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Design and Estimation for the National Health Interview Survey, 1995–2004

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
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Centers for Disease Control and Prevention
National Center for Health Statistics

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Preface

This report presents a detailed description of the sample design features for the National Health Interview Survey (NHIS) for the period 1995–2004. The report is a successor to an earlier publication, *Design and Estimation for the National Health Interview Survey, 1985–94.* (5)

NHIS is one of the major data collection programs of the National Center for Health Statistics (NCHS). Through NHIS, information concerning the health of the U.S. civilian noninstitutionalized population is collected in household interviews throughout the United States. NHIS has been in continuous operation since 1957, and its sample design has been reevaluated and modified following each of the last four decennial censuses of the U.S. population.

The 1995–2004 redesign of NHIS was a major undertaking that involved a number of government agencies as well as several private contractors. The Survey Design Staff in the Office of Research and Methodology (ORM), NCHS, in collaboration with the Division of Health Interview Statistics (DHIS), NCHS, had overall responsibility for the development and implementation of the 1995–2004 NHIS redesign. Monroe Sirken, formerly the ORM Associate Director, played a major role in the conceptualization and planning of the research program. The late James Massey, former Chief of the Survey Design Staff, and Donald Malec, formerly of the Survey Design Staff, had the primary responsibility for directing the redesign research and coordinating the research activities conducted by NCHS, the U.S. Bureau of the Census, and Westat, Inc. The late Steven Botman, formerly of the Survey Design Staff, had the lead responsibility in helping to implement the 1995–2004 NHIS redesign, and started developing a manuscript that was the genesis of this report. Van Parsons of the Statistical Methods Staff, ORM, contributed to the development of subdesigns for the 1995–2004 NHIS redesign. The late Owen Thornberry, formerly the Director, DHIS, and John Horm, formerly the acting Chief of the Survey Planning and Development Branch, DHIS, were the leading DHIS participants in the 1995–2004 NHIS redesign work.

Under contract with NCHS between 1989 and 1993, Westat, Inc., conducted a major portion of the research for the 1995–2004 NHIS redesign. The primary researchers at Westat included David Judkins, David Marker, and Joseph Waksberg. As part of Westat's research, a sample design referred to as the ''alpha'' design was developed. It assumed a 50-percent data collection budget increase to permit oversampling of racial and ethnic minorities. The Westat researchers also developed the ''beta'' design, a modification of the alpha design, which assumed no change in the NHIS data collection budget. The beta design, which became the design implemented in 1995, is the design described in this report. Another NCHS report, *National Health Interview Survey: Research for the 1995–2004 Redesign*, (6) provides a detailed description of Westat's research work, including a description of the alpha design.

Additional NHIS redesign research was conducted by the U.S. Bureau of the Census and coordinated through the Task Force on Household Survey Redesign, assembled and directed by the late Maria Gonzalez of the Office of Management and Budget (OMB). The task force was formed to coordinate and monitor the U.S. Bureau of the Census' redesigns of those household surveys conducted by the Bureau for itself and other Federal government agencies, and that are simultaneously redesigned after each decennial census. The task force played an important role in coordinating both the technical and funding requirements for the redesigns of the surveys.

The U.S. Bureau of the Census has been the primary data collector for NHIS since the inception of NHIS. The U.S. Bureau of the Census also has been involved with the research and implementation of the NHIS redesigns. For the 1995–2004 redesign, the Demographic Statistical Methods Division (DSMD) at the U.S. Bureau of the Census had the primary responsibility for evaluating alternative primary sampling unit (PSU) definitions for NHIS and for implementing the redesigned sample. Persons at the U.S. Bureau of the Census deserving special recognition for their contribution to the 1995–2004 NHIS redesign effort include Preston Jay Waite, formerly Chief of DSMD; Thomas Moore, Chief of the Health Surveys and Supplements Branch, DSMD; Robert Mangold, formerly Chief of the Health Surveys Branch, Demographic Surveys Division; Patricia Wilson of DSMD; and Lloyd Hicks, formerly of DSMD.

This report is organized into three chapters so researchers and other users of the NHIS data can refer to different parts of the report for different levels of detail about the NHIS design. Chapter 1 provides a general overview of NHIS, chapter 2 provides a detailed description of the NHIS sample design, and chapter 3 presents a description of the estimators used for analyzing NCHS data.

This report is dedicated to the memory of our late colleagues

Steven L. Botman

James T. Massey

Steven L. Botman and James T. Massey,
both formerly in the Survey Design Staff,
Office of Research and Methodology,
National Center for Health Statistics.
Both men made significant contributions to the
National Health Interview Survey.

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Abstract

Objectives

This report presents an overview, a detailed description of the sample design features, and estimation structures for the 1995–2004 National Health Interview Survey (NHIS). It is intended to serve the same role for the current (1995–2004) National Health Interview Survey design as the NCHS publication, Series 2, No. 110, *Design and Estimation for the National Health Interview Survey, 1985–94,* did for the previous design.

Methods

The 1995–2004 NHIS sample design uses cost-effective complex-sampling techniques including stratification, clustering, and differential sampling rates to achieve several objectives. These objectives include improved reliability of racial, ethnic, and geographical domains. This report provides a description of those methods.

Results

This report presents the operating characteristics of the 1995–2004 NHIS. The general sampling structure is presented along with a discussion of the weighting and variance estimation techniques. This report is intended for the general users of NHIS data systems. A companion report, Series 2, No. 126, *National Health Interview Survey: Research for the 1995–2004 Redesign,* provides a finer level of detail on the redesign process.

Keywords: *sampling • weighting • nonresponse adjustment • variance estimation*

Design and Estimation for the National Health Interview Survey, 1995–2004

Chapter 1. Overview of the National Health Interview Survey

Lead authors: Steven L. Botman and Christopher L. Moriarity, Office of Research and Methodology, National Center for Health Statistics

Background

The National Health Interview Survey (NHIS) is the Nation's primary source of general health information for the resident civilian noninstitutionalized population. NHIS is conducted by the National Center for Health Statistics (NCHS), a component of the Centers for Disease Control and Prevention, U.S. Public Health Service, Department of Health and Human Services. In accordance with specifications established by NCHS, the U.S. Bureau of the Census, under a contractual relationship, participates in the planning for NHIS and the collection of data. NHIS has continuously collected data since 1957. This continuous data collection has administrative, operational, and data quality advantages because fieldwork can be handled on a continuous basis with an experienced, stable staff.

NHIS provides estimates on health indicators, health care utilization and access, and health-related behaviors for the U.S. resident civilian noninstitutionalized population. Summary reports and reports on special topics for each year's data are prepared by NCHS' Division of Health Interview Statistics for publication in Series 10 of the *Vital and Health Statistics* publications series. In these reports, basic NHIS survey estimates are published annually for various population subgroups. These subgroups include those defined by age, sex, race, family income, census region (Northeast, Midwest, South, and West), place of residence (central city of a metropolitan area, metropolitan area but not in a central city, and nonmetropolitan areas), and other domains covered on the particular NHIS statistic. Statistics from NHIS also appear in other NCHS reports, in professional journal articles, and in many other publications.

NCHS releases annual NHIS microdata files in several forms. Since 1969, public use data files have been prepared for each year of data collection. Public use microdata also are available on compact disk read-only memory (CD-ROM) for data collection years starting in 1987. Recently, public use microdata also have been made available via the Internet.

The authors appreciate the input of several NCHS staff who reviewed the report at various stages of development. Deborah D. Ingram, Ph.D., Office of Analysis, Epidemiology, and Health Promotion, served as peer reviewer and made many useful comments. The authors also thank other NCHS staff who reviewed the report at various stages of development and made helpful comments and suggestions, particularly Iris M. Shimizu, Ph.D., and Myron J. Katzoff, Ph.D., Office of Research and Methodology. In addition, the authors thank Alfred G. Meier of the U.S. Bureau of the Census, who reviewed the report and supplied much useful material. The report was edited by Klaudia M. Cox and typeset by Zung T. N. Le of the Publications Branch, Division of Data Services.

These microdata files usually contain information that allows users to develop direct estimates of sampling errors that are consistent with the complex survey design of NHIS. Since 1985, NCHS has based estimates of NHIS sampling error on the Taylor series linearization method. This method can produce estimates that take into account the sample design, using a conceptual model of the NHIS sample design that captures many of its key features. In particular, for NHIS variance estimation, NCHS has used the SUDAAN software (1), which includes the Taylor series linearization method. To facilitate the use of software that permits analysis of NHIS data in which the sample design is taken into account, NCHS has coordinated with other agencies within the U.S. Public Health Service to support enhancements for the SUDAAN software.

To maintain respondent confidentiality in NHIS, NCHS withholds variables from the National Health Interview Survey's public use data files that could permit explicit or implicit identification of survey respondents. One of the major risks for inadvertent respondent identification is the inclusion of identifiers on survey files that place respondents in small geographic areas (for example, census block, census block group, county, or state). Thus, in these data releases, variables identifying specific geographic areas smaller than one of the four census regions usually are withheld to protect respondent confidentiality. However, NCHS has released information that allows identification of the largest metropolitan areas.

Sample Design and Basic Subsamples

The National Health Interview Survey is based on a stratified multistage sample design. The specific parameters of the design, however, have changed over time; a new sample design is implemented following each decennial census. For example, the 1973–84 survey design had 386 sample primary sampling units (PSU's), the 1985–94 survey design had 198 sample PSU's, and the current 1995–2004 survey design has 358 sample PSU's. For more details, refer to table 1 in chapter 2.

The 1995–2004 NHIS has been designed to produce estimates for the Nation, for each of the four census regions, and within census regions by areas determined by metropolitan and nonmetropolitan status. Although the 1995–2004 survey samples from all of the States and the District of Columbia, it is not designed to produce reliable State-level estimates for every State.

For the 1995–2004 survey design, the NHIS sample is partitioned into a number of subsamples. First, the sample for the 10-year survey period is partitioned into subsamples that are assigned for data collection each year from 1995 through 2004. Moreover, for survey administration, data collection, and processing, the NHIS annual sample is assigned to four calendar quarters. Within each quarter, the sample is assigned to individual weeks. The portion of the survey sample assigned to each calendar quarter of the year is representative of the target population. The portion of the survey sample assigned to each week also is representative of the target population, although estimates based on weekly samples tend to be unstable. (Two reasons for the instability are a small sample size and the fact that each sample PSU represented in a quarterly sample is not necessarily represented in the weekly sample. This reduces the precision of variance estimators.) The assignment of subsamples to specific data collection periods permits the NHIS sample to be used to estimate high frequency measures or to obtain estimates for large population groups from a short period of data collection. Other measures sometimes can be obtained by accumulating the survey sample for longer periods of time, including more than 1 year.

The assignment of the NHIS sample to weekly and quarterly subsamples also has a number of operational and administrative benefits. For example, the assignment of NHIS to weekly subsamples results in the field staff having a continuous workload, which enhances the quality of the resultant data.

Beginning with the 1985–94 survey design, the annual NHIS samples have been partitioned into four panels (subsamples) each having approximately the same number of sample households and conceptually similar statistical features. Each panel can be considered as a probability sample of the U.S. population. (Note that ''panels'' and ''calendar quarters'' are not the same; the set of four panels is a partition of the annual survey samples that encompasses the four calendar quarters.) The panels have several anticipated uses. They provide a mechanism to make large cuts in the survey sample size in case insufficient funds are available for data collection. Because the sample is reused as a sampling frame for other surveys, the panels also provide a mechanism for NHIS to provide nonoverlapping samples for reuse as sampling frames for other studies. After the 1995–2004 survey design sample was selected, NCHS partitioned the new sample into a new set of four panels.

Data Collection Instruments

The NHIS data collection instrument for 1995 and 1996 was similar to the instrument used before 1995. Prior to 1995, the last major revision of the instrument occurred in 1982. A major revision of the instrument occurred in 1997. The data collection instruments for 1995 and 1996, and 1997 and beyond, are described below.

NHIS data collection is conducted by the U.S. Bureau of the Census under an interagency agreement with NCHS. NHIS interviewers are employees of the U.S. Bureau of the Census. These interviewers receive extensive training, and their work is monitored through a quality assurance program. Data are collected from each family in the survey sample using a face-to-face interview. If a sampled household contains more than one family, many aspects of the interview are repeated for each family in the household.

For 1995 and 1996, the data collection instrument had three components: a basic health and demographic ''core'' questionnaire, a condition list, and one or more supplemental questionnaires that addressed health topics of special public health interest. The NHIS basic health and demographic questionnaire consisted of a fixed set of health and sociodemographic questions. Additionally, each household was randomly assigned one of six condition lists. The ''core'' questionnaire and the condition list responses are used for developing annual estimates of various health variables, including acute and chronic conditions, hospital stays, medical visits, and limitations of activities.

The supplemental questionnaires addressed health issues or topics identified as being of particular interest within the U.S. Public Health Service. From 1985 through 1994, these supplemental questionnaires on topics such as cancer control and cancer epidemiology, AIDS knowledge and awareness, and health promotion and disease prevention, were administered to a randomly selected adult in each family of the survey sample. For several years in the 1990's, the supplemental questionnaires on health insurance and access to health care were administered to the entire survey sample. In 1994 and 1995, NHIS included a supplement on disability that was administered to the entire sample. For the last few years prior to 1997, several supplements, such as ''Family Resources'' and ''Childhood Immunization,'' were included in the survey on an annual basis. Household data collection for the supplemental questionnaires averaged about 30–90 minutes.

Prior to 1997, the basic strategy for data collection was for the interviewer to assemble all available household members aged 19 years and older at a sample address. A knowledgeable adult could report for absent adults. In most cases, proxy reporting by a knowledgeable adult was used for persons under age 19 years, although persons aged 18 years could report for themselves and persons aged 17 years could report for themselves under some circumstances. As part of the enumeration of each household in the survey sample, persons in an individual household were partitioned into separate families if multiple families were present. A separate basic health and demographic questionnaire was administered to members of each individual family in the household.

In 1996, NHIS began testing the use of computer-assisted personal interviewing (CAPI) that was based on a revised data collection instrument. Beginning in 1997, the survey switched to a CAPI system and a revised data collection instrument that was restructured and shortened in an effort to reduce respondent burden. Many of the questions formerly asked of all persons in the ''core'' questionnaire are administered on a sample basis. The redesigned questionnaire has three parts or modules: a basic module, a periodic module, and a topical module.

The basic module functions as the new ''core'' questionnaire. Plans are for it to remain largely unchanged from year to year. The basic module contains three components: the family core, the sample adult core, and the sample child core. The family core component collects information on everyone in the family. Information collected in the family core component includes household composition and sociodemographic characteristics. It also includes basic indicators of health status and utilization of health care services. From each family in the survey, one sample adult and one sample child (if any children under age 18 are present) are randomly selected, and information on each is collected with the sample adult core and the sample child core questionnaires. Because some health issues are different for children than for adults, these two questionnaires differ in some items, but both collect basic information on health status, health care services, and behavior.

One important change implemented in 1997 is that random selection of one of six condition lists was eliminated. Instead a checklist of conditions appears in the sample adult core and sample child core.

The purpose of a periodic module is to collect more detailed information on some of the topics included in the basic module from the sample persons. It was used for the first time in 1998.

The role of a topical module is analogous to the supplemental questionnaires of the 1982–96 survey; that is, it is used to respond to public health data needs as necessary. In 1999, the first year a topical module was used, the topical module focused on disease prevention issues.

The family core component of the basic module is administered in a manner similar to the ''core'' questionnaire prior to 1997. All adult members of the household 17 years of age and over who are at home at the time of the interview are invited to participate and to respond for themselves. For children and adults not at home or unable to respond for themselves during the interview, information is provided by a responsible adult family member (18 years of age or over) residing in the household. For the sample adult core component, one adult per family is randomly selected, and this individual responds for him/herself to the questions in this section (i.e., no proxy response is allowed). Information for the sample child core component is obtained from a knowledgeable adult in the household.

Reuse of the Survey Sample

During the 1985–94 survey design period, the sample was reused for several surveys with smaller sample sizes. These surveys were for studies sponsored in part by NCHS' Division of Health Interview Statistics or by other units in NCHS. Such linkages are most cost-effective when the smaller survey is based on a subdomain of the population or if it oversamples domains whose membership can be determined from the NHIS interview.

The National Survey of Family Growth (NSFG), Cycles IV and V samples, were selected from respondents in the survey who met the NSFG eligibility criteria. Cycles IV and V of NSFG, sponsored by NCHS and other U.S. Public Health Service agencies, were surveys of women aged 15–44 years and focused on their reproductive history and intentions.

Phase 2 of the NHIS Disability Supplement was based on a reuse of certain respondents in the 1994–95 Phase 1 Disability Supplement.

The 1996 Medical Expenditure Panel Survey (MEPS), sponsored by the Agency for Healthcare Research and Quality, was based on a reuse of a portion of the 1995 NHIS sample. Subsequent years of the MEPS are based on reuse of a portion of the previous year's NHIS sample.

Sample Redesign

Since its inception in 1957, the NHIS sample has been redesigned following each decennial census of the population to accommodate changes in survey requirements and to take into account the changes in the population and its distribution (2–5). For the 1995–2004 NHIS sample design implemented in 1995, the U.S. Bureau of the Census and Westat, Inc., conducted research on issues related to the sample design using specifications provided by NCHS (6).

Although the main goals in the 1995–2004 NHIS sample design were improving the reliability of statistics for racial, ethnic, economic, and geographic domains, other issues also were addressed in the research. The results often led to conflicting sample allocations; that is, a sample allocation that would be optimal for one type of domain would be far from ideal for another type of domain. The final sample allocation was a compromise between ideal allocations for the various domains.

The primary features in the 1995–2004 NHIS sample design implemented in January 1995 are as follows:

1. *Use of an all area sampling frame*—The 1995–2004 survey is based on an area sampling frame for housing units in place at the time of the 1990 Census. Each of the other current demographic survey samples conducted by the U.S. Bureau of the Census (including the Current Population Survey, the National Crime Victimization Survey, and the Survey of Income and Program Participation) uses a combination of frames. The combination consists of an address sampling frame (i.e., addresses compiled for the preceding decennial census) and an area sampling frame, where the address information is incomplete. The use of an all area-frame sample permits NCHS to release the survey sample addresses to its contractors for additional data collection. U.S. Bureau of the Census confidentiality constraints do not permit the release of addresses that were obtained through listings compiled for the preceding decennial census. For this reason, the survey sample has been based on an all-area sampling frame starting with the 1985–94 design.

   In parts of the country where local governments issue building permits, the U.S. Bureau of the Census supplements the area sample with a sample of permits for residential housing units built after April 1990. In the rest of the country, the units constructed after April 1990 are included in the area frame.

2. *State stratification and an increase in the number of PSU's*— In most cases, the first-stage sampling strata do not straddle State boundaries. The exception is the largest metropolitan areas. These are self-representing PSU's and may straddle State boundaries. In these cases, the survey second-stage samples were drawn independently within each State component of the PSU. This State stratification, taken together with an almost doubling of the number of PSU's in the survey sample, enhances the ability of the survey to make reliable State-level estimates for the largest States. The State stratification and the increase in the number of PSU's also will allow easier integration of a random digit dialing telephone survey with the survey as a dual frame survey to make reliable subnational estimates if the decision is made in the future to do this type of integration.

   The largest increase in the number of sample PSU's occurs in those representing nonmetropolitan areas. A contributing factor to this increase is separate strata for metropolitan areas versus nonmetropolitan areas in all States (except New Jersey, which is entirely metropolitan). To obtain this increase, the average number of sample households assigned to such primary sampling units was substantially reduced. For the survey, two sample PSU's usually were selected from each nonself-representing first-stage stratum. However, there were 21 nonself-representing strata where only one sample primary sampling unit was selected.

3. *Oversampling of black and Hispanic persons*—The sample design implemented in 1995 oversamples black and Hispanic persons. This is accomplished with two features. First, the U.S. Bureau of the Census selected for NHIS a larger initial sample than would otherwise be required. A subsample of the initial sample was selected for interviewing with housing units in areas having higher concentrations of black and Hispanic persons being retained at higher rates. Second, all households in the subsample with one or more black or Hispanic eligible (i.e., civilian) members are retained in the survey, and only a subsample of other households are retained. The determination of a household's race and/or ethnicity status is accomplished through the administration of a brief screening interview. (The screening interview consists of the initial steps of the regular interview. After the household roster is determined, the decision is made to ''screen in'' or ''screen out.'')

   Approximate oversampling rates are 2:1 for Hispanic persons and 1.5:1 for black persons. Note that oversampling of black persons was done during the 1985–94 survey design. Oversampling of Hispanic persons is new to the current design.

Additional detail on the NHIS 1995–2004 sample design is included in chapter 2. Chapter 3 provides a detailed description of estimation procedures for the NHIS 1995–2004 design.

Chapter 2. 1995–2004 NHIS Sample Design

Lead author: Thomas F. Moore, Demographic Statistical Methods Division, U.S. Bureau of the Census

The 1995–2004 National Health Interview Survey (NHIS) sample design was implemented in 1995, and this design will be used through 2004. The current design will yield more reliable estimates for health-related characteristics of Hispanic persons than those based on the 1985–94 design.

In forming strata for the primary sampling units (PSU's), State was used as a stratification variable. Although the survey is not designed to produce reliable estimates for every State, this State stratification of PSU's enhances the survey's ability to produce data for a few of the most populous States and enhances the potential for using NHIS data with other data to produce State estimates.

Redesign Objectives Achieved

The following NHIS redesign objectives were achieved by the 1995–2004 sample design:

(a) Improving the reliability of estimates for Hispanic persons,

(b) Improving the reliability of estimates for subnational areas, including States, and

(c) Continuing to have NHIS serve as a sampling frame for follow-on surveys.

Other objectives also were considered as part of the redesign research (6).

Description of the Sample

NHIS is based on a stratified, multistage sampling plan. In the United States, primary sampling units are individual counties or contiguous groups of counties. (''County'' is used generically to include county equivalents such as parishes in Louisiana, independent cities in Virginia, Maryland, Missouri, and Nevada, etc.) Outside of New England, metropolitan areas (MA's) are defined at the county level, and were used as primary sampling units. In New England, MA's are defined at a subcounty level, so New England County Metropolitan Areas (NECMA's), which are defined at the county level, were used as primary sampling units instead of MA's. Secondary sampling units (SSU's) are noncompact clusters of housing units.

Table 1 summarizes the major features of the designs since 1973. Some of the terms used in the table are defined in the glossary and/or are described later in this chapter. The figures given for designated housing units per year, screened households per year, interviewed households per year, and interviewed persons per year are all estimates. ''Designated'' refers to the initial designation of units for interviewing and includes vacant and other ineligible units and households where no interviews occur (e.g., refusals). ''Screened'' refers to households where a successful interview has taken place, up to the point where screening can occur for those cases to be screened (described in more detail later in this chapter). ''Interviewed'' refers to households retained after the screening step (if applicable) and for which the interview process has been completed.

Note that table 1 shows information for the 1995–2004 design for both the alpha and the beta samples. The alpha sample is the sample originally selected for the 1995–2004 survey. The beta sample is a subsample of the alpha sample and is the sample actually fielded for the 1995–2004 survey. The alpha sample, with an expected annual interview size of 55,000 households, was designed and selected under the assumption of an increase in the NHIS budget for the 1995–2004 design. When the budget increase did not occur, the beta sample, with an expected annual interview size of 41,000 households, was selected. All the subsampling to select the beta sample was done within primary sampling units (i.e., all the PSU's selected for the alpha sample were retained for the beta sample). Additional details on how the beta sample was selected from the alpha sample are given later in this chapter. Additional information on the alpha sample is available in another publication (6).

PSU and Stratum Formation

For the 1995–2004 NHIS design, the United States was partitioned into 1,995 primary sampling units. The 1,995 PSU's are individual counties or groups of adjacent counties. Outside of New England, MA's were used as primary sampling units. In New England, NECMA's were used as primary sampling units instead of metropolitan areas. The PSU's for the 52 largest metropolitan areas were assigned to self-representing (SR) strata, each containing only one PSU. After the initial 52 SR strata were formed, the 1,995 PSU's were then partitioned into a total of 194 design strata. Because no individual PSU was allowed to account for more than 50 percent of a stratum's total size (estimated 1995 population), an additional 43 PSU's became self-representing after the initial stratification process. These 43 PSU's were assigned to self-representing strata, giving a final total of 237 design strata. All of the remaining 1,900 primary sampling units were nonself-representing (NSR), and each was assigned to one of the 142 NSR strata. In addition to the selection of the PSU in each of the 95 self-representing strata, two sample primary sampling units were selected from 121 of the NSR strata. The remaining 21 nonself-representing strata were so small, in terms of total estimated 1995 population, that only one sample PSU was selected from each of these strata.

Metropolitan areas include consolidated metropolitan statistical areas (CMSA's), metropolitan statistical areas (MSA's), and primary metropolitan statistical areas (PMSA's). PMSA's are used as building blocks for CMSA's, while MSA's are ''stand-alone.'' In areas with PMSA's and CMSA's, CMSA's were used as primary sampling units.

Table 2 displays information about several characteristics of the sampling strata for the 1995–2004 survey and table 3 shows the distribution of the self-representing and nonself-representing primary sampling units by census region.

PSU Stratification

Except for some of the 52 largest self-representing strata, no stratum straddles a State boundary. Several of the largest self-representing strata straddle State boundaries because those metropolitan areas straddle State boundaries. Even for these SR strata, because of the way the second-stage sample is drawn, one could consider State as a stratification variable for each stratum. Within a State, the approximate number of strata and sample PSU's was fixed in the design. PSU's in a State were partitioned by metropolitan and/or nonmetropolitan status.

If additional strata were required, the U.S. Bureau of the Census stratified the PSU's by the poverty rate. The stratification computer program was written for the redesign of several Census sample surveys and was based on a clustering algorithm developed by Friedman and Rubin (7). The procedure began with a random stratification. It systematically created a large number of stratifications by moving PSU's from one stratum to another or by exchanging pairs of PSU's in different strata. The resulting between-PSU variance for each stratification variable was calculated. The criterion for comparing possible stratifications was the sum of between-PSU variances for the stratification variables; the smaller the sum, the better the stratification. A constraint that limited the variability of the stratum size to plus or minus 25 percent of the average stratum size in a State also was used. Because the survey used only poverty to stratify within State and metropolitan and/or nonmetropolitan status, the stratification generally grouped PSU's with the lowest poverty rates in one stratum, the next lowest in the next stratum, and so forth. The size constraint caused some exceptions to this pattern. There is variability in stratum definitions from State to State due to variations in poverty and the size constraint.

Special Situations Arising From PSU Definitions

To coordinate sampling with the Current Population Survey and other ongoing census sample surveys, the U.S. Bureau of the Census partitions some PSU's, especially the self-representing PSU's for the largest metropolitan areas that have components in several States, into finer units (Basic Primary Sampling Unit Components) prior to selection of secondary sampling units. Also, one design PSU has components in two different census regions. For these situations, partitioning the PSU's into Basic Sampling Unit Components prior to second-stage sampling results in introducing State-level stratification. It occurs because these components always respect State boundaries.

For in-house variance estimation, NCHS uses the basic conceptual model with 237 strata and 95 self-representing PSU's, with some collapsing as necessary. Additional information on variance estimation is in chapter 3.

PSU Sample Allocation and Selection

Within a nonself-representing stratum, two PSU's usually were selected for the survey sample. In 21 nonself-representing strata, however, only one PSU was selected for the sample. A total of 358 PSU's was selected for the sample. One nonself-representing PSU is so small that it will be ''rotated'' out of the sample in 2000 and another PSU will be rotated in to take its place.

Primary sampling units were selected without replacement with probability proportional to the estimated 1995 PSU population size using Durbin's procedure (8).

Rotating PSU's

During the partition of the United States into PSU's, any that were too small (less than 3,000 housing units, as enumerated in the 1990 Census) to provide the minimum sample needed for the survey was defined as a potential rotating PSU. It was placed in a rotation cluster for sample selection. The rotation cluster included any other PSU in the same stratum that was too small to provide the minimum sample size. If the combined size of the rotation cluster was still too small, the next smallest PSU was added to the cluster.

The rotation cluster was treated as a single primary sampling unit for sampling. If it was selected, the PSU's in the rotation cluster were randomly ordered, and a random start was chosen to determine in which primary sampling unit the sample would start. A sequence of samples was designated based on the random start and the size of the PSU and continued on to the next primary sampling unit.

One such rotation cluster was selected for NHIS. The initial PSU includes the sample for 1995 through 1999. In 2000, it will be rotated out of the sample and another PSU in the rotation cluster will be rotated in to take its place for the remainder of the design.

Because of their small size, no oversampling is done in rotating primary sampling units.

Panels of PSU's

NCHS partitioned the survey sample into four panels of primary sampling units. Each panel is a subsample of the full set of 358 sample PSU's with the following properties:

- Each panel has the same sampling properties.
- Each panel produces unbiased estimates for the U.S. population.
- Each nonself-representing PSU is assigned to only one panel.

In addition to the properties listed above, the panels are approximately equal in the number of sample housing units. The assignment of PSU's to panels was intended to keep sampling variability small for a single-panel estimator.

The panels enable NCHS to restrict the portion of the NHIS sample that is reused as the sampling frame for other surveys to a subset of the full NHIS design. The panels also allow large sample reductions to be made, if necessary, by dropping one or more panels. This is more efficient than dropping weeks of interviewing or randomly chosen sample units.

To produce unbiased estimates for the U.S. population, the larger self-representing PSU's had to be in all panels. The U.S. Bureau of the Census divided the set of secondary sampling units in the 13 largest self-representing PSU's into four parts and assigned each part to a panel. The set of SSU's in the 20 medium SR PSU's was divided into two parts and assigned either to panels 1 and 3 or to panels 2 and 4. The small self-representing primary sampling units and the nonself-representing primary sampling units were assigned to single panels defined by NCHS.

The U.S. Bureau of the Census designated the self-representing PSU's as ''large,'' ''medium,'' or ''small.'' In general, PSU's with populations greater than 3,000,000 were designated as ''large,'' PSU's with populations between 1,600,000 and 3,000,000 were classified as ''medium,'' and PSU's with populations less than 1,600,000 were labeled as ''small.'' Some exceptions were made to reduce the variability in the sample sizes of the panels.

Substrata Within PSU's

Within each PSU, the survey uses an area frame. In some PSU's, a permit frame also is used. For the area sample, NHIS partitions the 1990 Census blocks (and in some cases ''combined blocks'') in the primary sampling unit into 20 substrata based on the 1990 Census concentration of black and Hispanic persons. The substrata definitions are consistent across PSU's. Hence, in some primary sampling units, some of the 20 substrata may be empty. In all PSU's, addresses corresponding to dwelling units built prior to April 1, 1990, are subject to sampling from these 20 substrata. In areas where governmental units issue and maintain building permits, dwelling units built since April 1, 1990, are subject to sampling only from the list of building permits. If a dwelling unit built since April 1, 1990, is encountered in the area frame, the interview is terminated and the unit is considered to be out of scope. When the permit frame is used in a PSU, it is considered to be the 21st substratum in that primary sampling unit. However, in areas that do not issue building permits and in rotating PSU's, all dwelling units regardless of when they were built are subjected to sampling in the 20 substrata in the area sample. Table 4 provides more information about the 21 substrata.

Units in higher density black or Hispanic areas are sampled at higher rates to improve the reliability of estimates for black and Hispanic persons. This is the first component of the oversampling strategy. The second component is discussed in the ''Assignment of Screening Code'' section.

It should be noted that density substratum 20 was so small that no survey sample cases were selected from it.

SSU Formation and Sampling

Using the U.S. Bureau of the Census' usual procedure in area segmentation, clusters of housing units were formed within the substrata to create secondary sampling units (SSU's). The sampling was done in conjunction with other census surveys, and operational techniques of implicit stratification and systematic sampling were used. An in-depth discussion of the methods used has been published (9). A simplified structural framework is given below. The ultimate sampling unit consists of a cluster containing an expected four housing units or equivalents, based on 1990 Census information. These clusters may be empty or may include ineligible units (e.g., vacant housing units) at the time of interview. For cost and statistical efficiency, the expected number of housing units to be covered annually by screening and sampling within an SSU was planned to be 8 or 12 for the area frame substrata and 4 for the permit frame substratum (see table 4, ''Beta SSU size'' column). For the area frame substrata, cluster sizes of expected size 8 or 12 were created by joining together 2 or 3 adjacent ultimate sampling units of expected size 4. However, the actual number of units may vary from the expected number, especially in PSU's where the survey does not use a permit frame. Moreover, about 20 percent of the addresses in a national area sample typically do not include any persons eligible for the survey.

Within a substratum, each secondary sampling unit is part of a ''super-SSU'' consisting of 12 ''annual-SSU's'' (the terms SSU or annual-SSU refer to the annual sampling unit). The 12 annual-SSU's in a super-SSU are intended to serve the survey for the entire 10-year design period and to provide 2 years of ''reserve sample'' as a contingency (e.g., if there was a delay in the implementation of the next NHIS design). Thus, any housing unit within a super-SSU can be in sample at most once in the 10-year design period.

The sampling process used to form the super-SSU's within the primary sampling unit substrata is outlined below. The following simplifications are made for ease of presentation:

Selection of a 10-year sample (without the reserve sample) is discussed.

The subsampling is described as ''within-PSU,'' rather than ''within Basic Primary Sampling Unit Components,'' which were discussed in the ''Special Situations Arising From PSU Definitions'' section.

The generic term ''block'' is used to denote both single 1990 Census blocks and ''combined blocks.'' Combined blocks are formed by joining 1990 Census blocks with a small number of housing units, as enumerated in the 1990 Census, with adjacent blocks.

The steps in the sampling process are:

1. All blocks within a PSU's density substrata are sorted in geographic order using the following 1990 Census variables: district office number, address register area number, and block number. Each block is assigned an associated measure of size defined as the number of housing units enumerated in the 1990 Census.

2. Each block contains an integral number of ''measures'' where each measure contains about four housing

units. The total number of measures varies from block to block, and a partition of the block into real measures does not occur unless the block is actually sampled.

3. Using systematic sampling procedures, a sequence of ''hit'' measures is selected. Each ''hit'' measure defines the first measure in a super secondary sampling unit. The super-SSU will contain the hit measure plus the next consecutive 19 or 29 measures (to yield a total of 8–12 expected housing units per year). The number of measures in the super-SSU varies by type of density substratum; it is the substratum's entry in table 4, ''Beta SSU size'' column, multiplied by {10/4} (the {10/4} comes from {10-year sample/measure of size equal to 4}). At this stage of sampling, every measure has the same probability of being ''hit.''

   One could characterize the sampling process as a systematic sample of sets of measures, or super-SSU's, from a hypothetical universe listing. Two possible conceptualizations of systematic sampling for either measures or super-SSU's can be made.

   A sampling interval SI_{mea} on a population M_{mea} of measures yields a sample of (M_{mea}/SI_{mea}) super-SSU's of size k measures each.

   One may also think of a corresponding population of super-SSU's of size M_{SSU} = (M_{mea}/k). Here, a sampling interval of $SI_{SSU} = SI_{mea}/k$ on M_{SSU} yields the same sample size.

   A representation of systematic sampling as a single sampling interval for either measures or super-SSU's will satisfy the following self-weighting criterion:

   For density substratum type (j), within PSU(i) sampled with probability π_i, $\pi_i / SI_{SSU}(j,i)$ = constant (j) (i.e., a constant that depends only on j), where $SI_{SSU}(j,i)$ is the sampling interval for density substratum type (j) within PSU(i).

   By the definition of a sampling interval, the conditional probability that a super-SSU is selected from substratum type (j), given that PSU(i) was selected, is either $1/SI_{SSU}(j,i)$ or $k/SI_{mea}(j,i)$, where k is the number of consecutive measures.

   Thus, the unconditional probability that a super-SSU from substratum type (j) is in sample is $\pi_i \bullet [1/SI_{SSU}(j,i)]$, which simplifies to constant (j).

4. The annual secondary sampling units within each selected super-SSU are constructed by combining every two or three consecutive measures, depending upon classification of density substratum.

Example of SSU Sampling

The following example illustrates the formation of super-SSU's as outlined in steps 1–4.

(Step 1) Let blocks A–H represent eight blocks in a substratum of a PSU that are in consecutive order as a result of sorting on selected characteristics (figure 1). The column ''Housing unit count'' shows the 1990 Census housing unit count for each block. In this figure, a number is assigned to each housing unit in the block to illustrate how housing units would be assigned to different measures within the block.

(Step 2) The column ''Measure count'' in figure 1 shows the number of measures each block contains. For example, block B consists of 19 housing units that are partitioned into 5 measures.

(Step 3) Suppose that measure 2 in block B is a sample ''hit'' measure from the population of measures. If this substratum requires an expected 80 housing units for the 10-year survey design period (i.e., the expected annual-SSU size is eight housing units), then the next 20 measures will be used to form the super-SSU. Starting with measure 2 in block B, the super-SSU will include measures from blocks B–G.

(Step 4) A well-defined U.S. Bureau of the Census listing process partitions the selected blocks B–G into the specified number of measures. The housing units within these selected blocks are listed by some adjacent or neighbor order. (Note: in this example, it is not necessary for the housing units in blocks A or H to be listed.) The assignment of the actual measure labels will look somewhat like those presented in figure 1 (e.g., the first six adjacently listed housing units in block B are assigned to measures 1,2,3,4,5,1, respectively). To form the annual-SSU's, the 20 measures labeled (B,2) to (G,1) are consecutively paired. Thus,

SSU (year 1) = measures (B,2),(B,3)
SSU (year 2) = measures (B,4),(B,5)
SSU (year 3) = measures (C,1),(C,2)
SSU (year 4) = measures (C,3),(C,4)
SSU (year 5) = measures (D,1),(D,2)
SSU (year 6) = measures (E,1),(E,2)
SSU (year 7) = measures (E,3),(F,1)
SSU (year 8) = measures (F,2),(F,3)
SSU (year 9) = measures (F,4),(F,5)
SSU (year 10) = measures (F,6),(G,1).

Figure 2 shows the year each housing unit in the super-SSU will be in a sample.

SSU Clustering Characteristics

There are several clustering aspects of the sample housing units within secondary sampling units that should be noted.

1. An examination of the sample housing units in an annual-SSU in figure 2 shows that in any given year, some housing units may be neighbors. However, the sample housing units will tend to be spread through the geography of a given block.

2. From one year to the next, there is a geographical clustering of sample housing units (i.e., sample housing units of a given year usually are neighbors of sample housing units of the next year). However, the geographical clustering weakens over time.

3. The annual-SSU's may cross blocks in any given year (e.g., years 7 and 10 in the example). The blocks in an SSU may not be adjacent.

4. The super-SSU's are not well-defined clustered population units like PSU's, but are artifacts of a block sort and random systematic sampling.

Figure 1. Housing unit distribution by measure

Block	Housing unit count	Measure count	Housing unit measure identification																					
A	8	2	1	2	1	2	1	2	1	2														
B	19	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4			
C	14	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2								
D	9	2	1	2	1	2	1	2	1	2	1													
E	12	3	1	2	3	1	2	3	1	2	3	1	2	3										
F	22	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4
G	17	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1					
H	9	2	1	2	1	2	1	2	1	2	1													

NOTES: Blocks ordered by a sorted list are a subset of eight blocks shown for illustration. Housing units ordered by adjacent units within block.

Figure 2. Housing unit distribution by annual secondary sampling unit

Block	Housing unit count	Measure count	Year[1] housing unit is in sample																					
A	8	2	x	x	x	x	x	x	x	x														
B	19	5	x	1	1	2	2	x	1	1	2	2	x	1	1	2	2	x	1	1	2			
C	14	4	3	3	4	4	3	3	4	4	3	3	4	4	3	3								
D	9	2	5	5	5	5	5	5	5	5	5													
E	12	3	6	6	7	6	6	7	6	6	7	6	6	7										
F	22	6	7	8	8	9	9	10	7	8	8	9	9	10	7	8	8	9	9	10	7	8	8	9
G	17	4	10	x	x	x	10	x	x	x	10	x	x	x	10	x	x	x	10					
H	9	2	x	x	x	x	x	x	x	x	x													

[1]1 is first year, 2 is second year, 10 is 10th year, etc. An x represents a housing unit not in the sample.

NOTES: Blocks ordered by a sorted list are a subset of eight blocks shown for illustration. Housing units ordered by adjacent units within block.

The within-substratum SSU sampling parameters needed to form selection probabilities and weights are provided in table 4. This table provides the alpha-design parameters along with the subsampling rates to achieve the beta-design that was implemented for the 1995–2004 design period.

Example of Within-Substratum Sampling Rates

Consider SSU sampling in density substratum 12 of a self-representing primary sampling unit from table 4. This substratum consists of all 1990 Census blocks in the PSU that contained 30–60 percent black persons and 5–10 percent Hispanic persons according to the 1990 Census. The reference group will be the permit substratum 21, which is not oversampled.

For simplicity, suppose that each substratum's universe can be defined as a set of population alpha annual-SSU's of a size defined by the ''Alpha SSU size'' column of table 4 (e.g., substratum 12 contains population secondary sampling units of size 12 housing units (3 measures) and substratum 21 contains SSU's of size 4 housing units (1 measure)).

Prior to any oversampling, a baseline sampling interval (referred to previously as SI_{SSU}) for the alpha-design was defined as 1,748 in all substrata in a self-representing PSU.

1. In substratum 21, 1 in every 1,748 SSU's is sampled.
2. In substratum 12, 1 in every 1,748/2 = 874 SSU's are sampled (the oversampling rate for the alpha-design in substratum 12 is 2; refer to the ''Original SSU unit oversampling rate'' column of table 4).

Then, to reduce the alpha-design SSU's to the NHIS beta-design, the following steps are taken:

1. In substratum 21, the ''SSU unit reduction'' column of table 4 indicates that a reduction of 30 out of 101 SSU's occurred. Hence, 71/101 of the SSU's are retained. Thus, the base weight is (101/71) • 1,748 = 2,486.5915
2. In substratum 12, the ''SSU unit reduction'' column of table 4 indicates that a reduction of 25 out of 101 SSU's occurred. Hence, 76/101 of the SSU's are retained. Also, referring to the ''Alpha SSU size'' and ''Beta SSU size'' columns of table 4, the expected SSU size was reduced from 12 to 8. Thus, the base weight is (101/76) • (12/8) • 874 = 1,742.25

These base weights are the inverses of the probability of annual-SSU selection.

Continuing with the step of oversampling black and Hispanic households after the secondary sampling unit has been selected (refer to the ''Nonminority household subsample rate'' of table 4):

1. In substratum 21, there is no oversampling. All housing units in the SSU are targeted for interview. Thus all target housing units receive the SSU base weight, 2486.5915.
2. In substratum 12, a proportion (0.7032) of all households are targeted for interview. The remaining are screened and interviewed only if

one or more eligible (i.e., civilian) black or Hispanic residents are found. Thus, households containing one or more eligible black or Hispanic residents are in sample with certainty; their multiplicative base weight is

SSU weight • 1 = 1,742.25

Nonminority households are subsampled and their base weights are

(1,742.25 / 0.7032) = 2,477.60

An example for density substratum type *(j)*, within nonself-reporting PSU(*i*) sampled with probability π_i, would be similar. The one difference would be that the original sampling interval would be adjusted from 1,748 to satisfy the self-weighting requirement $\pi_i / SI_{SSU}(j,i)$ = constant (*j*) (in this example, constant (*j*) is the reciprocal of the value in table 4, the ''Alpha SSU base weight'' column) , where $SI_{SSU}(j,i)$ is the sampling interval for density substratum type (*j*) within PSU(*i*).

Sampling in the Permit Frame

The proportion of the survey sample selected from the permit frame is about 5 percent of the total sample at the beginning of the 10-year design cycle and increases by about 1 percent per year. Hypothetical measures are selected during within-PSU sampling in anticipation of the construction of new housing units. Identifying the addresses for these permit measures involves a listing operation conducted at building permit offices, clustering of addresses to form measures, and associating these addresses with the hypothetical measures in the sample.

The U.S. Bureau of the Census conducts the Building Permit Survey, which collects information each month from all building permit offices in the United States about the number of housing units authorized to be built. The survey results are converted to measures with an expected size of four housing units. These measures are continuously accumulated and linked with the frame of hypothetical measures used to select the survey sample. This linking identifies which building permit offices contain measures that are in sample. U.S. Bureau of the Census field representatives then visit these building permit offices to obtain lists of addresses of units that were authorized to be built. These lists are used to identify the sample units. To the extent possible, the U.S. Bureau of the Census attempts to form groups of sample units that have some geographic clustering.

Sampling of Group Quarters

Noninstitutional, nonmilitary group quarters contain persons eligible for inclusion in NHIS. The sampling of group quarters is done exclusively from the area frame. If a group quarters unit is encountered during the address listing operation that occurs prior to NHIS interviewing, the NHIS address lister uses reference materials to determine whether the group quarters is noninstitutional and nonmilitary. If so, it is included in the address list. The permit frame never is used to select group quarters; any group quarters unit encountered among permit frame sample cases is considered to be out of scope. Interviewing within noninstitutional, nonmilitary group quarters is similar to household interviewing.

Sampling of Persons Within Households

In 1995 and 1996, persons within households were selected for NHIS questionnaire supplements using probability sampling methods. For example, in 1995 the ''Year 2000 Objectives'' supplement was administered to one sample adult randomly chosen from each family residing in half of the sample households. Beginning in 1997, one sample adult and one sample child (if children are present) are randomly selected from each family residing in a sample household for administration of a large portion of the survey interview.

Interviewer Assignments

The NHIS sample areas have been divided into 170 assignment areas of one or more counties. The areas were defined by the U.S. Bureau of the Census' Field Division for the survey. Generally there is a single interviewer for each assignment area, with several interviewers assigned to the larger assignment areas. The sample for each quarter is divided into approximately 930 weekly interviewer assignments. The number of weekly interviewer assignments in each assignment area is part of the input to the balancing procedure discussed below.

The survey samples secondary sampling units in each assignment area and quarter, and they are grouped into weekly interviewer assignments. Interviewers have an expected 10–12 completed interviews per week. To minimize travel in a weekly interviewer assignment, secondary sampling units were grouped in the same county whenever possible. SSU's from adjacent counties were used to complete weekly assignments that could not be formed within a single county.

Balancing the Sample

For operational reasons, the specific weeks that each interviewer receives an assignment should be as evenly spaced as possible throughout all 52 weeks of the year, not simply within the 13 weeks of each quarter. Because some assignment areas have more than 13 weekly interviewer assignments and more than one interviewer, the weekly interviewer assignments in each assignment area were distributed evenly among the weeks. The census regional office staffs then distribute the weekly interviewer assignments among the interviewers in multi-interviewer assignment areas.

For estimation purposes, the weekly interviewer assignments are distributed among the 13 weeks in a quarter. This minimizes the variation among the weeks in the number of measures and number of expected completed interviews in the following categories:

- Each census regional office
- Each census region (Northeast, Midwest, South, West) and the total United States
- Each census region and the total United States by type of PSU (SR and NSR)

- Each census region and the total United States by the geographic categories C, B, U, R (C is the central cities of a metropolitan area; B is the urbanized area not in category C; U is the urban places not in an urbanized area and not in category C; R is all other areas), and by new construction

The U.S. Bureau of the Census developed software to balance the sample within these operational and estimation constraints.

Additional Subsampling Situations

During the address listing operation that occurs prior to interviewing, sometimes a larger than expected number of housing units is identified in a secondary sampling unit. If the address lister finds more than twice the number of expected units in an SSU, the lister subsamples the units. This causes an adjustment in the probability of sample selection for all units in that SSU.

Sometimes the NHIS interviewer encounters extra units at a sample address that were not identified during the listing operation. Often when three or more additional units are identified, the interviewer subsamples one of the units. This causes an adjustment in the probability of sample selection for the particular unit that is selected. This type of subsampling is rare and is carried out to maintain reasonable interviewer workloads.

Assignment of Screening Code

The second component of the oversampling strategy involves the elimination of some sample households that do not contain any black or Hispanic persons. First, screening codes are assigned to sample addresses. Then screening interviews eliminate some households.

Prior to data collection, but after the address listing operation and SSU level subsampling (if necessary), some of the addresses from each SSU are randomly assigned a screening code of *I* (interview) by the U.S. Bureau of the Census. Others are assigned a screening code of *S* (screen). The proportion of addresses assigned to either *I* or *S* depends on the sampling substratum from which the SSU was drawn (see the ''Nonminority household subsample rate'' column of table 4). The *S* cases are spread out as much as possible within the SSU. As indicated in the ''Nonminority household subsample rate'' column of table 4, all sample cases drawn from the permit frame are assigned an *I* code.

For 1995 and 1996, the assignment of screening codes was carried out by using a systematic sampling procedure using integer-length sampling intervals. For example, if 75 percent of the addresses in a particular substratum were to be assigned a screening code of *I*, all of the addresses in half of the SSU's in this substratum would be selected, and the addresses in the other half of the SSU's would be selected at a rate of 1 of every 2. All the selected units would be assigned a code of *I* and the remainder a code of *S*. This systematic sampling procedure was necessary because the subsampling was a systematic sampling clerical procedure carried out in the Census regional offices, and the U.S. Bureau of the Census headquarters staff wanted the regional office staff to use integer-length sampling intervals.

Starting in 1997, the assignment of screening codes was automated. Integer-length sampling intervals were no longer needed, and a single sampling interval is used in each substratum. In the example above, using a uniform systematic selection rate of 3 out of every 4, selected units would be assigned a code of *I* and the remainder would be assigned the *S* code.

Sampling Rule Implementation

The interviewers conduct the usual NHIS basic health and demographic interview for every address that contains a household and has a screening code of *I*.

For every household at addresses with a code of *S*, the interviewers conduct the interview by collecting the household roster and the race and ethnicity for each household member. If the *S* household contains one or more eligible (i.e., civilian) black or Hispanic persons, then the household is retained in the sample and the interviewer completes the remainder of the interview. If the *S* household contains neither an eligible black person nor an eligible Hispanic person, then the household is not retained in the sample, and the interviewer does not complete the remainder of the interview.

Because *I* and *S* codes are assigned prior to interviewing, there can be discrepancies between expected subsampling rates and actual subsampling rates. For example, all the *I* codes in a secondary sampling unit could be assigned to addresses that contain households, while all of the *S* codes in the SSU are assigned to addresses that are vacant housing units. In this case, no subsampling would occur in the secondary sampling unit. Another example is when all households in an SSU that do not include any eligible black or Hispanic persons are assigned *I* codes. In this case, no subsampling would occur. Presumably, subsample fluctuations at the secondary sampling unit level balance out over the entire sample.

During 1995 and 1996, if the interviewer had made two unsuccessful attempts to conduct screening at an occupied sample unit with a code of *S*, the interviewer could contact two neighbors to ask if the sample household contained any black or Hispanic persons. If both neighbors agreed the household did not contain any black or Hispanic persons, the household did not need to be interviewed. Otherwise, the interviewer was supposed to continue trying to contact the sample household to determine whether a complete interview was required.

Beginning in 1997, information from neighbors no longer was used for screening purposes.

Table 1. National Health Interview Survey designs: 1973–84, 1985–94, 1995–2004

Design period	1973–84	1985–94	1995–2004 Alpha	1995–2004 Beta
Sampling frame	Address, area, permit, group quarters	Area, permit	Area, permit	Area, permit
PSU definitions	One or more counties	One or more counties	One or more counties	One or more counties
	1970 SMSA's	1983 MSA's	1990 MSA's	1990 MSA's
SR sample PSU's	156	52	95	95
NSR sample PSU's	220	146	263	263
Total sample PSU's	376	198	358	358
Sample PSU's per NSR stratum	1	2	Normally 2, sometimes 1	Normally 2, sometimes 1
First level of stratification	4 census regions	4 census regions	50 States and the District of Columbia	50 States and the District of Columbia
Designated housing units per year	51,000	61,400	124,000	70,000
Screened households per year	Not applicable	Not applicable	99,000	57,000
Interviewed households per year	40,000	49,000	55,000	41,000
Interviewed persons per year	108,000	132,000	159,000	107,000
SSU size (except permit frame) — expected number of housing units	4	8	8, 12, 16	8, 12
Permit frame SSU size — expected number of housing units	4	4	4	4
Number of panels	Not defined	4	Not defined	4
Minority sampling techniques	None	Oversample for black persons	Oversample and screen for black and Hispanic persons	Oversample and screen for black and Hispanic persons

NOTE: PSU is primary sampling unit, SSU is secondary sampling unit, SR is self-representing, NSR is nonself-representing, SMSA is Standard Metropolitan Statistical Area as defined by the U.S. Office of Management and Budget in 1959, MSA is Metropolitan Statistical Area as defined by the U.S. Office of Management and Budget in 1983, and MA is Metropolitan Area as defined by the U.S. Office of Management and Budget in 1990.

Table 2. Sampling strata characteristics: National Health Interview Survey, 1995–2004

Stratum type	Number of strata	Universe coverage (population)	Sample PSU's	Size of strata (population)
SR	95	64%	95	90,000–18,000,000
NSR, 2 PSU's	121	34%	242	380,000–1,000,000
NSR, 1 PSU	21	2%	21	90,000–360,000
Total	237	100%	358	. . .

. . . Category not applicable.

NOTE: PSU is primary sampling unit; SR is self-representing; NSR is nonself-representing.

Table 3. Primary sampling units by census region: National Health Interview Survey, 1995–2004

Type of primary sampling unit	Census region: Northeast	Midwest	South	West	Total
Self-representing	22	19	34	20	95
Large	5	2	4	2	13
Medium	4	7	4	5	20
Small	13	10	26	13	62
Nonself-representing	29	76	119	39	263
Total	51	95	153	59	358

NOTES: The designation of self-representing primary sampling units as ''large,'' ''medium,'' or ''small'' was done by the U.S. Bureau of the Census. In general, primary sampling units with populations greater than 3,000,000 were designated as ''large,'' PSU's with populations of 1,600,000–3,000,000 were designated as ''medium,'' and PSU's with populations less than 1,600,000 were designated as ''small.''

Table 4. Race and ethnicity density strata and within primary sampling unit sampling parameters: National Health Interview Survey, 1995–2004

Substratum label	1990 Census density		Percent of U.S. population in 1990	Original SSU unit over-sampling rate[3]	Revised SSU unit over-sampling rate[4]	SSU unit reduction[5]	Alpha SSU size[6]	Beta SSU size[7]	Alpha SSU base weight[8]	Beta SSU base weight[9]	Nonminority household[1]	
	Percent black[2]	Percent Hispanic[2]									Subsample rate[10]	Base weight[11]
1	<10	<5	55.3	1.60	1.00	17	16	12	1,092.5000	1,751.4683	0.7032	2,490.7114
2	<10	5–10	7.7	2.00	1.50	0	16	12	874.0000	1,165.3333	0.4688	2,485.7793
3	<10	10–30	8.0	3.20	1.50	38	16	12	546.2500	1,167.6455	0.4688	2,490.7114
4	<10	30–60	3.1	4.00	1.60	61	12	12	437.0000	1,103.4250	0.4395	2,510.6371
5	<10	60+	3.5	4.00	2.30	43	8	8	437.0000	760.9828	0.3057	2,489.3123
6	10–30	<5	4.6	1.60	1.00	38	12	12	1,092.5000	1,751.4683	0.7032	2,490.7114
7	10–30	5–10	1.4	2.00	1.50	25	12	12	874.0000	1,161.5000	0.4688	2,477.6024
8	10–30	10–30	1.9	3.50	1.50	58	12	12	499.4286	1,173.0764	0.4688	2,502.2961
9	10–30	30–60	0.9	4.00	1.50	63	8	8	437.0000	1,161.5000	0.4688	2,477.6024
10	10–30	60+	0.7	4.00	2.00	51	8	8	437.0000	882.7400	0.3516	2,510.6371
11	30–60	<5	2.3	1.70	1.00	12	12	8	1,028.2353	1,750.3106	0.7032	2,489.0652
12	30–60	5–10	0.5	2.00	1.00	25	12	8	874.0000	1,742.2500	0.7032	2,477.6024
13	30–60	10–30	0.8	3.50	1.00	58	12	8	499.4286	1,759.6146	0.7032	2,502.2961
14	30–60	30–60	0.7	4.00	1.50	63	8	8	437.0000	1,161.5000	0.4688	2,477.6024
15	30–60	60+	0.2	4.00	2.00	51	8	8	437.0000	882.7400	0.3516	2,510.6371
16	60+	<5	6.6	1.95	1.05	49	8	8	896.4103	1,741.1045	0.7032	2,475.9735
17	60+	5–10	0.6	2.00	1.00	51	8	8	874.0000	1,765.4800	0.7032	2,510.6371
18	60+	10–30	0.9	3.50	1.20	66	8	8	499.4286	1,441.2082	0.5860	2,459.3996
19	60+	30–60	0.2	4.00	1.50	63	8	8	437.0000	1,161.5000	0.4688	2,477.6024
20	60+	60+	[12]0.0	4.00	1.50	63	8	8	437.0000	1,161.5000	0.4688	2,477.6024
21	permit	permit	. . .	1.00	1.00	30	4	4	1,748.0000	2,486.5915	1.0000	2,486.5915

. . . Category not applicable.

[1]Nonminority includes everyone except black and Hispanic persons.

[2]For intervals of form ‘‘x-y,’’ the lower endpoint is included and the upper endpoint is not included.

[3]Alpha-design is the oversampling rate for secondary sampling units.

[4]Beta-design is the oversampling rate for secondary sampling units.

[5]The number of alpha-design secondary sampling units that are removed per 101 alpha-design secondary sampling units to obtain the beta-design secondary sampling units.

[6]Expected number of housing units in each alpha-design secondary sampling unit.

[7]Expected number of housing units in each beta-design secondary sampling unit.

[8]Annualized base weight of alpha-design secondary sampling units. A given entry in this column is equal to 1,748 divided by the corresponding entry in the ‘‘Original SSU unit oversampling rate’’ column. For example, the first entry in this column, 1092.5000, is equal to 1,748/1.6.

[9]Annualized base weight of beta-design secondary sampling units. A given entry in this column is equal to the corresponding entry in the ‘‘Alpha SSU base weight’’ column, multiplied by a factor to compensate for SSU unit reductions (see the ‘‘SSU unit reduction’’ column), and multiplied by a factor to compensate for change in the SSU size (see the ‘‘alpha SSU size’’ and ‘‘beta SSU size’’ columns). For example, the first entry in this column, 1751.4683, is equal to 1092.5000 • [101/(101–17)] • (16/12).

[10]Expected fraction of nonminority households sampled in NHIS secondary sampling units.

[11]Base weight of nonminority household in NHIS SSU. A given entry in this column is equal to the ratio of the corresponding entries in the ‘‘Beta SSU base weight’’ column and the ‘‘nonminority household subsample rate’’ column. For example, the first entry in this column, 2490.7114, is equal to (1751.4683/0.7032).

[12]Quantity more than zero but less than 0.05.

NOTE: SSU is secondary sampling unit.

Chapter 3. Design and Estimation Structures for the 1995–2004 NHIS

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Introduction

The National Health Interview Survey (NHIS) is designed to make inferences about the civilian noninstitutionalized population of the United States. While a general description of the NHIS sample design is presented in chapter 2 of this report, this chapter focuses on the design structures needed in making statistical inference. The NHIS program at the National Center for Health Statistics (NCHS) focuses its attention on making design-based inferences about the health of persons and households in the target population. This is accomplished by inflating the responses of each surveyed person or household in NHIS, referred to as elementary units, by a national weight factor. This is called a national weight because it permits an (approximately) unbiased design-based estimator of any U.S. target population total. With this weight an unbiased estimator, $\hat{X}$, for any given true population characteristic total, X, can be expressed as a weighted sum over all elementary units:

$$\hat{X} = \sum_{u} W_f(u)\, x(u) \qquad (1)$$

where

u represents an elementary unit of NHIS

$x(u)$ is the characteristic or response for unit u

$W_f(u)$ is the final national weight for unit u

This estimator of total is used to generate the NHIS estimates of totals, percents, and rates that appear in NCHS official publications. A national weight is provided on the NHIS Public-Use databases that allows users to directly create estimators of the form in equation (1). In the sections that follow, the technical aspects of the procedures used to create national weights and the procedures used to estimate the variances of NHIS estimators are discussed.

Methods for Creating Weights and Estimators

Complex estimation techniques are required for the survey because it is based on a highly stratified multistage probability sample. The true sampling distributions of any survey implementing complex clustering structures, implicit stratification, and systematic sampling tend to be mathematically intractable. Therefore, the survey design will be conceptualized in a somewhat simplified framework. This conceptual design will provide a tractable structural model that captures the most important design features. The primary sampling unit (PSU) and within-PSU sampling steps discussed in chapter 2 can be expressed as a hierarchical sampling design with levels and probabilities shown in table 5.

It should be noted that the number of super-secondary sampling units (SSU's) in the survey is a random variable, but with very little variability; hence the super-SSU sample sizes will be treated as fixed.

The number of eligible households in an SSU also is a random variable. A housing unit (HU) may be classified as an eligible household or an ineligible unit. Nationally, about 20 percent of all addresses yield an ineligible classification (e.g., vacant). New construction and/or destruction of housing units within a block in the 5 years or more after the 1990 Census results in a degradation of the original frame composition information. It is possible, although a rare event, that extreme conditions can occur within a secondary sampling unit at the time of sampling. Either no eligible households exist or too many new HU's exist (use of a permit frame and/or field subsampling, as discussed in chapter 2, dampen the influence of the latter condition). The annual number of persons in the sample also is a random variable. As a consequence, the annual surveys exhibit different sample counts of households and persons.

The three broad estimation criteria that NCHS applies when deciding on estimation strategies to use for survey data are:

1. The estimation methods must be *design-based* for finite populations. That is, the randomness of the data is a result of sampling finite universes having no imposed distributional assumptions. This is in contrast to a model-based approach where the data typically have imposed distributional assumptions. The design-based methods may be thought of as nonparametric and robust.
2. The design-based methods should be practical and should permit (approximately) unbiased estimators of population totals.
3. The design-based methods should permit practical variance estimation strategies to assess the stability of the estimator.

To satisfy these criteria, NCHS, as well as many other sponsors of large government surveys, has been using standard accepted design-based methods discussed in such classic references as Cochran (10), Kish (11), and Hansen, Hurwitz and Madow (12).

National Weights

The NHIS estimator of a characteristic total as presented in equation (1) uses methodology based on the features of the complex multistage probability sample to define a national weight, W_f, for each elementary unit. This national weight is the product of up to four of the following weighting factors:

1. Inverse of the probability of selection
2. Household nonresponse adjustment
3. First-stage ratio adjustment

4. Second-stage ratio adjustment (poststratification)

When the elementary unit is an individual, all four weighting factors define the person's final weight. Because the NHIS ratio adjustments are based on person characteristics, only the first two weighting factors are used to define a national household weight.

NCHS creates weights for each calendar quarter of the NHIS sample, using information provided by the U.S. Bureau of the Census. These weights permit national estimates to be made for each quarter. Quarterly weights are divided by 4 to create annual weights, which are used when making national estimates from a calendar year of the survey sample.

Base Weight Estimator

The overall probability that a unit is in sample is the product of the conditional selection probabilities presented in table 5. This *basic inflation weight* is defined as:

$W_I(u)$ = 1/Probability (unit u is in sample).

Roughly speaking, based on probabilistic sampling, unit u represents $W_I(u)$ population units. This weight depends in part on the minority status of the household and substratum class to which the unit u belongs. W_I is the first component weight of W_f in equation (1). Table 4 in chapter 2 presents the target household inflation weights in the ''Beta SSU base weight'' and ''Nonminority household base weight'' columns.

Infrequently, this base sampling weight, W_I , will be modified. If, during the HU selection process of step 4 in table 5, a secondary sampling unit is determined to contain too many housing units for interview, then a subsample will be selected. If the subsample consists of less than 1/4 of all HU's in the secondary sampling unit, then the conditional probability of selection will be truncated by the U.S. Bureau of the Census at 1/4. This is a rare occurrence, and the biases introduced by such a modification should be small.

In an ideal hypothetical sampling situation having no nonsampling error components (e.g., frame problems, nonresponse, and interviewer effects), equation (1) with W_I substituted for W_f becomes

$$\hat{X}_0 = \sum_u W_I(u)\, x(u) \qquad (2)$$

which will provide an unbiased estimator for the true population total, X. Such an estimator is referred to as a *base weight estimator* or as a Horvitz-Thompson estimator.

Factors Contributing to Annual Weight Fluctuations

Complex sampling implemented by specified guidelines is difficult to achieve in the real world. Some types of special situations that may occur during the survey and will have an influence on weighting procedures for a given year are:

1. Initial start-up problems during the first year of the survey may result in minor deviations from the sampling plan.

2. NHIS budgetary changes may result in additional subsampling to reduce the sample. For example, in 1985 and 1986 the NHIS samples were reduced by 25 and 50 percent, respectively, but 1987–94 were full budget years. Similar contingency plans exist for the 1995–2004 design (see the section ''Panels of PSUs'' in chapter 2).

3. Phase-in of new field operations may modify the sample. In 1996, the transition from paper and pencil to computer-assisted interview resulted in only 5/8 of the full survey sample being targeted for eventual public release.

4. In recent years, the survey has used one or more weeks at the beginning of the year (during quarter 1) for interviewer training. During this period, no data are collected for release. In this situation, all sampled units for quarter 1 have their basic inflation weight increased by an appropriate factor to inflate to 13 weeks. For example, if 1 week was used for training, the factor is 13/12; if 2 weeks were used for training, the factor is 13/11.

5. Unexpected one-time events may alter the design. For example, interviewing for the 1995 survey was not completed due to a government shutdown in December 1995. As a result, the within-PSU sampling came up 3 weeks ''short'' for several PSU's that year. For quarter 4 of 1995, the basic inflation weight was increased by a factor of 13/10.

In this report, only the anticipated weighting adjustments are considered for a full sample of the survey.

Household Nonresponse Adjustment

During 1995–97, the first 3 years of the current survey design, the household nonresponse rates for the core survey were about 6.2, 6.2, and 8.2 percent, respectively. Although small, this household nonresponse will most likely bias an estimator of the form shown in equation (2), and consequently, a weighting adjustment for household nonresponse is justified. This need results in the creation of the second weight factor, the household *nonresponse adjustment*.

The standard household nonresponse adjustment is done by inflating the sampling weights for all responding households within an SSU to compensate for the nonresponding households within that same secondary sampling unit. A special situation does occur. Typically, 5–15 SSU's in a quarter have 100 percent nonresponse. In such a situation, no nonresponse adjustment is made. It is assumed that the poststratification ratio adjustment will compensate for the nonresponse.

In the 1985–94 NHIS design, when all eligible households (i.e., households with one or more civilian members) in a secondary sampling unit were sampled with certainty (i.e., no screening occurred), NCHS used the simple nonresponse adjustment

$$\frac{\Sigma \text{ all eligible households in SSU}}{\Sigma \text{ all responding households in SSU}}$$

(Note that this unweighted sum usually is equivalent to the sum obtained using the base weights because the base weight is constant within an SSU. The only exception is the rare occurrence when the interviewer discovers three or more additional units at a sample address. Additional information is available in ''Additional Subsampling Situations'' in chapter 2.

In the 1995–2004 NHIS design, households that have no black or Hispanic persons are subsampled at the SSU level in the area frame, as described in chapter 2. The subsampling occurs after all housing units in the SSU have been randomly divided by the U.S. Bureau of the Census into two groups, coded *I* and *S*, prior to interviewing. All sampled households that have no black or Hispanic persons must come from the *I* group. Those in the *S* group are screened out. All black and Hispanic households in either group are interviewed. This within-SSU subsampling creates two issues that did not have to be addressed in previous survey designs:

1. The race/ethnicity of some households cannot be determined because the interviewer never succeeds in making contact with the household. If the true status is black or Hispanic, then these are nonresponding households. If the true status is ''other,'' then the household may be nonsampled or sampled, but nonresponding.

2. Even with no nonresponse, the base weight estimated total number of households within the SSU, based on the interviewed sample, may not be equal to the true total number of households within the secondary sampling unit. (The expected value, however, is unbiased.) A simple hypothetical example is: Suppose the *I*/*S* sampling rule requires that within every substratum of type *a*, a subsample of 1 of every 2 household units within an SSU be taken. All households that have no black or Hispanic persons in this *I* subsample are targeted for interview, but all black and Hispanic households in the entire SSU are targeted. Thus, every sampled black and Hispanic household will receive a component weight of 1, while every sampled ''other'' household will have a weight of 2. The sum of the ''other'' household weights will be an even number that may not equal the true value.

Methodology for 1995 and 1996 Surveys

In 1995 and 1996, NCHS used the following method to adjust for nonresponse:

Each household in a given SSU was classified as belonging to 1 of 3 groups:

M = black or Hispanic household
O = ''other race'' household
U = unknown race and ethnicity status household

The class *O* households were subsampled, but all class *M* households were selected for interview.

Let W_H = conditional inflation weight restricted to step 5 of table 5 (and any other special inflation factors as discussed in the ''Base Weight Estimator'' section above).

The following weighted sums (with respect to W_H) were computed across the SSU:

$W_H(M)$ = weighted sum of sample class *M* households
$W_H(O)$ = weighted sum of sample class *O* households
$W_H(M_{res})$ = weighted sum of responding sample class *M* households
$W_H(O_{res})$ = weighted sum of responding sample class *O* households

The nonresponse adjustment for identified class *M* or *O* households in the SSU was defined as

$$NR_{OM} = \frac{[W_H(M) + W_H(O)]}{[W_H(M_{res}) + W_H(O_{res})]}$$

This does not include the unknown class *U*. To compensate, let

$N(M,O,U)$ = unweighted sum of all households (M,O,U) in the SSU, and $N(M,O)$ = unweighted sum of *M* and *O* households in the SSU.

Note, here the unweighted sums $N(M,O,U)$ and $N(M,O)$ are over the entire SSU, while the weighted sums, $W_H(\ )$, are computed only on the sampled component.

The nonresponse adjustment factor for the SSU was defined as

$$NR = [N(M,O,U) / N(M,O)] \bullet NR_{OM}$$

If all households were successfully screened with respect to race/ethnicity, i.e., if $N(M,O,U) = N(M,O)$, then

$$NR = NR_{OM}$$

The final household nonresponse adjustment factor for the SSU, W_{nr}, was defined as

$$W_{nr} = \text{minimum}\ (NR,2.0)$$

That is, the final factor was truncated to 2 to control the variability in the weights due to this factor. Typically, fewer than 0.5 percent of SSU's used this truncated factor.

Methodology for 1997 Survey and Beyond

Beginning in 1997, NCHS has used a different method to adjust for nonresponse. This method accounts for the difference in eligibility for inclusion in the survey, based on use of the *I* and *S* screening codes, as described in chapter 2.

All of the households in a given SSU that belong to one of the following four groups are eligible:

M_I = black or Hispanic household, *I* screening code
M_S = black or Hispanic household, *S* screening code
O_I = ''other race'' household, *I* screening code
U_I = unknown status household, *I* screening code

None of the households in the SSU in the following group are eligible:

O_S = ''other race'' household, *S* screening code

Some, none, or all of the households in the SSU in the following group are eligible:

U_S = unknown status household, *S* screening code

If the number of households in the U_S group is not zero, the proportion of eligible households in the SSU is estimated using information from households with known race and/or ethnicity. The eligible proportion is estimated by summing the number of M_I, M_S, O_I, and O_S households in the SSU and then computing:

$$\text{MINPROP} = \frac{(M_I + M_S)}{(M_I + M_S + O_I + O_S)}$$

assuming the denominator is not zero; otherwise, MINPROP is set equal to 0. Once MINPROP is defined, the complementary proportion OTHPROP is defined as [1−MINPROP] if the denominator of MINPROP is not zero; OTHPROP is set equal to 0 if the denominator of MINPROP is zero.

Let W_H = conditional inflation weight restricted to step 5 of table 5 (and any other special inflation factors as discussed in the ''Base Weight Estimator'' section).

The following weighted sums (with respect to W_H) are computed across the SSU:

$W_H\ (M_I)$ = weighted sum of sample class M_I households

$W_H\ (M_S)$ = weighted sum of sample class M_S households

$W_H\ (O_I)$ = weighted sum of sample class O_I households

$W_H\ (M_{I,\ \text{res}})$ = weighted sum of responding sample class M_I households

$W_H\ (M_{S,\ \text{res}})$ = weighted sum of responding sample class M_S households

$W_H\ (O_{I,\ \text{res}})$ = weighted sum of responding sample class O_I households

Then, the nonresponse factor for the SSU is computed as:

$$NR = [W_H(M_I) + W_H(M_S) + W_H(O_I) + f_1(U_I) + f_2(U_S)] \,/\, [W_H(M_{I,\ \text{res}}) + W_H(M_{S,\ \text{res}}) + W_H(O_{I,\ \text{res}})]$$

where $f_1(U_I)$ denotes a partition of the households in U_I using MINPROP and OTHPROP, with appropriate W_H factors applied to each piece, and $f_2\ (U_s)$ denotes estimation of the black and/or Hispanic households in U_S using MINPROP, and the appropriate W_H factor applied to that piece.

More specifically,

$$f_1(U_I) = W_{H(\text{OTH})}\ (\text{OTHPROP} \bullet U_I) + W_{H(\text{MIN})}\ (\text{MINPROP} \bullet U_I)$$

$$f_2(U_S) = W_{H\,(\text{MIN})}\ (\text{MINPROP} \bullet U_S)$$

where

$W_{H\,(\text{OTH})}\ (\text{OTHPROP} \bullet U_I)$ = weighted sum of the ''other race'' estimated proportion of U_I households, where the weight $W_{H\,(\text{OTH})}$ is the weight applied to ''other race'' households in the SSU.

$W_{H\,(\text{MIN})}\ (\text{MINPROP} \times U_I)$ = weighted sum of the black and Hispanic estimated proportion of U_I households, where the weight $W_{H(MIN)}$ is the weight applied to black and Hispanic households in the SSU.

$W_{H\,(\text{MIN})}\ (\text{MINPROP} \times U_S)$ = weighted sum of the black and Hispanic estimated proportion of U_S households, where the weight $W_{H(\text{MIN})}$ is the weight applied to black and Hispanic households in the SSU.

In essence, the nonresponse factor NR consists of a numerator that is an estimate of the total number of eligible households in a given SSU, and a denominator that is the total number of interviewed households. Weight factors that account for subsampling within the SSU are included as appropriate.

The final household nonresponse adjustment factor for the SSU, W_{nr}, is defined as

$$W_{nr} = \text{minimum}\ (NR, 2.0)$$

That is, the final factor is truncated to 2 to control the variability in the weights due to this factor. Typically, fewer than 0.5 percent of SSU's use this truncated factor.

Estimator Based on the Product of W_I and W_{nr}

The estimator produced by substituting the product of W_I and W_{nr} for W_f in equation (1)

$$\hat{X}' = \sum_u W_I(u) \bullet W_{nr}(u) \bullet x(u) \qquad (3)$$

should produce approximately unbiased estimators for the population total X, as long as the true nonresponding population does not significantly differ from the responding population.

Beginning in 1997, the weight $W_I \bullet W_{nr}$ is used to define a final national weight for households, and it is used to produce estimates of household characteristics. (In 1995 and 1996, the weight W_I was used to define a final national weight for households.)

Ratio Adjustments for Person-Level Weights

The third and fourth weighting factors to be defined are ratio adjustments. Statistical sampling theory has demonstrated that in many situations, the estimators obtained using a ratio estimation procedure often have smaller mean squared error (MSE) than the base weight estimators expressed by equation (2). More precisely, if X' and Y' are base weight estimators of two population characteristic totals, X and Y, respectively, and the ''true'' total Y is known, then the ratio estimator $X'' = (X'/Y')\ Y$ for X will have smaller MSE than the estimator X' when there is a high positive correlation between X' and Y' and the sample size is large.

The ratio adjustment also is used to help correct survey bias due to systematic undercoverage. It should be noted that an observed survey estimator of the form shown in equation (3) may be larger or smaller than the true value just by chance alone. There are some populations that the U.S. Bureau of the Census has identified as ''difficult to sample.'' For example, historically, there has been survey undercoverage of the young black male population in the NHIS, and the estimator of equation (3) may be negatively biased in estimating young black male population characteristic totals. Such a bias due to undercoverage is often reduced by the use of the ratio adjustments.

Note that the ratio adjustments are applied at the person level, which can introduce variation in the person-level weights within a given sampled household. The previous two components of the weights, the inverse of the probability of selection and the household nonresponse adjustment, are equal for all persons in a given sampled household.

First-Stage Ratio Adjustment

The first-stage ratio adjustment is used in an attempt to reduce the between-PSU variance component of sampling variation among the nonself-representing (NSR) PSU's. For each of six residence and/or race-ethnicity classes within the nonself-reporting strata of each of the four census regions, the first-stage ratio adjustments are defined using the following methodology and are also presented in table 6.

The first-stage ratio adjustment factors are created by the U.S. Bureau of the Census. The 24 residence and/or race-ethnicity classes in the United States defined within the NSR PSU's will be indexed by the letter *c*,

$c = 1,2,...,24.$

Let

Z_c = the projected 1995 population total for class *c* over all NSR PSU's in the population.

Considering only the first stage of sample selection as presented in the conceptual design (refer to step 1 in table 5), the sample of NSR PSU's can produce an unbiased estimator of Z_c, say, $\hat{Z}_c$,

$$\hat{Z}_c = \sum_{\text{NSR PSU's}_{(si)}} Z_{sic} / \pi_{si}$$

where Z_{sic} = projected 1995 population total for class *c* in sample NSR PSU *i* of stratum *s*, and π_{si} = the selection probability of PSU *i* of stratum *s* (refer to step 1 in table 5).

Note, Z_{sic} is based on U.S. Bureau of the Census projections and not on the fielded sample.

The first-stage ratio adjustment factor associated with class *c* is defined as

$$F_c = Z_c / \hat{Z}_c$$

with adjustment (i.e., collapsing with another class and/or truncation) occurring if the factor falls outside the interval [0.8125, 1.3].

The U.S. Bureau of the Census suggested that the lower and upper bounds should satisfy the symmetric equations L = 1/(2−(1/U)) and U = 1/(2−(1/L)). With the upper bound specified at U = 1.3, the lower bound is determined to be L = 0.8125.

A universal *first stage ratio adjustment*, W_{r1}, can be defined for each sample person by defining a new class index, *c* = 0, to denote all persons not receiving the F_c ratio adjustment:

$$W_{r1} = W_{r1(c)} = F_c \quad \text{if } c = 1,2,...,24 \text{ for NSR PSUs}$$

$$W_{r1} = W_{r1(c)} = 1 \quad \text{if } c = 0 \text{ for SR PSU's}$$

A first-stage ratio-adjusted national estimator, $\hat{X}''$, of a population total, *X*, is defined by equation (1) when the weight W_f is replaced with the product of the first three component weights: $W_I \bullet W_{nr} \bullet W_{r1}$,

$$\hat{X}'' = \sum_u W_I(u) \bullet W_{nr}(u) \bullet W_{r1}(y) \bullet x(u) \quad (4)$$

As shown in table 2, about 64 percent of the U.S. population resides in the self-representing strata, which do not receive the first-stage ratio adjustment. The research of Parsons and Casady (13) on the previous 1985–94 NHIS design has shown that the inclusion of the first-stage ratio adjustment factor had very little impact on NHIS estimates.

Table 6 shows the first-stage ratio adjustment factors for 1997. These are typical values for the entire 1995–2004 NHIS design. However, they were different in 1996 because of the reduced sample, and there will be a small change starting in 2000 when one nonself-representing PSU rotates out and another nonself-representing PSU rotates in (refer to ''Rotating PSU's'' in chapter 2).

Second-Stage Ratio Adjustment (Poststratification)

The main advantages of the ratio-estimation process are exploited by the introduction of a second ratio factor, the poststratification adjustment weight. This weight assures that the NHIS estimates for 88 age-sex-race and/or ethnicity classes of the civilian noninstitutionalized population of the United States (shown in table 7) agree with independently determined population controls prepared by the U.S. Bureau of the Census. Furthermore, these independent controls also include an adjustment for net undercoverage in the 1990 Census, and are the same controls used for the Current Population Survey (CPS). Thus, the national population estimates for any combination of the age-sex-race and/or ethnicity groups from the two surveys are the same, which greatly enhances comparability of the two surveys.

Each month, the U.S. Bureau of the Census produces national estimates for the 88 age-sex-race and/or ethnicity classes. While the survey is conducted weekly, the poststratification adjustment is only computed for quarterly estimates. The quarters and the dates of the population estimates used as the controls are:

NHIS Quarter	*Population Estimates*
January-March	February 1
April-June	May 1
July-September	August 1
October-December	November 1

For each quarter, 88 age-sex-race and/or ethnicity adjustment weights are computed, for a total of 352 adjustment weights annually. If *a* represents one of the 88 age-sex-race and/or ethnic classes, *Y(a)* represents the U.S. Bureau of the Census population estimate for class *a*, and $\hat{Y}''(a)$ represents the NHIS first-stage ratio-adjusted national total for class *a*, that is:

$$\hat{Y}''(a) = \sum_u W_I(u) \bullet W_{nr}(u) \bullet W_{r1}(u) \bullet I_a(u),$$

where

$$I_a(u) = 1 \text{ if person } u \text{ is in class } a$$
$$= 0 \text{ otherwise}$$

then the *second-stage ratio adjustment* for class *a*, W_{r2}, is defined as:

$$W_{r2}(a) = Y(a) / \hat{Y}''(a)$$

In implementing the above second-stage ratio adjustment, NCHS generally requires each class *a* to contain at least 30 sample persons. If a class contains too few sample persons, that class will be pooled with an adjacent age class. The two-stage ratio adjusted national estimator, $\hat{X}$, of a population total, *X*, is defined by formula (1) with the weight W_f defined by the product of the four component weights: $W_I \cdot W_{nr} \cdot W_{r1} \cdot W_{r2}$, i.e.,

$$\hat{X} = \sum_u W_I(u) \cdot W_{nr}(u) \cdot W_{r1}(u) \cdot W_{r2}(u) \cdot x(u) \quad (5)$$

In the 1973–84 and 1985–94 NHIS designs, both the first-stage and poststratification ratio adjustments were structured similarly to the structures presented in tables 6 and 7, but the racial classes were black and nonblack. The introduction of oversampling Hispanic households and the use of Hispanic class ratio adjustments in 1995 have improved the precision of Hispanic domain statistics.

Creation of Other Weights

The preceding discussion has outlined the procedure for creating household-level and person-level weights for the survey. Other weights also were created for 1995 and 1996 NHIS supplements, and beginning in 1997, for sample adult, sample child, and family-level files. The basic strategy for creating these other weights is similar to the preceding discussion. Some form of the household-level weight or the person-level weight always is the starting point for creating the other weights. As appropriate, additional levels of sampling are accounted for. In some instances, an additional nonresponse adjustment is done (e.g., someone may have responded to the main survey, but refused to respond to a supplement). Usually, some form of poststratification is done; for example, the sample adult weight uses a smaller set of poststrata than the 88 poststrata listed in table 7.

Variance Estimation

Most of the estimates produced by NCHS from the survey are totals and ratios of totals, such as means, percents, and rates. All such totals are produced using the final national weight as described in the preceding sections. These estimators are subject to both sampling and nonsampling errors. The nonsampling errors such as response errors, defective sample frames, nonresponse, and undercoverage are difficult quantities to measure, but every effort is made to minimize such errors at each step of the NHIS operation. The sampling error, however, can be measured by the variance of the estimator.

While equation (1) provides a functional form that permits simple computation of point estimates, the variances of such estimators are more difficult to compute. The functional form of a variance estimator depends on the nature of the survey design and methods used to adjust the weights. Some complexities in the survey design that require some special techniques are:

1. The higher levels of sampling (e.g., selection of SSU's within a PSU) are the result of a very complicated process involving the partitioning of block groups, estimating measures of size, and applying systematic sampling techniques. Even given the census information about the PSU, it would be extremely difficult to define a ''user friendly'' sampling mechanism that captured all the true stochastic structure of the system and could be implemented with a standard variance estimation procedure.
2. Although there are 21 density substrata definitions, most PSU's have only a few such substrata within the PSU that are nonempty. Many density strata within a primary sampling unit have just one sampled SSU.
3. Some nonself-representing strata have only one sampled PSU.
4. Some self-representing strata are small. They are part of large multi-State metropolitan areas, but sampled as distinct areas.
5. To protect the confidentiality of survey respondents, NCHS cannot release design information that could be used to identify smaller geographical areas in which the survey was conducted. Small sample areas with rare socioeconomic-demographic characteristics must not be explicitly or implicitly identifiable by design information.
6. With weighting adjustments applied to the base sampling weight, estimators of total become nonlinear in nature. This complicates the variance estimation procedure.
7. In practice, data analysts who study NHIS data use large-sample theory when making inferences about populations. Variance estimation procedures suitable for large subpopulations may be unstable for smaller subpopulations. NCHS targets stable, all-purpose variance estimation structures that should be easy to implement with existing computer software.

Simplified Design Structures for Variance Estimation

Wolter (14) and Rust (15) wrote excellent reviews of design-based variance estimation for complex surveys. Of the available methods, the two most commonly used are the Taylor series linearization method and the Balanced Repeated Replication (BRR) method. Software for analysis of complex surveys include PC CARP, STATA, SUDAAN, VPLX, and WESVAR. A comparison of these software packages is beyond the scope of this report, but an Internet world wide web page, *Summary of Survey Analysis Software*, currently located at http://www.fas.harvard.edu/~stats/survey-soft/survey-soft.html, provides references and discussion.

Currently, NHIS public use files contain design information suitable for the Taylor series linearization method (also suitable for some replication software).

Variance Estimators for National Estimators

First, a variance estimation structure is developed for self-representing PSU's. Then, a structure is developed that accounts for the PSU sampling for nonself-representing PSU's. The two structures are then combined to give a variance estimator for national estimators. These structures are described in more detail below.

SR PSU's: Conceptual NHIS Within PSU Sampling and Estimation Structures

1. The super-SSU will be considered as a well-defined population cluster where within-super-SSU sampling inflation weights, steps 3 to 6 of table 5, produce an unbiased estimator of super-SSU total.
2. The super-SSU sampling, step 2 of table 5, can be treated as a traditional "with replacement sampling" from an infinite population of super-SSU's within a substratum. All population super-SSU's within a substratum have the same selection probability. Sampling is independent over substrata.

Under assumptions 1 and 2 above, one can develop a variance estimator for the estimated total at the substratum level. The following indices shall be used to denote the levels of nesting within the survey design:

s	stratum
i	PSU
j	substratum
k	sampled annual-SSU
u	sampled elementary unit within annual-SSU *k*.

For substratum *j* nested within PSU *i*, nested within stratum *s*, let

N_{sij} = the number of population super-SSUs in substratum *j*

n_{sij} = { the number of super-SSUs sampled in substratum *j*; the probability in step 2 of table 5 times N_{sij} }

W_{jlsi} = N_{sij} / n_{sij} = super-SSU selection weight within substratum *j*

$W_{uk|sij}$ = within super-SSU conditional selection weight for unit *u* in annual-SSU *k* computed using the inverses of probabilities of selection as specified in steps 3–6 of table 5.

An unbiased estimator of the total of a characteristic *X* for substratum *j* may be expressed as:

$$\hat{X}_{sij} = \sum_{k=1}^{n_{sij}} \left(\sum_{u \varepsilon SSUk} W_{j\,|\,si} \bullet W_{uk\,|\,sij} \bullet x_u \right)$$

$$= \sum_{k=1}^{n_{sij}} \hat{X}_{sijk}$$

and an unbiased estimator of its variance is:

$$Var(\hat{X}_{sij}) = n_{sij}\, \hat{S}^2_{sij}$$

where

$$\hat{S}^2_{sij} = \sum_{k=1}^{n_{sij}} (\hat{X}_{sijk} - \bar{X}_{sij.})^2 / (n_{sij}-1)$$

$$\bar{X}_{sij.} = \sum_{k=1}^{n_{sij}} \hat{X}_{sijk} / n_{sij}$$

These functional forms can be extended over all the substrata within the primary sampling unit to obtain an unbiased estimator of the PSU total and its corresponding variance estimator:

$$\hat{X}_{si} = \sum_{j=1}^{21} \sum_{k=1}^{n_{sij}} \hat{X}_{sijk} \quad \text{and}$$

$$Var(\hat{X}_{si}) = \sum_{j=1}^{21} n_{sij}\, \hat{S}^2_{sij} \qquad (6)$$

Treating the sampling as "with replacement" when it actually is "without replacement" results in a positive, but not dominating, variance estimator bias. Furthermore, because many substrata may be empty or have few sampled SSU's, the substrata may be collapsed within PSU by substrata characteristics to form fewer substrata. Using these new substrata will typically result in a more stable variance estimator, but greater positive variance estimation bias.

Typically, the variance estimator with a reduced set of substrata will be

$$\sum_{j \varepsilon C_{si}} n_{Csi(j)}\, \hat{S}^2_{Csi\,(j)} \qquad (7)$$

where C_{si} is some collapsing of the original 21 substrata of PSU *i* in stratum *s*, with the *n* and S^2 terms defined as in equation (6), but on the new collapsed substrata. For example, one possible collapsing would be $C_{si} = \{C_{si(1)}, C_{si(2)}\}$, where

$C_{si\,(1)} = \{1,2,3,4,5,6,7,8,9,10,11,12,13,16,17,18,21\}$
$C_{si(2)} = \{14,15,19,20\}$

NSR PSU's: Variance Estimator that Accounts for PSU Sampling

The variance estimators presented above in equations (6) and (7) appear reasonable for totals restricted to self-representing strata. In the nonself-representing strata, the variance estimator should also reflect the first-stage selection of PSU's. First, consider a hypothetical NHIS having 100 percent response and using only the weights determined from steps 1–6 in table 5. The basic inflation estimator of equation (2) is:

$$\hat{X}_0 = \sum_u W_{I(u)} \bullet x(u)$$

which can also be expressed as

$$\hat{X}_0 = \sum_{s:stratum} \sum_{i:PSU} \frac{\hat{X}_{si..}}{\pi_{si}} = \sum_{s:stratum} \sum_{i:PSU} \hat{X}_{wsi..}$$

Here, $\hat{X}_{wsi..}$ is the estimator of PSU total in equation (6), inflated by $1/\pi_{si}$. The variance estimator of $\hat{X}_{wsi..}$ corresponding to equation (6) will be denoted as

$$\sum_{j=1}^{21} n_{sij}\, \hat{S}^2_{wsij}$$

where

$$\hat{S}^2_{wsij} = \sum_{k=1}^{n_{sij}} (\hat{X}_{wsijk} - \bar{X}_{wsij.})^2 / (n_{sij}-1)$$

using the SSU totals based on the entire inflation weight, W_I.

Variance Estimators for National Estimators: Combining Across NSR and SR PSU's

An estimator for the variance of $\hat{X}_0$ is

$$\hat{Var}(\hat{X}_0) = \sum_{s \in NSR2} \left[\frac{(\pi_{s1}\pi_{s2} - \pi_{s12})}{\pi_{s12}} (\hat{X}_{ws1..} - \hat{X}_{ws2..})^2 + \sum_{i=1}^{2} \pi_{si} \sum_{j \in C_{si}} n_{Csi(j)} \hat{S}^2_{wCsi(j)} \right] + \sum_{C_{str} \in NSR1} \sum_{i \in C_{str}} m(C_{str(i)}) \hat{S}^2_{wC_{str(i)}} + \sum_{s \in SR} \sum_{j \in C_{si}} n_{Csi(j)} \hat{S}^2_{wCsi(i)} \quad (8)$$

Here, the set *NSR*2 is a set of NSR strata with two sampled PSU's. The variance estimators for these strata are the so-called *Yates-Grundy-Sen* 2-stage forms with the $C_{si(j)}$ representing the collapsed PSU substrata as discussed in equation (7). The set *NSR*1 is a union of collapsed original NSR strata (denoted by C_{str}) defined in a manner analogous to the example that was given in the discussion that follows equation (7). Here, $m(C_{str(i)})$ is the number of PSU's in a given set, and the PSU's are treated as being sampled with replacement from this collapsed stratum. Only the first-stage unit will be used for variance computation. The S^2 form is the variation of PSU totals, $\hat{X}_{wsi..}$, within a $C_{str(i)}$ collapsed set.

The set SR is a set of SR strata, with possibly collapsed original strata and/or substrata, defined in a manner analogous to the example given in the discussion following equation (7).

As mentioned earlier, about 94 percent of NHIS households respond. Therefore, it is assumed that the nonresponse-adjusted weight can be treated as an inflation weight within the SSU sampling level with little bias. Furthermore, for national NHIS estimators, previous research by Parsons and Casady (13) has shown that the first-stage adjustment seems to have little impact on the magnitude of the estimated variances. With this in mind, equation (8) is extended to cover the nonresponse and first-stage ratio weighting adjustments. For the nonresponse-adjusted estimator $\hat{X}'$ of equation (3) or the first-stage ratio-adjusted national estimator, $\hat{X}''$, of equation (4) an approximate variance estimator is given by equation (8), but with the W_I weight replaced by the W_{nr} and W_{r1} weights, respectively.

Estimating Variances for Poststratified Totals and Nonlinear Statistics

The final national weight estimator *X* of equations (1) and (5) incorporates a poststratification adjustment. This is the form of the estimator that is presented in official NCHS publications and is the form that most analysts study. This estimator is nonlinear because of the poststratification adjustment. A commonly used method for estimating the variance of a nonlinear statistic is to "linearize" the statistic using Taylor series methods and then to use equation (8) applied to the linearized form. Estimators of totals using poststratification weights can be linearized. Basically, equation (8) is used to estimate the variance of the linearized total, but a prepost-stratification inflation weight is used in the computation of equation (8).

Several of the variance estimation methods just discussed will be examined using NHIS data in tables 8–10. A set of NHIS variables used in these tables are:

- Binary variables:
  ACT = 1 if person has an activity limitation
  LDR = 1 if person has not seen a doctor in 2 or more years
  HLT_FP = 1 if person reports fair or poor health
  BIN10 is a randomly generated variable with a Bernoulli distribution and a probability of success 0.10 for each person
- Event count variables over past year:
  HDI = number of hospital discharge incidents
  HED = number of hospital episode days
- Event count variables over past two weeks:
  AIC = number of acute incidence conditions
  BED = number of bed days
  EPI = number of injury episodes
  RAD = number of restricted activity days
  TDV = number of doctor visits

The tables that use these "two-week recall" variables present all tabulations in an annualized time frame. Further discussion of these variables will be presented as needed and will focus on specific tables.

In practice, implementation of computer software packages based on linearization often requires the final weight, W_f , which may include a poststratification adjustment, to be treated as an inflation weight. For example, in the SUDAAN version 7.5 software, regression statistics can be linearized, but not with a simultaneous linearization of the poststratification weights. Thus, SUDAAN regression computations for variance assume the final poststratification weight is an inflation weight. For estimated totals, this practice tends to lead to somewhat inflated variance estimators. For ratios of totals (e.g., means or percents) the impact varies. Table 8 presents some comparisons of variance estimates from the 1995 survey obtained by treating final weights as inflation weights versus a linearization of the final weight. Table 9 supplies auxiliary information to the domains shown in table 8. The presentation in table 8 is not intended to be a comprehensive study of this issue. However, one can see that the impact of the linearization of the poststratification weights on the estimated standard errors of totals can be substantial, while the corresponding impact on the standard errors of means is somewhat marginal, in general. For many health variables, empirical evidence suggests that the inflation in the estimated standard errors of means may be of little practical importance. The treatment of the final weight, W_f, as an inflation weight, may be reasonable if software limitations warrant such a simplification. It should be noted that the population domains that are aggregates of several component poststratification classes should be expected to have a greater variance reduction than those population domains covered by few poststratification classes. In general, economic-type variables may exhibit a greater impact than health-type variables. For regression-type analysis, the inclusion of age-sex-race and/or ethnic predictors tends to reduce the impact of treating the final weight as an inflation weight.

Public Use Data and Limitations on Design Structures

NCHS forbids the disclosure of information that may compromise the confidentiality promised to survey respondents. These concerns about confidentiality require the omission or concealing of some design information from public-use databases. The following types of information have been subject to omission or concealment on public-use databases. Policies on design information release often change, and NHIS data users should check database documentation for the available design information.

1. Most of the distinct probabilities of selection of table 5 are not released, although some products of sequential weights are released. In particular, the π_{si} and π_{sij} probabilities have not been released.

2. Original strata, density substrata, and PSU's may have been collapsed with others to avoid implicit or explicit geographical disclosure or collapsed to create convenient forms for variance estimation. For example, the PSU counts in table 2 will not agree with tabulations from public-use databases.

Obviously, without knowledge of the π_{si} and π_{sij}, equation (8) must be replaced with a reasonable substitution. Here, all *NSR*2-type strata may be treated as the *NSR*1-type strata (i.e., the strata having two sampled PSU's are treated as being sampled with replacement). No second-stage component would be included in the functional form for these *NSR*1-type strata because overestimating the variance on the average is expected. In the SR strata, the second-stage variation would still be used. Thus, with this limited information, an approximation for equation (8) will be

$$\hat{Var}(\hat{X}_0) = \sum_{s\varepsilon NSR2} (\hat{X}_{ws1..} - \hat{X}_{ws2..})^2 + \sum_{C_{str}\varepsilon NSR1} \sum_{i\varepsilon C_{str}} m(C_{str(i)})\, \hat{S}^2_{wC_{str(i)}} + \sum_{s\varepsilon SR} \sum_{j\varepsilon C_{si}} n_{Csi(j)}\, \hat{S}^2_{wCsi(j)} \qquad (9)$$

where,

*NSR*2 is a set of original NSR strata, each with two sampled primary sampling units,

*NSR*1 is the set of collapsed strata, C_{str}, defined in a manner analogous to the discussion that follows equation (7), and

SR is a set of SR strata, possibly collapsed original strata.

The above form can be expressed in a condensed form:

$$\hat{Var}(\hat{X}_0) = \sum_{c} m_c\, \hat{S}^2_{wc} \qquad (10)$$

where c represents a (collapsed) stratum, either NSR or SR, and $\hat{S}^2_{wc}$ is the sample variance of the m_c weighted PSU totals within a nonself-representing stratum or the m_c weighted SSU totals within a self-representing stratum. This functional form is easily implemented. Sample SUDAAN code for equations (9) or (10) and additional explanations of NHIS public-use variance estimation are documented (16) and are provided with released data. Table 10 provides some comparisons for these two design structures. SUDAAN software, using the design structures of equation (8) both with and without a linearization of the final poststratification weight and using equation (9) on public-use design structures, are implemented in this table. For both means and totals, there is a tendency for standard errors using equation (8) to be slightly smaller than those produced by equation (9). It also appears that the poststratification implementation has a greater impact than the choice of equation (8) or (9), especially for the standard errors of totals.

Beginning with the 1997 survey, some geographical disclosure concerns resulted in a further coarsening of the released public-use design information. The techniques of stratum collapse, stratum partitioning and SSU mixing were used to coarsen the self-representing design structures with little anticipated bias, but at the expense of loss of *degrees of freedom*. (These techniques are discussed briefly in Eltinge (17) and Parsons and Eltinge (18)). The result was a public-use design structure with an imposed 2-PSU's per stratum design with over 300 nominal degrees of freedom. The variance estimator takes the generic form of the first term of equation (9) and is implemented by many software packages.

Precision Comparisons Between Surveys

As discussed in another publication (6), the funding for the originally proposed alpha-design survey was reduced, and the beta version was implemented for the 1995–2004 NHIS. In planning the general cost and precision, objectives were:

1. The 1995–2004 design would have comparable funding to the previous 1985–94 design.

2. The precision of estimators for black domains would be comparable to the previous design.

3. The precision of estimators for Hispanic domains would be improved over the previous design and comparable to those for black domains.

4. The precision for white and total domains may be allowed to drop to compensate for meeting objectives 1, 2, and 3.

In table 11, some precision measures were estimated for the 1995 and 1994 NHIS samples for some select variables discussed earlier in this chapter. Table 12 presents some auxiliary information for the domains shown in table 11. For table 11, SUDAAN software, along with a design corresponding to equation (8), was used. The final weight was treated as an inflation weight. It should be kept in mind that the coefficients of variation (CV's) presented in table 11 are random variables subject to sampling variability, and one should consider trends and/or patterns as opposed to looking at single sample realizations. Furthermore, the variables TDV and AIC are subject to outlier response, which will increase estimated CV instability for any given year. BIN10, a randomly generated binary response for each sampled person having probability of success 0.10, has been included as a standard. This variable is independent of the design. One may attribute its CV to a ''pure'' clustering and sampling process having no interaction with the variable itself.

One caveat about this table is that 1995 was the start-up data collection year of the current NHIS design. Several sampling changes were made before the sampling parameters were actually finalized. Furthermore, 3 weeks of intended interviews were lost due to the government shutdown in December 1995. To make table 11 values look somewhat more representative of a ''full'' NHIS, the 1995 sample sizes were inflated by 51/48 and CV's were deflated by $(48/51)^{1/2}$. Some general observations are:

1. Objectives 2 and 3 appear to have been met. For black persons, some of the 1995 CV's are smaller than the 1994 CV's, some are larger; there is no distinct pattern. Sample sizes for black domains tend to be smaller in 1995 than in the previous design. The 1995 sample tends to have at least an 80 percent increase in Hispanic domain sample sizes.

2. The Hispanic domain CV's for 1995 show great improvement over 1994. A comparison of corresponding black and Hispanic domains by CV's does not show a consistent order relation pattern.

3. For Objective 4, there seems to be no great loss of precision. Again, there is no consistent order relation pattern when comparing 1994 to 1995.

Based on this limited study, there is no reason to believe that general objectives 1–4 were not achieved.

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Table 5. Components of conceptual sampling design: National Health Interview Survey, 1995–2004

Sample step	Sample unit	Within level unit	Conditional probability of selection
1.	PSU[1]	Stratum	π_{si}, for PSU i from stratum s π_{sij}, joint selection probability for PSU's i and j from stratum s
2.	Super-SSU[1]	PSU's substratum	Pr(super-SSU | substratum)
3.	Annual-SSU[1]	Super-SSU	1/10
4.	HU[2]	SSU	Pr(HU | SSU)
5.	Household[2]	HU	1 if black/Hispanic household, Pr (''other'') if nonblack/non-Hispanic household
6.	Person(s)	Household	Pr (person | household)

[1]See chapter 2 for details.

[2]HU is the residential dwelling selected, without regard to its occupants (if any). The household is the collection of occupants selected by characteristics within the HU (see chapter 2).

NOTE: PSU is primary sampling unit, SSU is secondary sampling unit, and Pr is probability.

Table 6: First-stage ratio adjustment factors: National Health Interview Survey, 1997

Residence, race, and ethnicity	Census region			
	Northeast	Midwest	South	West
Metropolitan area				
Hispanic	0.941306	1.120916	0.906019	0.851367
Non-Hispanic black	0.894335	1.033701	1.038407	0.879097
Non-Hispanic other	1.001781	0.995499	0.985160	1.043640
Nonmetropolitan area				
Hispanic	0.853849	1.194508	0.812500	0.956770
Non-Hispanic black	0.812500	0.814337	1.063537	1.121297
Non-Hispanic other	0.995420	0.997996	1.009349	1.010929

Table 7. The 88 age-sex-race/ethnicity classes used for poststratification: National Health Interview Survey, 1995–2004

Age	Hispanic		Non-Hispanic black		Non-Hispanic other	
	Male	Female	Male	Female	Male	Female
Under 1 year	X	X	X	X	X	X
1–4 years	X	X	X	X	X	X
5–9 years	X	X	X	X	X	X
10–14 years	X	X	X	X	X	X
15–17 years	X	X	X	X	X	X
18–19 years	X	X	X	X	X	X
20–24 years	X	X	X	X	X	X
25–29 years	X	X	X	X	X	X
30–34 years	X	X	X	X	X	X
35–44 years	X	X	X	X	X	X
45–49 years	X	X	X	X	X	X
50–54 years	X	X	X	X	X	X
55–64 years	X	X	X	X	X	X
65–74 years[1]	X	X	X	X	X	X
75 years and older	X	X	X	X	X	X

[1]Age categories 65–74 years and over were collapsed into one category, 65 years and over, for Hispanic persons.

Table 8. Impact of poststratification on variance estimation: National Health Interview Survey, 1995

[Treatment of the final poststratification weight as a base weight versus a linearization of the final poststratification weight]

Domain and variable	Estimated totals			Estimated means		
	Number in thousands[1]	CV_{post}[2]	Ratio CV_{base}/CV_{post}[3]	Mean[4]	CV_{post}[5]	Ratio CV_{base}/CV_{post}[6]
All persons						
ACT	38,521	1.09	1.26	0.15	1.09	1.08
AIC	456,872	1.65	1.15	1.74	1.65	1.00
BED	1,593,023	2.09	1.06	6.08	2.09	1.01
EPI	61,304	3.70	1.01	0.23	3.70	0.99
HDI	27,505	1.82	1.10	0.11	1.82	1.03
HED	134,271	2.80	1.01	0.51	2.80	1.01
LDR	36,133	1.23	1.26	0.14	1.23	1.00
RAD	4,097,080	1.55	1.11	15.64	1.55	1.02
TDV	1,547,136	1.27	1.17	5.91	1.27	1.02
All females						
ACT	20,237	1.22	1.25	0.15	1.22	1.12
AIC	246,914	2.14	1.10	1.84	2.14	1.01
BED	915,213	2.58	1.06	6.81	2.58	1.01
EPI	28,212	5.12	1.01	0.21	5.12	1.00
HDI	16,070	2.25	1.07	0.12	2.25	1.01
HED	71,556	3.15	1.03	0.53	3.15	1.02
LDR	13,154	1.86	1.14	0.10	1.86	1.01
RAD	2,349,449	1.86	1.09	17.49	1.86	1.01
TDV	921,550	1.63	1.13	6.86	1.63	1.01
Currently employed persons						
ACT	11,729	1.80	1.10	0.09	1.76	1.00
AIC	180,163	2.44	1.07	1.44	2.39	1.00
BED	397,326	3.47	1.03	3.18	3.45	1.00
EPI	27,538	5.48	1.01	0.22	5.46	1.00
HDI	8,951	3.12	1.04	0.07	3.10	1.00
HED	31,347	3.78	1.01	0.25	3.75	1.00
LDR	22,505	1.29	1.25	0.18	1.25	1.00
RAD	1,324,768	2.41	1.06	10.61	2.38	1.00
TDV	602,286	2.18	1.09	4.82	2.15	1.00
Family income over $35,000						
ACT	4,518	3.02	1.03	0.11	2.66	1.01
AIC	75,804	4.33	1.03	1.78	3.99	1.00
BED	173,114	5.79	1.01	4.06	5.58	1.00
EPI	9,528	9.92	1.01	0.22	9.85	1.00
HDI	3,311	5.43	1.03	0.08	5.20	1.01
HED	13,004	6.94	1.00	0.31	6.78	1.01
LDR	5,396	3.27	1.05	0.13	2.86	1.00
RAD	483,943	4.29	1.02	11.35	4.02	1.00
TDV	237,663	4.52	1.03	5.58	4.28	1.00
College graduate, ages 35–44 years						
ACT	956	5.73	1.02	0.08	5.59	1.00
AIC	18,612	7.06	1.02	1.60	6.81	1.00
BED	41,005	10.57	1.00	3.52	10.43	1.00
EPI	2,340	18.32	1.00	0.20	18.29	1.00
HDI	809	9.79	1.02	0.07	9.62	1.00
HED	2,372	11.80	1.01	0.20	11.72	1.01
LDR	1,698	4.52	1.03	0.15	4.14	1.00
RAD	123,529	7.64	1.01	10.61	7.36	1.00
TDV	61,898	5.56	1.03	5.32	5.33	1.00
Black, ages 65–74 years						
ACT	737	4.90	1.51	0.44	4.82	1.00
AIC	1,367	20.67	1.01	0.81	20.68	1.00
BED	24,154	14.48	1.05	14.34	14.50	0.99
EPI	215	47.88	1.03	0.13	47.89	1.03
HDI	476	11.96	1.18	0.28	11.99	1.04

Table 8. Impact of poststratification on variance estimation: National Health Interview Survey, 1995—Con.

[Treatment of the final poststratification weight as a base weight versus a linearization of the final poststratification weight]

Domain and variable	Estimated totals			Estimated means		
	Number in thousands[1]	CV_{post}[2]	Ratio CV_{base}/CV_{post}[3]	Mean[4]	CV_{post}[5]	Ratio CV_{base}/CV_{post}[6]
Black, ages 65–74 years—Continued						
HED	2,573	13.40	1.08	1.53	13.43	1.03
LDR	146	11.92	1.03	0.09	11.89	0.99
RAD	57,212	10.93	1.08	33.98	10.95	1.00
TDV	16,664	8.92	1.20	9.90	8.93	1.02

[1]Estimated total is based upon poststratification weight.

[2]Estimated CV of total using linearized final weight, shown as a percent.

[3]A given entry in this column is the ratio of the CV of total using the final weight as an inflation weight, divided by the corresponding entry in the ''Estimated totals CV_{post}'' column.

[4]Estimated mean based upon poststratification weight.

[5]Estimated CV of mean using linearized final weight, shown as a percent.

[6]A given entry in this column is the ratio of the CV of mean using the final weight as an inflation weight, divided by the corresponding entry in the ''Estimated means CV_{post}'' column.

NOTE: CV is coefficient of variation; ACT is persons with activity limitation; AIC is number of acute incidence conditions, based on 2-week recall of event; BED is number of bed days, based on 2-week recall of event; EPI is number of injury episodes, based on 2-week recall of event; HDI is number of hospital discharge incidents; HED is number of hospital episode days; LDR is persons who have not seen a doctor in 2 or more years; RAD is restricted activity days, based on 2-week recall of event; and TDV is total doctor visits, based on 2-week recall of event.

Table 9. Sample size and weighted size of persons by domain: National Health Interview Survey, 1995

Domain	Sample size	Weighted size[1]
All persons	102,467	261,890,000
All females	53,658	134,319,000
Currently employed	46,730	124,900,000
Family income over $35,000	15,707	42,622,000
College graduate, ages 35–44 years	4,162	11,644,000
Black, ages 65–74 years	772	1,684,000

[1]Numbers rounded to the nearest thousand.

Table 10. Comparison of variance estimates obtained by two methods: National Health Interview Survey, 1995

[Yates-Grundy-Sen variance estimator with poststratification versus public-use, collapsed strata, single-stage, with-replacement design]

Variable	All persons	Sex: Male	Sex: Female	Age: 0–17 years	Age: 18–44 years	Age: 45–64 years	Age: 65 years and over
LDR[1]							
Sample size	102,467	48,809	53,658	29,711	40,801	20,000	11,955
Weighted size	261,889,549	127,570,237	134,319,312	70,670,755	108,040,689	51,713,265	31,464,840
Mean	0.13784	0.17991	0.09789	0.08845	0.18484	0.14484	0.07587
Standard error (full-p)	0.00170	0.00221	0.00182	0.00258	0.00248	0.00298	0.00268
Standard error (full)	0.00170	0.00222	0.00184	0.00265	0.00249	0.00299	0.00269
Standard error (public-p)	0.00174	0.00228	0.00183	0.00265	0.00253	0.00301	0.00269
Standard error (public)	0.00174	0.00231	0.00184	0.00271	0.00254	0.00303	0.00269
Total	36,098,739	22,950,542	13,148,198	6,250,515	19,970,576	7,490,307	2,387,341
Standard error (full-p)	44,4710	282,405	244,714	182,641	268,084	154,026	84,414
Standard error (full)	560,398	357,742	280,044	210,839	329,031	182,239	88,117
Standard error (public-p)	455,090	291,298	245,310	187,526	273,660	155,834	84,523
Standard error (public)	578,577	369,213	283,769	212,932	340,961	187,949	89,183
TDV[2]							
Sample size	102,467	48,809	53,658	29,711	40,801	20,000	11,955
Weighted size	261,889,549	127,570,237	134,319,312	70,670,755	108,040,689	51,713,265	31,464,840
Mean	5.90468	4.89733	6.86141	4.29787	4.87876	7.08472	11.09687
Standard error (full-p)	0.07511	0.08320	0.11217	0.09066	0.11858	0.16180	0.27613
Standard error (full)	0.07693	0.08483	0.11368	0.09241	0.11917	0.16290	0.27573
Standard error (public-p)	0.07587	0.08303	0.11331	0.09007	0.11749	0.16023	0.28469
Standard error (public)	0.07704	0.08503	0.11403	0.09116	0.11805	0.16109	0.28387
Total	1,546,373,944	624,753,629	921,620,316	303,733,537	527,105,033	366,374,024	349,161,350
Standard error (full-p)	19,671,625	10,613,283	15,067,049	6,406,983	12,811,560	8,367,336	8,688,269
Standard error (full)	23,120,033	11,875,947	16,950,069	7,296,215	13,916,041	9,418,063	10,273,218
Standard error (public-p)	19,870,304	10,592,542	15,219,637	6,365,507	12,693,608	8,285,799	8,957,873
Standard error (public)	24,081,902	12,019,642	17,611,040	7,264,252	13,955,259	9,457,535	10,601,351
HLT_FP[3]							
Sample size	101,277	48,266	53,011	29,183	40,423	19,834	11,837
Weighted size	258,974,266	126,232,939	132,741,328	69,441,900	107,059,972	51,315,313	31,157,082
Mean	0.10127	0.09125	0.11080	0.02555	0.06624	0.16633	0.28322
Standard error (full-p)	0.00137	0.00159	0.00165	0.00116	0.00153	0.00342	0.00487
Standard error (full)	0.00148	0.00166	0.00179	0.00117	0.00153	0.00348	0.00496
Standard error (public-p)	0.00140	0.00164	0.00167	0.00116	0.00155	0.00343	0.00493
Standard error (public)	0.00152	0.00174	0.00182	0.00118	0.00157	0.00351	0.00501
Total	26,225,462	11,518,295	14,707,167	1,774,227	7,091,475	8,535,450	8,824,311
Standard error (full-p)	356,321	201,393	218,719	80,234	163,364	176,090	152,043
Standard error (full)	419,927	227,337	255,322	83,095	173,960	199,162	207,802
Standard error (public-p)	362,920	207,377	222,266	80,641	166,380	176,367	154,171
Standard error (public)	428,842	234,288	260,217	83,466	178,137	201,110	209,683

[1]LDR is last doctor visit over 2 years ago.

[2]TDV is number of doctor visits in past year.

[3]HLT_FP is health classified fair or poor.

NOTE: The following NHIS design structures and SUDAAN were used for variance estimation:
(full): use equation (8) of this report, with final weight treated as inflation weight
(full-p): use equation (8) of this report, along with linearization for poststratification

(public): use equation (9) of this report, with final weight treated as inflation weight
(public-p): use equation (9) of this report, along with linearization for poststratification.

Table 11. Precision comparisons between two survey designs: National Health Interview Survey, 1985–94 and 1995–2004

Domain and variable[1]	Mean 1994	Mean 1995[2]	Percent of CV 1995[3]	Percent of CV change	Deft 1994[4]	Deft 1995
All persons						
LDR	0.14	0.14	1.23	3	1.58	1.58
ACT	0.15	0.15	1.18	9	1.51	1.57
HLT_FP	0.10	0.10	1.46	0	1.62	1.56
TDV	6.09	5.91	1.30	3	1.25	1.27
AIC	1.71	1.74	1.66	−3	1.38	1.32
BIN10	0.10	0.10	0.98	0	1.09	1.05
Age 65 years and over:						
LDR	0.08	0.08	3.53	10	1.09	1.11
ACT	0.38	0.37	1.44	2	1.30	1.21
HLT_FP	0.28	0.28	1.75	−8	1.38	1.20
TDV	11.30	11.10	2.48	−9	1.16	1.09
AIC	1.10	1.03	5.36	2	1.19	1.09
BIN10	0.10	0.10	2.81	1	1.10	1.03
Black						
LDR	0.13	0.13	3.21	−3	1.57	1.44
ACT	0.16	0.16	2.75	−14	1.76	1.41
HLT_FP	0.15	0.14	2.97	−15	1.79	1.40
TDV	5.41	5.18	3.34	1	1.13	1.14
AIC	1.54	1.39	4.74	−2	1.39	1.26
BIN10	0.10	0.11	2.64	0	1.09	1.07
Age 18–44 years:						
LDR0	0.17	0.17	3.70	−6	1.36	1.25
ACT	0.12	0.12	4.59	0	1.28	1.25
HLT_FP	0.11	0.12	4.41	−7	1.30	1.17
TDV	4.96	4.52	5.23	−13	1.15	1.04
AIC	1.54	1.33	7.32	19	1.08	1.18
BIN10	0.10	0.11	4.43	6	1.06	1.13
Age 65 years and over:						
LDR	0.07	0.08	10.37	14	0.99	1.04
ACT	0.48	0.46	3.78	11	1.26	1.18
HLT_FP	0.43	0.42	4.42	2	1.46	1.27
TDV	11.97	10.42	7.08	−9	1.10	0.99
AIC	0.94	0.80	16.17	−29	1.54	0.95
BIN10	0.09	0.10	8.41	−24	1.37	0.98
Hispanic						
LDR	0.18	0.19	2.16	−31	1.56	1.53
ACT	0.11	0.11	3.08	−20	1.43	1.57
HLT_FP	0.11	0.11	3.09	−21	1.41	1.57
TDV	4.83	4.43	3.49	−3	1.07	1.35
AIC	1.68	1.62	4.11	−15	1.23	1.41
BIN10	0.11	0.10	2.25	−22	1.04	1.08
Age 18–44 years:						
LDR	0.25	0.26	2.28	−30	1.29	1.28
ACT	0.09	0.07	4.59	−19	1.19	1.21
HLT_FP	0.09	0.09	4.57	−13	1.17	1.36
TDV	4.29	3.38	5.46	−7	1.01	1.17
AIC	1.31	1.25	5.83	−19	1.09	1.17
BIN10	0.11	0.10	3.52	−16	1.02	1.09
Age 65 years and over:						
LDR	0.09	0.10	10.05	−26	1.05	1.07
ACT	0.42	0.40	4.55	−14	1.08	1.22
HLT_FP	0.35	0.35	4.97	−31	1.27	1.19
TDV	9.78	11.05	8.58	−9	1.12	1.04
AIC	1.40	0.99	18.27	−9	1.10	1.09
BIN10	0.08	0.10	10.34	−25	1.01	1.16

Table 11. Precision comparisons between two survey designs: National Health Interview Survey, 1985–94 and 1995–2004—Con.

Domain and variable[1]	Mean 1994	Mean 1995[2]	Percent of CV 1995[3]	Percent of CV change	Deft 1994[4]	Deft 1995
All females						
Age 18–44 years:						
LDR	0.10	0.11	2.41	6	1.15	1.22
ACT	0.10	0.10	2.38	5	1.16	1.16
HLT_FP	0.08	0.08	2.65	−3	1.18	1.11
TDV	6.39	6.38	3.17	45	1.10	1.37
AIC	1.83	1.79	3.17	10	1.10	1.19
BIN10	0.10	0.10	2.15	2	1.07	1.06
Age 65 years and over:						
LDR	0.07	0.07	4.51	3	1.07	1.03
ACT	0.39	0.38	1.64	−2	1.21	1.06
HLT_FP	0.28	0.28	2.12	1	1.16	1.10
TDV	11.77	11.61	3.25	−13	1.24	1.09
AIC	1.29	1.12	6.80	10	1.14	1.08
BIN10	0.10	0.10	3.64	1	1.07	1.02
White female						
Age 18–44 years:						
LDR	0.10	0.10	2.81	11	1.13	1.25
ACT	0.10	0.10	2.64	6	1.13	1.16
HLT_FP	0.07	0.07	3.14	−3	1.15	1.11
TDV	6.67	6.67	3.64	51	1.11	1.41
AIC	1.87	1.86	3.42	9	1.08	1.18
BIN10	0.10	0.10	2.38	4	1.05	1.06
Age 65 years and over:						
LDR	0.07	0.07	4.81	2	1.07	1.02
ACT	0.38	0.37	1.77	−3	1.19	1.05
HLT_FP	0.26	0.26	2.30	0	1.13	1.07
TDV	11.62	11.67	3.50	−14	1.24	1.09
AIC	1.31	1.11	7.35	15	1.10	1.08
BIN10	0.10	0.10	3.88	4	1.03	1.03
Black female						
LDR	0.09	0.09	5.03	10	1.33	1.37
ACT	0.16	0.16	3.21	−10	1.48	1.22
HLT_FP	0.16	0.16	3.20	−15	1.54	1.20
TDV	6.21	5.86	3.97	6	1.07	1.11
AIC	1.64	1.53	5.56	−4	1.28	1.14
BIN10	0.10	0.10	3.48	−2	1.10	1.01
Age 18–44 years:						
LDR	0.09	0.11	6.20	3	1.12	1.19
ACT	0.11	0.11	5.46	−1	1.13	1.07
HLT_FP	0.13	0.13	5.06	−2	1.18	1.08
TDV	5.50	5.33	5.60	1	1.06	1.02
AIC	1.78	1.58	8.06	1	1.13	1.06
BIN10	0.09	0.11	5.54	−2	1.07	1.07
Age 65 years and over:						
LDR	0.06	0.06	15.55	31	0.97	1.07
ACT	0.48	0.48	4.15	10	1.13	1.04
HLT_FP	0.42	0.43	5.21	2	1.34	1.20
TDV	14.26	11.26	8.76	−13	1.15	0.99
AIC	1.09	1.02	18.45	−41	1.76	0.96
BIN10	0.09	0.08	11.61	−7	1.26	0.92
Hispanic female						
Age 18–44 years:						
LDR	0.15	0.16	3.74	−30	1.10	1.09
ACT	0.09	0.08	5.75	−20	1.13	1.15
HLT_FP	0.11	0.11	4.98	−20	1.11	1.19
TDV	5.68	4.25	5.64	−13	1.06	1.16
AIC	1.47	1.36	7.58	−21	1.10	1.14
BIN10	0.11	0.10	4.60	−20	1.00	1.06

Table 11. Precision comparisons between two survey designs: National Health Interview Survey, 1985–94 and 1995–2004—Con.

Domain and variable[1]	Mean 1994	Mean 1995[2]	Percent of CV 1995[3]	Percent of CV change	Deft 1994[4]	Deft 1995
Age 65 years and over:						
LDR	0.08	0.09	13.33	−31	1.07	1.04
ACT	0.43	0.40	5.46	−12	1.00	1.12
HLT_FP	0.35	0.35	6.09	−27	1.13	1.11
TDV	9.87	11.55	10.69	−18	1.18	1.00
AIC	1.48	1.17	22.02	−4	1.01	1.08
BIN10	0.09	0.10	12.83	−24	0.99	1.08

[1]LDR is proportion of persons with no doctor visit in 2 years or more, ACT is proportion of persons with an activity limitation status, HLT_FP is proportion of persons with fair or poor health, TDV is mean number of doctor visits per person, AIC is mean number of acute incidence conditions per person, and BIN10 is proportion of persons with a 10 percent characteristic, independent of design.

[2]Values are adjusted to account for 1995 reduced sample.

[3] (CV(1995) - CV(1994))/CV(1994) * 100.

[4]Deft is sqrt (Variance (Mean | NHIS) / Variance (Mean | SRS)), SRS based on observed domain sample size.

Table 12. Sample size and percent change by domain: National Health Interview Survey

Domain	Adjusted sample size in thousands for 1995	Percent change from 1994 to 1995
All persons	108.9	−6
Age 65 years and over	12.7	−13
Black	14.7	−11
Age 18–44 years	5.7	−10
Age 65 years and over	1.2	−23
Hispanic	22.1	+89
Age 18–44 years	9.4	+86
Age 65 years and over	1.1	+86
Female	([1])	([1])
Age 18–44 years	22.8	−5
Age 65 years and over	7.4	−1
White	([1])	([1])
Age 18–44 years	18.5	−4
Age 65 years and over	6.5	−12
Black	8.1	−13
Age 18–44 years	3.3	−1
Age 65 years and over	0.7	−29
Hispanic	([1])	([1])
Age 18–44 years	4.9	+85
Age 65 years and over	0.7	+84

[1]Data not available.

Appendix

Glossary

Acronyms

CAPI	computer-assisted personal interviewing
CD-ROM	Compact Disk-Read Only Memory
CPS	Current Population Survey
CMSA	consolidated metropolitan statistical areas
CV	coefficient of variation
DHIS	Division of Health Interview Statistics
DSMD	Demographic Statistical Methods Division
HU	Housing unit
MA	metropolitan area
MEPS	Medical Expenditure Panel Survey
MSA	metropolitan statistical area
MSE	mean square error
NCHS	National Center for Health Statistics
NECMA	New England County Metropolitan Area
NHIS	National Health Interview Survey
NSFG	National Survey of Family Growth
NSR	nonself-representing
OMB	Office of Management and Budget
ORM	Office of Research and Methodology
PMSA	primary metropolitan statistical area
PSU	primary sampling unit
SI	sampling interval
SR	self-representing
SSU	secondary sampling unit
WWW	world wide web

Definition of Terms

Address frame—is a portion of the 1973–84 NHIS sample frame consisting of addresses compiled during the 1970 decennial census.

Alpha sample—is the sample originally selected for the 1995–2004 NHIS. This sample is described in more detail in another publication (6).

Area frame—is a portion of the 1985–94 and 1995–2004 NHIS sample frames consisting of geographic areas where address listing operations are conducted to obtain a list of addresses from which NHIS sample cases are selected.

Beta sample—is the sample actually used for the 1995–2004 NHIS. It is a subsample of the alpha sample.

Condition list—is a portion of the NHIS data collection instrument used in 1995–96 consisting of a list of medical conditions (e.g., arthritis, deafness, gallstones, diabetes, heart disease, asthma). There were six different condition lists; one of the six lists was chosen randomly for each interviewed household.

Group quarters frame—is a portion of the 1973–84 NHIS sample frame consisting of a list of group quarters compiled during the 1970 decennial census. ‘‘Group quarters’’ are defined by the U.S. Bureau of the Census as a type of residential quarters where the residents share common facilities or receive authorized care or custody.

Household—is an occupied residential housing unit.

Nonself-representing primary sampling unit—is a primary sampling unit selected from a sampling stratum containing other primary sampling units (i.e., a primary sampling unit selected with probability less than 1).

Oversample—is a sampling procedure designed to give a demographic or geographic population a larger proportion of representation in the sample than the population's proportion of representation in the overall population.

Permit frame—is a portion of the 1985–94 and 1995–2004 NHIS sample frames consisting of residential building permits.

Screen—is an interviewing procedure whereby households who do not meet specified criteria (e.g., households that do not contain any civilian black or Hispanic members) are not administered a full-length interview. In NHIS, the screening procedure consists of the initial portion of the NHIS interview, up to and including the point where the household composition is determined.

Self-representing primary sampling unit—is a primary sampling unit that is the only member of its sampling stratum (i.e., a primary sampling unit selected with certainty).

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For answers to questions about this report or for a list of reports published in these series, contact:

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