed the number of women aged 15-44 years in the NHIS sample. For Cycle IV of the NSFG, accumulation of the NHIS sample over more than one year was needed to meet NSFG sample size requirements. Also, the placement of the NSFG sample must follow the placement of the NHIS sample. For example, the 1985-1994 NHIS design had no sample cases in two states; hence, Cycle IV of the NSFG had no sample cases in those two states.

Another complication of a linked design is the need to trace persons selected for the NSFG who have moved from the address where they were interviewed for the NHIS to their new residence. The tracing operation has the potential to be costly, and persons unsuccessfully traced contribute to decreased response rates for the

NSFG. With a number of anticipated changes in the analytical objectives and specific subdomains for the next cycle of the NSFG, research will be needed to examine strategies for the continued linkage of NSFG and NHIS. In the future, with the implementation of computer assisted personal interviewing (CAPI) in the NHIS, a follow-on interview shortly after the NHIS interview may be feasible, thus reducing tracing costs. However, the impact on refusal rates would need to be evaluated.

4.2 National Health and Nutrition Examination Survey (NHANES)

The National Health and Nutrition Examination Survey is a periodic survey that has been conducted by NCHS since the 1960s. The NHANES collects a wide range of information on socio-demographic, health and nutrition characteristics of the U.S. civilian noninstitutionalized population through standardized household interviews and physical examinations at Mobile Examination Centers (MEC). The NHANES is based on a complex multistage area probability sample design. The most recent NHANES, NHANES III, was conducted from September 1988 to October 1994 (National Center for Health Statistics, 1994).

Similar to previous NHANES, the major goals of the next NHANES are as follows:

- To estimate the number and percent of persons in the U.S. population and designated subgroups with selected diseases and risk factors;
- To monitor trends in the prevalence, awareness, treatment and control of selected diseases;
- To monitor trends in risk behaviors and environmental exposures;
- To analyze risk factors for selected diseases;
- To study the relationship between diet, nutrition and health;
- To explore emerging public health issues and new technologies; and
- To establish a national probability sample of genetic material for future genetic testing.

Based on the goals of the DHHS survey integration plan, the next NHANES design will have a continuous, annual sample design. Each single year and any combination of consecutive years will comprise a nationally representative sample. This will facilitate linkage not only to the NHIS but to other surveys that provide yearly estimates, in particular the Continuing Survey of Food Intake by Individuals (CSFII), conducted by the U.S. Department of Agriculture. This design will also allow limited national estimates from NHANES on

an annual basis. However, it is expected that at least three years of data will be required for more detailed estimates by age, sex, and race/ethnicity.

The four alternative levels of linkage described in section 4 were researched for linkage of NHANES and NHIS. There are some unique features of the NHANES primarily related to specified analytical subdomains and the operational and logistical constraints associated with the examination component that had to be considered for the alternative NHIS linkage options. For example, due to the time and cost associated with moving MECs between survey locations, the sample size per PSU must be large enough to produce an efficient workload at each PSU. Also equal workloads of about 450 sample persons per PSU is desirable. This operational constraint also means that only about 15 PSUs can be visited per year. Also, in order to maximize survey response, travel to the MEC should be kept to a minimum, therefore, the PSUs for NHANES are defined as individual counties. A number of these NHANES survey constraints limit the current NHIS linkage level options. For example, the NHIS currently does not oversample persons by age and sex and thus is not an optimal source to provide the required equal precision for the NHANES age, sex and race/ethnicity analytical subdomains. In addition, there are a number of the NHIS sample PSUs that exceed the NHANES maximum efficient PSU sample size of 600 persons. Unfortunately, there are also a number of NHIS sample PSUs that are far below the NHANES minimum sample size of 300. Finally, the NHIS PSUs include some multiple counties. Due to these NHANES design constraints and the current features of the NHIS sample design, it would not be economical to link at the household or person level without more extensive research. Therefore, the NHANES to be fielded in 1999 will be linked to the NHIS at the PSU level. To further meet the survey integration goals, NHANES and NHIS will also be linked at the content level using a selected core of household interview questions which match those used in the NHIS.

A nationally representative sample of 90 counties or PSUs, a subsample of PSUs in two panels of the 1997 NHIS, will be used as the sampling frame for the next six year NHANES survey. NHANES is expected to visit 15 PSUs each year of the survey with approximately 5,000 examined persons annually and 15,000 for each three years of data collection. During the first three years of NHANES, an evaluation of linkage at the address or person level of a purposively selected PSU (of those randomly selected) will likely be undertaken for an evaluation of a more fully linked NHIS and NHANES design. After evaluation of this linkage alternative, a different evaluation of linkage may occur in years two and three. In addition, five "reserve" PSUs will be selected each year for a possible recreational vehicle (RV) based study. The examination components of an RV NHANES would be shorter than the regular MEC exam. The design of the next NHANES will also allow the flexibility to replace one of the 15 PSUs annually with a

purposively selected PSU for special studies of a sub-population such as Puerto Ricans in New York.

Some potential key advantages of the linked NHANES design are highlighted below:

- improved analytic capability;
- feasibility of model based small area estimates;
- feasibility of model based extrapolation between two surveys;
- cost-efficiency;
- reduced overlap in questionnaire content;
- enhanced nonresponse adjustments and bias analyses.

4.3 Medical Expenditure Panel Survey (MEPS)

The Medical Expenditure Panel Survey (MEPS) Household Component is an ongoing annual survey, with each sample panel collecting data over a 30 month period to obtain information that covers two consecutive calendar years. The MEPS collects data on the specific health services that Americans use, how frequently they use them, the cost of these services and how they are paid for, as well as data on the cost, scope, and breadth of private health insurance held by and available to the U.S. population. MEPS is unparalleled for the degree of detail in its data, as well as its ability to link health service medical expenditures and health insurance data to the demographic, employment, economic, health status, utilization of health services, and other characteristics of survey respondents. Moreover, MEPS is the only federally sponsored national survey that provides a foundation for estimating the impact of changes in sources of payment and insurance coverage on different economic groups or special populations of interest, such as the poor, elderly families, veterans, the uninsured, and racial and ethnic minorities. The survey is conducted by the Agency for Health Care Policy and Research with co-sponsorship from the National Center for Health Statistics.

The 1996 MEPS is the most recent in a series of medical expenditure surveys that began in 1977 as the National Medical Care Expenditure Survey and later became the National Medical Expenditure Survey (NMES). The last study in this series was conducted in 1987. The redesigned Medical Expenditure Panel Survey reflects the first stage of implementation of the Department of Health and Human Services' Survey Integration Plan, which provided directives targeted to the improvement in the analytic capacity of programs, the filling of major data gaps, and the establishment of a framework in which DHHS data activities are streamlined and rationalized. The DHHS survey integration plan and its implications for the MEPS design have been previously discussed (Arnett *et al.*, 1996). Through the survey integration efforts, the MEPS has achieved a number of significant design improvements and analytic enhancements. To fill major data gaps identified by the DHHS, the MEPS was specified as a continuous on-going

survey to permit annual estimates of health care utilization, expenditures, insurance coverage and sources of payment for the U.S. civilian noninstitutionalized population. In addition, the MEPS Household Component now permits longitudinal analyses of health care use, expenditures, insurance coverage and source of payment patterns for each sample cohort, covering a two year period.

MEPS consists of four component surveys: the Household Component, the Medical Provider Component, the Insurance Component, and Nursing Home Component. The MEPS data collected in the Household Component are enhanced with additional information collected from the respondents' medical providers, employers, and insurance providers. The design efficiencies incorporated into MEPS are in accordance with the DHHS Survey Integration Plan which focused on consolidating DHHS surveys, achieving cost efficiencies, reducing respondent burden, and enhancing analytical capacities. A primary feature of the MEPS design includes linkage with the NHIS. The original MEPS sample design called for an independent screening interview to identify a nationally representative sample and facilitate oversampling of policy relevant population subgroups. Data collection and training costs associated with this independent screening interview were projected to exceed 7 million dollars. As part of the DHHS Survey Integration Plan with the use of NHIS as the sampling frame for the MEPS, the separate screening interview to identify the expenditure survey sample was eliminated. In addition to the cost savings achieved by the substitution of the NHIS as the MEPS sample frame, the design modification has resulted in an enhancement in analytical capacity of the resultant survey data. Use of the 1995 NHIS data in concert with the data collected for the 1996 MEPS provide an additional capacity for longitudinal analyses not available in the original design. Furthermore, the greater number and dispersion of the sample PSUs that comprise the MEPS national sample has resulted in improvements in precision over the original design specifications (Cohen, S.B., 1996).

4.3.1 MEPS Household Component Sample Design

The 1996 MEPS Household sample linked to the 1995 NHIS was selected from a nationally representative NHIS sub-sample from 2 NHIS panels out of 4 to represent the nation, and encompassed half of the households in the NHIS sample during the second and third quarters of 1995. As described previously, it should be noted that the NHIS has been designed to permit nationally representative subsamples to be selected by restricting the sample to one of four distinct panels. Any combination of 1 to 4 panels will provide a nationally representative sample of households. Furthermore, each NHIS panel subsample for a given quarter of a calendar year is nationally representative.

The nationally representative 1995 NHIS subsample selected for the 1996 MEPS consisted of 195 PSUs, and

in the two targeted quarters of 1995 these PSUs included 1,675 sample segments (second stage sampling units) and 10,597 responding NHIS households. This NHIS sample reflects an over-sample of households with Hispanics and blacks at the following approximate ratios of representation relative to the remaining households (Hispanics 2.0:1, blacks 1.5:1). The 1996 MEPS sample size targets required approximately 9,000 reporting units yielding the complete series of core interviews (i.e., Rounds 1-3) to obtain use and expenditure data for calendar year 1996 (Cohen, S.B., 1997).

Five in-person interviews are conducted with each NHIS panel selected for the MEPS at three- to four-month intervals over an approximately 30-month field period. The first three of these rounds (Rounds 1-3) define the 1996 MEPS Household survey, which collected the main body of annual utilization and expenditure data for calendar year 1996. Rounds 3-5 of the 1996 MEPS panel will be combined with Rounds 1-3 of the 1997 MEPS panel to yield the sample base for the 1997 MEPS Household survey and the source of annual estimates for that calendar year. All interviews are conducted in person through a computer assisted personal interview (CAPI) as the principal data collection mode. Round 1 asks about the period since January 1 of the MEPS year to the date of that interview; Round 2 asks about the time since the Round 1 interview through the date of the Round 2 interview; and Round 3 collects data since the date of the Round 2 interview through the date of the Round 3 interview in 1997 (Cohen, J.W., 1997).

A new 1997 MEPS panel sample was selected as a nationally representative subsample of households responding to the 1996 NHIS. The 1997 MEPS sample was also selected from two of the four NHIS panels, consisting of the same 195 PSUs selected for the 1995 MEPS household sample. A nationally representative subsample of approximately 6,300 NHIS responding households were selected for the new 1997 MEPS panel. This sample consisted of an oversample of the following policy-relevant subgroups: functionally impaired adults, children limited in activities, adults predicted to have high medical expenditures, and persons predicted to have family income less than 200 percent of the poverty level. In 1998 a new MEPS sample of approximately 5,400 households was selected as a nationally representative subsample of households that responded to the 1997 NHIS.

4.3.2 NHIS Linkage and MEPS Household Component Response Rates

Since the MEPS sample is a nationally representative sub-sample of households that were part of the 1995 NHIS, the response rate which has implications in the development of national estimates from MEPS is a function of the response rates in both surveys. More specifically, the overall Round 1 MEPS response rate can be derived as the product of the following three components:

- (1) the NHIS response rate achieved for the households eligible for the MEPS (93.9 percent)
- (2) the proportion of NHIS units selected that had sufficient information to permit MEPS data collection (99.6 percent)
- (3) the MEPS round 1 reporting unit response rate (83.1 percent).

The combination of these factors resulted in a response rate of 77.7 percent (.939 x .996 x .831) for the 1996 MEPS Round 1 Household Component. In contrast, the 1987 NMES achieved a 85.4 percent response rate for the round 1 interview. The higher 1987 NMES survey response rate was partially attributable to the address design of the survey and a decision to re-field a sample of survey nonrespondents that did not respond to the NMES screener interview. In MEPS, households that did not respond to the NHIS were not re-fielded to help improve the survey response rate. In the absence of a design strategy to refield survey nonrespondents in the 1987 NMES, the comparable Round 1 response rate would be 82.1 percent.

In debriefings with the MEPS data collection organizations to better understand the lower survey response rates experienced in MEPS relative to the 1987 NMES, field staff suggested that MEPS response rates suffered as a consequence of the impact of greater respondent burden attributable to NHIS participation. The relatively less clustered nature of the NHIS sample, which required the use of traveling interviewers in MEPS rather than local interviewers for the sites with relatively low sample concentrations, was also identified as a potential contributory factor in explaining the lower survey response rates.

4.3.3 Informed Nonresponse Adjustment Strategy and Data Collection Nonresponse Conversion Efforts

As a consequence of the national scope and depth of the MEPS data collection effort, and the use of resultant survey estimates to inform national health policies, the adoption of data collection and estimation strategies that improve the quality and accuracy of survey estimates is of particular importance. An investigation was conducted to help ascertain potential sources of nonresponse bias that were attributable to MEPS complete dwelling unit nonresponse and to incorporate the findings in the specification of the MEPS nonresponse adjustment strategy to help reduce the impact of nonresponse bias (Cohen and Machlin, 1997). As a consequence of the MEPS sample linkage to the NHIS, detailed information on the socio-demographic and health characteristics of the eligible MEPS sample was available to inform the investigation. The results of this investigation revealed that the dwelling units responding to the first round of the MEPS household survey differed from the nonrespondents on a number of dimensions. Based on the

results of multivariate analysis, the effects of family income, dwelling unit size, health status of household members (as measured by personal help needs), phone availability, MSA size, and item nonresponse for employment classification, were significant factors in distinguishing the MEPS respondents.

Study findings revealed that the nonresponding dwelling units were more likely to consist of single or two person households and had a higher representation in large metropolitan statistical areas. These results are generally consistent with the profiles that distinguish survey response status in prior cycles of national medical expenditure surveys. Single person households and households located in large metropolitan areas are generally more difficult to schedule interviews with, posing additional challenges to a field staff in obtaining their survey participation. In addition, the comparison with respect to family income revealed that the nonresponding households had a significantly higher representation of high income classifications. Furthermore, the comparison of the health specific summary measure, which classified dwelling units into distinct categories based on the ability of its members to perform personal care activities or other routine needs and by age, demonstrated that nonresponding households were more likely to include healthy elderly members. Based on the results of analysis, the measures that were most significant in differentiating MEPS survey response status were used in the specification of the MEPS Round 1 dwelling unit nonresponse adjustments. Through the identification of weighting classes in MEPS that capture the greatest variation across subgroups in response rates, a reduction in the bias attributable to survey nonresponse should be achieved.

Nonresponse adjustment strategies help yield improvements to the accuracy of survey estimates after the data collection effort has been completed. Up front survey design and data collection strategies that help improve survey response rates, both overall and for distinct population subgroups, will also have a positive impact on improving the quality of resultant survey estimates. The study findings also provide additional insights into the specification of modified survey design and data collection strategies in future MEPS surveys to improve upon overall survey response rates. For example, the analysis revealed that an interviewer's years of survey experience with the MEPS data collection organization was associated with MEPS survey response status. Future MEPS survey efforts would potentially benefit by a reduction in the representation of interviewers that have recently joined the respective data collection organization. Study findings also suggest that more targeted training efforts should be directed towards the male interviewers and those relatively new to the survey organizations, to help improve their field completion rate in MEPS.

Finally, the analysis showed that nonresponding households were dramatically less likely to have responded to the income question, provided their

telephone numbers, or responded to the work classification question in the 1995 NHIS. Taken together, these findings suggest that initial indicators of survey non-cooperation, such as item nonresponse or explicit refusals to provide specific information, are strong indicators of future behavior. By providing interviewers with information that identify households with these indicators that are least likely to benefit from the application of nonresponse conversion techniques, future MEPS data collection efforts could be better targeted to potentially yield higher overall response rates at less cost.

4.3.4 Summary of Benefits and Limitations of MEPS Linkage to NHIS

The benefits of the redesign incorporated in MEPS included significant cost savings, enhanced analytic capacities, increased opportunities for longitudinal analyses, reduction of major data gaps, and major improvement in providing timely data access to the research community and health policy makers. In addition to the cost saving achieved by substituting NHIS as the MEPS sample frame for oversampling policy relevant population subgroups, the design modification resulted in enhancements in analytic capacity. In addition, use of the 1995 NHIS data in conjunction with the 1996 MEPS data provided an additional capacity for longitudinal analyses not available in the original NMES-3 design. In addition, the greater number as well as the dispersion of the PSUs has resulted in improvements in precision over the original design specifications, as a consequence of lower survey design effects. Use of NHIS detailed information on the socio-demographic and health characteristics of the eligible MEPS sample have also enhanced the ability to implement survey nonresponse adjustments that would yield reductions in bias attributable to survey nonresponse.

While the benefits of survey linkage for MEPS are notable, the MEPS redesign has not been achieved without also experiencing some limiting features. The MEPS linkage to the NHIS has resulted in lower survey response rates relative to the experience of the NMES. NHIS linkage has resulted in greater restrictions in access to the MEPS data than would be necessary for an independent survey, in order to insure the confidentiality of the data collected by each of the respective surveys. In non-peak years of the survey, which requires limited oversampling of specific population subgroups, the cost advantages of use of the NHIS as a sample frame for the MEPS are less obvious. Other limitations related to the MEPS and NHIS linked design include the need to track movers between NHIS and MEPS, re-enumeration of MEPS sample membership to capture changes in household composition since the NHIS, and the dispersion of the NHIS PSUs, which constrains flexibility in sample allocations that ensure efficient data collection strategies.

5. Other Survey Design Integration Strategies Related to State Level Data

Another major goal of the survey integration plan calls for improved capacity for state-level data. As health care markets respond to new incentives and states gain increasing responsibility for administering health and welfare programs, high quality standardized State level data are recognized as increasingly important to the public health and health policy community. As part of the Childhood Immunization Initiative, a large-scale random-digit-dialing (RDD) survey, the National Immunization Survey (NIS), was initiated in April 1994 (Ezzati-Rice *et al.*, 1995). The NIS is designed to produce estimates of vaccination coverage levels among young children at the State and local level. The immunization questions in the NIS are comparable to those in the NHIS for its child immunization questionnaire. Thus, there is linkage of the NIS and the NHIS at the content level. Further, since the NHIS is a face-to-face survey, it includes both telephone and nontelephone households. The ratio of vaccination coverage rates in nontelephone and telephone households from the NHIS has been used to adjust for noncoverage of nontelephone households in the NIS. Another level of design integration is undergoing pilot testing with a new State and Local Area Integrated Telephone Survey or SLAITS. In screening for children aged 19-35 months, the NIS samples a large number of households containing persons of all ages. Thus, the NIS offers the cost-effective option of collecting broad based health and welfare data for individuals in other age groups. There are three levels of integration for SLAITS. First, SLAITS makes use of the NIS which already contacts and screens nearly one million households per year. The health module uses questions on health status, access to care, health insurance coverage and utilization of health services from the NHIS. Finally, as for the NIS, data from the NHIS are used for adjustment of noncoverage of households without telephones.

6. Re-design Issues for the Future

While a number of benefits exist with use of the NHIS sample for other surveys, there are also some limitations resulting from the fact that the current NHIS design developed following the 1990 decennial census occurred before the formal DHHS survey integration plan. Thus, the 1995-2004 sample design was not developed with linkage as a specific design requirement. In order to facilitate more efficient linkage of various population based surveys to the NHIS in the future, a number of design considerations and methodological issues should be researched for the next redesign of the NHIS following the year 2000 Census and for implementation in 2005. Selected issues for consideration in the redesign of the NHIS to more fully accommodate linkage to other surveys in the future include:

- Expanding the sampling frame and increasing PSU sample sizes to accommodate surveys like NHANES, MEPS, and NSFG, as well as other surveys that might require large population size, geographic distribution, etc.;
- Investigating the feasibility of increasing the level of clustering, e.g., fewer PSUs to reduce interview costs;
- Investigating the feasibility of more oversampling by age, sex, race/ethnicity and low income domains;
- Evaluating strategies to increase response rates and reduce respondent burden.;
- Assessing the risk of new sources of survey error that may be associated with survey linkage such as the combined effect of area frame noncoverage and nonresponse;
- Evaluating the impact on response rates of recontacting NHIS respondents and households.

Options for improved coverage of the U.S. population and subpopulations will also be important such as:

- Optimizing the sample design to satisfy survey requirements to obtain geographic and State level information;
- Enhancing geographic coverage of linked surveys;
- Improving coverage of population subgroups that were characterized by undercoverage problems in previous surveys;
- Obtaining reliable annual estimates for the total population, low income, and other demographic subgroups.

Other considerations for improved survey coordination and linkage include:

- Coordinating data collection and data analysis;
- Coordinating questionnaire content between linked surveys;
- Coordinating timing of data release and preparation of comprehensive survey linkage documentation;
- Enhancing analytic capabilities of linked survey data release products;

- Eliminating duplication of efforts between surveys to reduce cost and increase timeliness of data.

In addition, the various surveys targeted for linkage should examine their survey analytical and precision requirements and data collection cycles to determine if any adjustments could be made to make the linkage more feasible. For example, the ability to conduct the NSFG survey on an annual basis versus every three years might provide some gains with more constant sample requirements on an annual basis rather than a large sample size every three or four years.

7. Summary

In summary, the integration of various DHHS surveys poses a number of challenging goals, but there can be important gains in the coordination of survey efforts, in filling data gaps, and in improving analytic potential. In addition, efficiencies in sampling, survey design, data collection, questionnaire design and testing, and survey operations can be achieved. In particular, duplicative survey efforts can be avoided through, for example, use of a common framework for questionnaire content, data editing, imputation and estimation procedures, and formats for databases; thus providing more timely data to the health policy and research community. Furthermore, use of NHIS detailed socio-demographic and health characteristics information provides for enhanced survey nonresponse adjustments and the potential for important reductions in potential nonresponse bias in the survey estimates. Further, the most measurable gain from linkage of the NHIS and other surveys is the potential for reduction in sampling and screening costs which is especially important for surveys with large oversamples of selected subgroups of the population.

Important progress has been made towards survey integration and coordination with the implementation of the MEPS and NHIS linkage. Also, another survey linkage goal will be met next year with the implementation of the NHANES on an annual basis with linkage to the NHIS at the PSU level. Progress is also being made for State level data capacity with the development of SLAITS and continued research on an NHIS and RDD dual frame survey. Nevertheless, additional research is needed to improve the capacity and efficiency of linkage to reduce certain limitations related to tracking of movers; maximizing survey response rates; minimizing respondent burden; providing for potential expansions to meet specific survey requirements and competing uses of the NHIS sample; improving the dispersion and size of the PSUs; evaluating confidentiality issues; and, finally, accommodating data release of linked surveys.

References

Arnett, R.A., Hunter, E., Cohen, S., Madans, J., and Feldman, J. (1996). "The Department of Health and Human Services' Survey Integration Plan." *1996 Proceedings of the Section on Government Statistics*. Alexandria, VA.: American Statistical Association. 142-147.

Cohen, S.B. and Machlin, S.R. (1997). "Characteristics of Nonrespondents in the 1996 Medical Expenditure Panel Survey: Household Component." *1997 Proceedings of the Section on Government Statistics*. Alexandria, VA.: American Statistical Association. 329-334.

Cohen, S.B. (1997). "Sample Design of the 1996 Medical Expenditure Panel Survey Household Component." *MEPS Methodology Report*, No. 2. AHCPR Pub. No. 97-0027. Rockville (MD): Agency for Health Care Policy and Research.

Cohen, J.W. (1997). "Design and Methods of the Medical Expenditure Panel Survey Household Component." *MEPS Methodology Report*, No. 1. AHCPR Pub. No. 97-0026. Rockville (MD): Agency for Health Care Policy and Research.

Cohen, S.B. (1996). The Redesign of the Medical Expenditure Panel Survey: A Component of the DHHS Survey Integration Plan. *Proceedings of the COPAFS Seminar on Statistical Methodology in the Public Service*. Statistical Policy Working Paper 26, OMB, pp. 211-249.

Ezzati-Rice, T.M., Zell, E.R., Battaglia, M.P., Ching, P., and Wright, R.A. (1995). "The Design of the National Immunization Survey." *Proceedings of the Section on Survey Research Methods*. Alexandria, VA.: American Statistical Association. 668-672.

Hunter, E.L. and Arnett, R. (1996). "Survey 'Reinventing' at Health and Human Services." *CHANCE*, Volume 9, No. 3, 54-57.

Judkins, D., Marker D., and Waksberg J. (1994). National Health Interview Surveys: Research for the 1995 Redesign. Unpublished Report. Prepared under contract for the National Center for Health Statistics. Rockville, MD. Westat, Inc., 1994.

National Center for Health Statistics. (1958). "The Statistical Design of the Health Household-Interview Survey." *Health Statistics*. PHS Pub. No. 584-A2. Public Health Service. Washington: U.S. Government Printing Office.

National Center for Health Statistics. (1975). Health Interview Survey Procedure, 1957-1974. *Vital and Health Statistics*. Series 1, No. 11. DHEW Pub. No. (HRA) 75-1311. Health Resources Administration. Washington: U.S. Government Printing Office.

National Center for Health Statistics. (1985a). Kovar, M.G., and Poe, G.S. "The National Health Interview Survey Design, 1973-1984, and Procedures, 1975-83." *Vital and Health Statistics*. Series 1, No. 18. DHHS Pub. No. (PHS) 85-1320. Public Health Service. Washington: U.S. Government Printing Office.

National Center for Health Statistics. (1985b). Waksberg, J. and Northrup, D.R. "Integration of Sample Design for the National Survey of Family Growth, Cycle IV, With the National Health Interview Survey." *Vital and Health Statistics*. Series 2, No. 96. DHHS Pub. No. (PHS) 86-1370. Public Health Service. Washington: U.S. Government Printing Office.

National Center for Health Statistics, Mathiowetz, N. Northrup, D. Sperry, S. and Waksberg, J. (1987). "Linking the National Survey of Family Growth With the National Health Interview Survey: Analysis of Field Trials." *Vital and Health Statistics*. Series 2, No. 103. DHHS Pub. No. (PHS) 87-1377. Public Health Service. Washington: U.S. Government Printing Office.

National Center for Health Statistics. (1989). Massey, J.T., Moore, T.F., Parson, V.L., and Tadros, W. "Design and Estimation for the National Health Interview Survey,

1985-94." *Vital and Health Statistics*. Series 2, No. 110. DHHS Pub. No. (PHS) 89-1384. Public Health Service. Washington: U.S. Government Printing Office.

National Center for Health Statistics, Judkins, D.R., Mosher, W.D., and Botman, S. (1991). "National Survey of Family Growth: Design, Estimation, and Inference." *Vital and Health Statistics*. Series 2, No. 109. DHHS Pub. No. (PHS) 91-1386. Public Health Service. Washington: U.S. Government Printing Office.

National Center for Health Statistics. (1993). Waksberg, J., Sperry, S., Judkins, D. and Smith, V. "National Survey of Family Growth, Cycle IV, Evaluation of Linked Design." *Vital and Health Statistics*. Series 2, No. 117. DHHS Pub. No. (PHS) 93-1391. Public Health Service. Washington: U.S. Government Printing Office.

National Center for Health Statistics. (1994). "Plan and Operation of the Third National Health and Nutrition Examination Survey, 1988-94." *Vital and Health Statistics*. Series 1, No. 32. Public Health Service. Washington: U.S. Government Printing Office.

National Center for Health Statistics. (1998). Potter, F.J., Iannacchione, V.G., Mosher, W.D., Mason, R.E. and Kavee, J.D. "Sample Design, Sampling Weights, Imputation, and Variance Estimation in the 1995 National Survey of Family Growth." *Vital and Health Statistics*. Series 2, No. 124. DHHS Pub. No. (PHS) 98-1398. Public Health Service. Washington: U.S. Government Printing Office.