

# **Quality Control and Measurement of Nonsampling Error in the Health Interview Survey**

A report describing the selection and training of interviewers, interviewer observation program, a reinterview program, measures of interviewer performance, the editing and coding of questionnaires, a response error study, and an interviewer variability study. The report is based on the Bureau of the Census experience with the Health Interview Survey.

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### COOPERATION OF THE BUREAU OF THE CENSUS

Under the legislation establishing the National Health Survey, the Public Health Service is authorized to use, insofar as possible, the services or facilities of other Federal, State, or private agencies.

In accordance with specifications established by the National Center for Health Statistics, the Bureau of the Census, under a contractual arrangement, participated in planning the survey and collecting the data.

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## FOREWORD

This report is one in a series designed to document the methodology of the Health Interview Survey (HIS) and to investigate the quality of HIS statistics. In previously published reports, the emphasis was on questionnaire development (Series 1, Number 2) and on sample design (Series A, Number 2). Other reports (e.g., Series 2, Numbers 6, 7, 18, 28, and others) present findings of methodological studies that investigated the accuracy of health data collected in household surveys.

Specifically, this report deals with the quality-control procedures for the data-collection operations of the Survey. It describes procedures for selecting, training, supervising, and observing interviews and measuring interviewer performance, and for editing and coding questionnaires. It also describes the reinterview program. In this program, a staff of field supervisors and senior interviewers reinterview subsamples of households in the Survey. This report presents estimates of nonsampling error based on the reinterview program and estimates of the interviewer contribution to nonsampling variance based on results of a special study designed for this purpose. These statistics have a dual utility. They are useful in evaluating the quality of HIS data and in improving the design of the Survey.

Through contractual arrangements with the National Center for Health Statistics, the Bureau of the Census prepares the sample and conducts the field collection process of the Health Interview Survey, and, until 1968, also carried out the data-coding and initial editing procedures. The particular quality-control procedures described in this report are essentially applications of methods that are used by the Census Bureau to monitor the field operations of national household surveys. However, the findings presented in this report relate only to the Health Interview Survey.

The work for this report was done under a special contract with the Statistical Research Division, Bureau of the Census, in close collaboration with the Office of Statistical Methods and the Division of Health Interview Statistics.

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### SYMBOLS

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Quantity more than 0 but less than 0.05----	0.0
Figure does not meet standards of reliability or precision-----	*

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# QUALITY CONTROL AND MEASUREMENT OF NONSAMPLING ERROR IN THE HEALTH INTERVIEW SURVEY

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## INTRODUCTION

This report presents a summary of procedures used in the Health Interview Survey (HIS) to control the quality of the data collection and data processing operations. It also provides some results of measurements related to the quality of HIS statistics.

### PURPOSE OF THE HEALTH INTERVIEW SURVEY

The Health Interview Survey is an integral part of the program of the National Center for Health Statistics (NCHS). This program is designed to provide continuing statistical measurements of the extent of disease, disability, and other health characteristics of the population.

The legislation authorizing the HIS, The National Health Survey Act,<sup>1</sup> contains the following provisions:

(b) It is, therefore, the purpose of this Act to provide (1) for a continuing survey and special studies to secure on a non-compulsory basis accurate and current statistical information on the amount, distribution, and effects of illness and disability in the United States and the services received for or because of such conditions: and (2) for studying methods and survey techniques for securing such statistical information, with a view toward their continuing improvement.

This provision for methodological research has strongly influenced the NCHS program. Since the HIS began, emphasis has been placed on improving statistical output rather than on continuity and comparability of estimates. Changes to improve the methods and procedures used in the survey have been made since it began in 1957.

### BRIEF DESCRIPTION OF THE SURVEY

A description of the HIS is necessary to understand the quality control procedures used during the collection and processing of data.

The Health Interview Survey uses a questionnaire to obtain information on injuries, acute illnesses, chronic conditions, impairments, utilization of medical services, and other health topics, in addition to information about personal and demographic characteristics. The findings from the survey are tabulated for the Nation as a whole and published by NCHS. Separate reports are issued which cover one or more of the specific topics.

The population covered by the sample for the Health Interview Survey is the civilian, noninstitutional population of the United States living at the time of the interview. Persons in long-stay hospitals, nursing and convalescent homes, and so forth are excluded from the universe to be sampled.

The sampling plan of the survey follows a multistage probability design which permits a continuous sampling of the civilian population of the United States. The first stage of this design consists of drawing a sample of 357 from about 1,900 U.S. geographic divisions called primary sampling units (PSU). A PSU is a county, a group of contiguous counties, or a standard metropolitan statistical area (SMSA).

Within PSU's, ultimate stage units called segments, selected from clusters of 18 neighboring households or addresses, are defined so that each one contains an average of six households. (In July 1968, the average segment size



changed from nine to six households.) Two general types of segments are used: (1) area segments, which are defined geographically, and (2) other segments, which are defined from a list of addresses from the 1960 Decennial Census and a current Survey of Construction.

Prior to interviewing in area segments, interviewers make a list of the addresses of all households or dwelling units in the selected segments.

Wherever possible, the visit of the interviewer is preceded by a letter from the Director of the U.S. Bureau of the Census announcing that an interviewer may be expected to visit and setting forth the general purposes of the survey. The confidential treatment that will be accorded any information given is emphasized.

As a general rule any adult member, 19 years of age and over, of a family may be interviewed concerning the characteristics of all the members of the family. Persons in the household who are not related to the head of the household are expected to answer all questions about themselves. Exceptions are made for persons who are not competent to answer for themselves. Persons aged 17-18 may respond for themselves, while persons under 17 must be responded for by an adult.

The sample is evenly distributed throughout the year, so that interviews are conducted in approximately 800 households each week. Since household members interviewed each week are a random sample of the population, samples for successive weeks can be combined into larger samples. Thus the design permits both continuous measurement of characteristics of high incidence or prevalence in the population and, through the larger consolidated samples, more detailed analysis of less common characteristics and smaller categories. This continuous collection of information has administrative, operational, and technical advantages since it permits field work to be handled by an experienced, stable staff. In addition, this design eliminates biases due to the seasonal nature of certain conditions or the occurrences of short-run epidemics.

Approximately 100 interviewers, about half of whom work each week, are used in the HIS. Each interviewer is assigned an average of three segments (about 18 households) as a week's

work. (As of July 1968, an average interviewer assignment changed from two nine-household segments to three six-household segments.)

The interviewers, as well as the entire field staff for the HIS, are employees of the U.S. Bureau of the Census. Specifications for the survey are established by the NCHS. In accordance with these specifications, the U.S. Bureau of the Census selects the sample, conducts the field interviewing as an agent of the Center, and checks questionnaire entries. Data preparation, consisting of the preliminary editing and the coding of questionnaires, is carried out by the NCHS. Further editing and preparation of tabulations is done by NCHS using electronic computers.

The Bureau of the Census has 12 regional offices located in 12 major cities where supervisors of the HIS are stationed. Each supervisor spends a great deal of time visiting the approximately 30 PSU's in his region in which the interviewing is carried out. Since there are three to four PSU's per interviewer, many of the interviewers are also required to do a considerable amount of travel.

## CONTROL OF THE SURVEY PROCESS

The quality control program for the HIS has two purposes: to minimize errors in the survey results and to provide data to evaluate the extent of bias caused by interviewers and respondents.

Nonsampling errors can occur at any stage of a survey. They may result from the improper statement of the objectives, from faulty concepts, or from improper definition of the population to be studied. They may arise during the sample selection, during the conduct of an interview, or during the processing of the data, e.g., coding, editing, or tabulating. Both the field and office quality control programs of the HIS strive to minimize these errors and to maintain the quality of the interviewing and of the editing, coding, and other data-processing operations.

The quality control activities in the field are process controls rather than product controls. That is, very little work in the field is done over again because it does not meet quality control standards. To control errors contributed by

interviewers, the program seeks to identify interviewers whose work is defective in particular areas so that remedial action can be taken to improve future work. Such remedial action generally takes the form of retraining the interviewers on those aspects of the survey in which their performance was poor. Sometimes, however, interviewers cannot be helped by retraining and must be replaced. Some interviewers resign when they discover through the field quality control program that their performance is not up to par. The turnover, including interviewers whose performance is satisfactory but who resign for personal and other reasons, is about 15 to 25 persons per year among the approximately 100 interviewers assigned to the HIS. However, about 40 percent of the interviewers have been with the survey for at least 5 years.

## MEASUREMENT OF NONSAMPLING ERROR

Nonsampling errors that arise during the interview may have as their source the respondent, the interviewer, or the questionnaire. They may result from such causes as respondent memory lapse, the misunderstanding of a question, improperly omitted questions, or incomplete answers.

# PART I. CONTROL OF DATA COLLECTION AND DATA PROCESSING

## INTRODUCTION

Quality control is commonly achieved by measuring performance and setting standards. Illustrations of performance measures are noninterview rates, item-response rates, editing-failure rates, and error rates in clerical and card-punching work. Such measures are frequently the basis for applying formal quality controls in the conduct of surveys. These quality controls are specified in terms of minimum performance standards that maintain the quality of work in various operations and thus contribute to the accuracy of survey results.

This part of the report describes the controls imposed on the collection and processing of HIS data. Quality control measures are applied at five different stages in the HIS: (1) interviewer selection, (2) training of interviewers, (3) obser-

Two of the many attempts that have been made to measure the nonsampling error in the HIS are discussed in this report.

One attempt has been the systematic supervisory reinterview which consists of reinterviews conducted by the field supervisory staff and senior interviewers at a subsample of households included in the survey. The results of the reinterview survey are compared on a case-by-case basis with the results of the original survey. Data from these comparisons are presented as net and gross differences. Net differences are differences between the statistics produced from regular HIS interviews and the statistics produced from the reinterviews. Gross differences are disagreements in individual classifications made by the interviewers and the reinterviewers. A more detailed discussion of these measures is included in this report in the section part II Response Errors as Determined by a Reinterview Survey.

Another approach has been an interviewer variability study in which interviewer assignments were randomized to obtain estimates of between-interviewer variance. (See Interviewer Variability Study in this report for a more detailed discussion.)

vation of interviewers, (4) supervisory reinterview, and (5) editing of the completed questionnaires.

In the HIS, about 30 percent of the total field budget goes into quality control. Table 1 provides a distribution of the costs incurred by activity for calendar year 1968.

## SELECTION AND TRAINING OF INTERVIEWERS

### Selection

HIS interviewers are selected with great care. Because of the potentially delicate nature of an HIS interview, candidates must have not only the necessary qualifications for handling the interview questionnaire but also unusual tact and sensitivity.

Table 1. Percent distribution of field costs by detail expense item: Health Interview Survey, 1968

Detail expense item	Total	Salaries	Travel	Other <sup>1</sup>
Total . . . . .	100.0	47.6	27.7	24.7
Interviewing . . . . .	63.3	29.5	20.8	13.3
Initial training . . . . .	4.1	2.0	0.8	1.2
Group and home training . . . . .	5.3	2.3	1.7	1.3
Reinterview <sup>2</sup> . . . . .	8.3	3.3	2.7	2.3
Observation . . . . .	4.4	1.8	1.2	1.4
Office work <sup>3</sup> . . . . .	12.1	7.5	( <sup>4</sup> )	4.6
All other . . . . .	2.2	1.2	0.3	0.6

<sup>1</sup> Includes overhead.

<sup>2</sup> Includes a check for completeness of coverage.

<sup>3</sup> Includes preparation of reinterview assignments.

<sup>4</sup> Less than 0.05 percent.

Employment as HIS interviewers is limited to women. The typical respondent, a housewife, is generally thought to be more willing to reveal complete health information to another woman than to a man. In addition, employment of women with formal nursing or medical training as HIS interviewers is discouraged because interviewers with such training may tend to diagnose or interpret rather than merely record the information obtained from respondents during the interview. Interviewers must pass a test that measures reading comprehension, arithmetic ability, and map-reading ability. An elaborate program of training and observation early in an interviewer's career also appears to aid in the selection process. The very low level of refusal, about 1 percent of households contacted, and of complaints received seems to show that the interviewers who are finally selected appear to be doing a good job of gaining public cooperation.

### Initial Training

The initial training consists of five separate stages: preclassroom training, classroom training, postclassroom training, on-the-job training, and editing of questionnaires by the supervisor.

*Preclassroom training.*—Preclassroom training is designed to familiarize the new interviewers with both the purpose, scope, and general uses of the HIS and the interviewing materials and the interviewing job.

The usual method of presenting such training is through self-study materials. The interviewer is given a self-study package to complete before reporting for classroom training. The contents include administrative materials, a copy of the HIS questionnaire, an interviewer's manual with instructions to read certain sections, and copies of the letters that the respondents receive. Occasionally, in order to become better acquainted with the survey, the new interviewer also spends 1 day observing an experienced interviewer.

*Classroom training and practice interviewing.*—Classroom training consists of 5 days of instruction, which covers the interviewer's manual, the questionnaire and related forms, and interviewing techniques. This training is usually conducted in one of the 12 Census Regional Offices, permitting the trainee to become acquainted with some of the regional office staff members and with general office procedures.

The classroom portion of the initial training combines formal classroom training with mock interviewing. Mock or hypothetical interviews are created from situations the interviewer may face. The formal classroom training is primarily for teaching survey concepts.

Several training techniques besides mock interviewing are employed in the classroom. They include lectures by the trainer, reading portions of the interviewer's manual, answering questions, participating in group discussions, and completing written exercises.

Practice field interviewing gives the trainee a chance to apply her knowledge of the survey materials to actual interviewing situations. This serves to familiarize her as early as possible with the work she will be doing as well as to stimulate her learning of the concepts and techniques by using them under actual conditions.

An observer accompanies the interviewer during practice interviewing assignments. He coaches her on how to handle difficult situations and explains interviewing techniques. During the interview, the observer does not interrupt the trainee unless she becomes very confused. It may occasionally be necessary for the observer to conduct the first interview so the interviewer can get an idea of how the interview should be conducted.

The observer uses an observation report to record all pertinent details of each interview, including any errors the interviewer makes. After they leave the household, the observer discusses with the interviewer the points that he has marked on his report and gives her some hints on how to improve her interviewing techniques or to solve problems that arose during the interview. He encourages her to look up the solutions to problems in the interviewer's manual.

In addition to evaluating the interviewer's technical understanding of the rules and definitions that apply to subject matter, the observer checks the interviewer's performance in the following specified areas:

1. Introduction at the doorstep
2. Use of identification card
3. Explanation of survey
4. Getting settled in the household
5. Interviewer's ability to maintain a businesslike but friendly attitude with the household members
6. Ability to handle unusual or difficult situations
7. Adeptness with forms (i.e., following skip patterns, probing where answer is incomplete, asking questions as worded, recording answers as instructed)
8. Dress and posture

*Postclassroom training.*—Postclassroom training is designed to familiarize the interviewer

with rules and procedures that, although important, are not as frequently used as those covered during the classroom training.

The first postclassroom assignment is completed after classroom training and before the first interviewing assignment. It consists of reviewing classroom topics, completing a lesson that describes the persons to be included in the survey along with a description of housing and sample units, and reading a discussion of administrative forms the interviewer will use.

The second postclassroom training assignment is completed at home by the interviewer between her first and second interviewing assignments. This assignment is designed to help the interviewer understand sample unit coverage in area segments, the use and background of the address lists taken from the 1960 Decennial Census, and the procedures to be followed at special dwelling places, e.g., motels or convents.

The third postclassroom training assignment is completed at home by the interviewer immediately before her first listing assignment. A list of all housing units in each area segment must be compiled before any addresses can be selected for interviewing in these segments. The interviewer travels around the segment and records the addresses or other description of all places where people live or might live within the segment.

*On-the-job training.*—On-the-job training is conducted by the supervisor-trainer during the interviewer's first two interviewing assignments and her first listing assignment. This type of training is usually referred to as initial observation and is discussed more fully in the section "Observation of Interviewers."

*Edit of questionnaires.*—All work of new interviewers is edited by the field supervisor. This includes questionnaires for about 70 households from about four assignments conducted over an 8-week period. A complete check is made of the questionnaire, errors are identified and tallied, and the number and description of the errors is given to the interviewer.

### Continuing Training

Several different kinds of continuing training are used.

*Group training.*—Group training is used for experienced interviewers and normally takes place twice a year. Interviewers are brought together in the 12 Regional Office cities. This provides an opportunity for the widely scattered interviewers to meet one another, exchange views, and receive formal training. There is one session in December or January of each year to learn the new questionnaire for the next calendar year, and a midyear refresher session usually held in June or July.

*Home study and exercises.*—There is a formal home-study program for which the interviewers are paid. Home-study assignments, which generally take an average of 3 hours to complete, are made four times a year. These assignments cover various aspects of the interviewer's job, such as the order in which the questions should be asked, when a question is necessary, etc. They also emphasize the importance of the survey and of the interviewer's vital role in its operation.

*Feedback of errors.*—Supervisors in the regional offices edit 1 week's assignment per interviewer per quarter. Additional editing is done as needed, i.e., when previous editing results, observation, or reinterview indicate any consistent type or pattern of omissions or inconsistencies. On the average, about one-sixth of the completed questionnaires are edited each quarter in the regional offices. Certain categories of errors are identified and tallied, and the errors are recorded on forms that are forwarded to the interviewer immediately upon completion of the editing. For example, the interviewer may be required to give an explanation of each error or to make a written reference to the part of the interviewer's manual that describes the correct procedure.

A second edit is carried out at an early stage of the data-processing operation in Washington, D.C. Here the data from all questionnaires are examined. This edit takes place, however, weeks or even months after the questionnaires have been filled out by the interviewers. Although the immediate feedback that is provided by the field edit is lost, the degree of uniformity in the detection of errors made by interviewers becomes much greater in the central office edit. This procedure therefore provides a better basis for the numerical error scores that

are an important part of each interviewer's performance record.

*Other training.*—Informal training takes place every time supervisors and interviewers get together in connection with the quality control programs discussed in the next two sections.

In addition to formal training and the informal meetings with supervisors, interviewers are encouraged to use referral sheets for describing problems. They can mail these sheets directly to the regional offices where solutions for their problems can be quickly determined and mailed back to them.

## OBSERVATION OF INTERVIEWERS

### Introduction

An important part of the quality control program for the HIS is the observation of interviewers. Either the HIS Program Supervisor, Alternate Supervisor, or Senior Interviewer observes in each regional office. An interviewer is observed in a group of households in her assignment. The observation program contributes to on-the-job training as well as evaluation of the interviewer's performance. The main focus of the observation is to see how the interviewers conduct themselves in obtaining information in their assigned households. The type of controls possible through the observation program depends a great deal on the ability of the supervisor to detect inadequacies and correct them. An HIS observation report (appendix V) is used as a guide while observing interviews. On it are recorded the observer's impression of the interviewer's performance. Some of the items are entered on a person-by-person basis, and some relate to the day's work. A copy is placed in the interviewer's performance file in the regional office, and the original is sent to the U.S. Bureau of the Census.

### Types of Observations

Observations are classed as initial, systematic, and special needs. Although the same procedure is followed for all kinds of observations, they have different purposes.

*Initial observations.*—The purpose of the initial observations is to give new interviewers on-the-job training to correct weaknesses at the beginning of their interviewing career. Initial observations are conducted for each new interviewer for 2 full days on her first interviewing assignment, for 1 full day on her second interviewing assignment, and for part of a day on her first listing assignment.

The new interviewer begins her day by locating the segment in which she will work. The observer allows the interviewer to find the segment without guidance, unless she becomes completely confused in reading the maps. If this occurs, he assists her in finding the first household.

On interviewing assignments, the interviewer introduces herself, and the observer merely observes unless the interviewer asks for help or makes errors. If the interviewer is having serious difficulties, the observer then assists by conducting as much of the interview as needed to show the interviewer the proper procedures.

At the end of the interview, the observer reviews with the interviewer any general problems that have arisen, such as misapplication of definitions or poor interviewing techniques. He discusses his notes with her immediately after leaving the interviewed household and before going to the next. He also reviews (edits) the questionnaire for completeness. At the end of the observation, he may also review the interviewer's time and mileage records and discuss any general points he noted for special attention.

*Systematic observations.*—Most observations are regularly scheduled visits by the supervisor. These are called systematic observations and are designed to serve three broad purposes: to give on-the-job training in areas where specific weaknesses are observed; to allow each interviewer a regular opportunity to discuss her work with her supervisor, to make suggestions, and to communicate in general with the regional office; and to provide information for evaluation of the overall quality of the interviewing in the HIS.

Systematic observation assignments are made by the regional offices. One-half of the experienced interviewers are observed each quarter. A systematic observation is made of newly trained interviewers in the quarter following

their initial training. No observation is conducted when assignments are also scheduled for reinterview.

Before conducting a systematic observation, the observer reviews records of the interviewer's past performance. In addition, he edits recent examples of her listing of households, reviews the office copy of the report of her last observation, and, in general, tries to determine which points should be observed most closely.

*Special-needs observations.*—Some interviewers need more contact with their supervisor than is provided by the systematic observations, and the regional offices need the flexibility of being able to give additional training to interviewers when it is needed. Special-needs observations are used for this additional training.

A special-needs observation is usually made for an interviewer whose work is rejected in reinterview. Rejection in reinterview is based on the number of differences between the original interviewer's results and the reinterviewer's results. An interviewer's work is rejected if the number of differences is in excess of specified limits given in a table of acceptability. (See the next section for further discussion of the reinterview program.) The special-needs observation is scheduled for the interviewer's first assignment following the reinterview.

A special-needs observation may also be made for an interviewer whose work falls below certain minimum performance standards such as the following: poor production, e.g., too few completed interviews per day or too much travel time; a high noninterview rate; an excessive number of recording errors and omissions on the questionnaire filled out by the interviewer; and poor performance on recent observation.

The purpose of the special-needs observation is retraining. If, in the judgment of the supervisor, an interviewer needs retraining after falling below the minimum standard for some aspect of her work, an observation is conducted. Sometimes a seemingly poor performance can be explained, for example, a high noninterview rate in the summer, and no retraining is necessary. Except in the case of rejection in reinterview, the decision to conduct a special-needs observation is made entirely in the regional offices.

The procedure for the special-needs observation is the same as that for the systematic

observation, but with special attention given to the aspect of the interviewer's work that needs improvement.

## **SUPERVISORY REINTERVIEW PROGRAM**

### **Introduction**

The major purpose of the program of supervisory reinterviews is to control quality. The program provides a process control on the work of individual interviewers so that interviewers with high levels of error can be identified and remedial action taken. The remedial action is intended to improve the quality of the individual interviewer's work through retraining, observation, and discussion of errors with the interviewer, as necessary. The reinterview also serves as a periodic check on interviewers to see that assignments are carried out as instructed.

This process also provides assessments of the reliability and accuracy of the HIS because the quality control technique employed in this program requires that the supervisors fill out complete questionnaires that can then be matched with the questionnaires filled out by the interviewers. Since these questionnaires constitute, by design at least, a probability sample of all HIS interviews, estimates bearing on the reliability and accuracy of HIS statistics can be made.

### **Sample Design**

Reinterview assignments are made on the basis of interviewer workload, that is, interviewers with larger workloads have more reinterviews in a given year. A reinterview assignment consists of one weekly work assignment, and there is an average of three reinterview assignments per year per interviewer. Originally, one reinterview assignment was carried out for each interviewer per quarter. In January 1963, the program was reduced to three assignments per year per interviewer. On July 1, 1965, the selection method was changed to reflect the variability of interviewer workload.

An additional reinterview assignment is made for interviewers rejected in the previous quarter. The number of interviewers for which this is

done is limited to not more than 10 percent of the total number of interviewers. Reinterview assignments are evenly divided among the weeks of the quarter, and there is only one reinterview assignment in a regional office area in any given week. A reinterview of 12 of the 18 households in a typical interview assignment is conducted with one person reinterviewed in each of the 12 households selected.

The reinterview sample is divided into two parts. The sample of households selected for reinterview is subdivided into an 80-percent subsample and a 20-percent subsample. In the 80-percent subsample of households, the supervisor carries out a reconciliation of reinterview results with the results of the original interview. No reconciliation is carried out for persons in households designated for the 20-percent subsample. The division of the reinterview sample into an 80-percent subsample and a 20-percent subsample began in January 1959. Before that, reconciliation was carried out for the entire reinterview sample.

### **Content of Reinterview**

The first part of the reinterview is a coverage check to see if all household members have been properly included in the survey. The second part of the reinterview deals with the reporting of personal and health characteristics.

In general, the reinterview covers all questions relating to the reporting of health conditions and their characteristics originally included in the first interview. Supplements, such as hospital insurance, eyeglasses, or hearing aids, are not usually included in the reinterview.

### **Field Procedures**

At the beginning of each quarter, regional supervisors are told which weeks will have a reinterview assignment. One week before interview week, they are told which assignments are to be reinterviewed and given instructions for selecting the subsample of households designated for reinterview and the sample persons within reinterview households. One person per household is randomly selected for the part of the reinterview that covers personal and health characteristics.

The reinterviewer is instructed not to look at the original interview results before reinterview. The HIS reconciliation questionnaire (appendix VI) containing the transcribed information from the original interview is given to him in a sealed envelope. He does not open this envelope until he completes the reinterview.

For the 20-percent subsample of households for which reconciliation is not carried out, the original questionnaires are not transcribed. For these households, the note "Omit Content Reconciliation" is placed on the reconciliation questionnaire inside a sealed envelope. Thus the supervisor is not supposed to know in advance the households where he will not do reconciliation. The data from the 20-percent group are used to test the extent to which accessibility of original responses to the reinterviewer has apparently affected reinterview results.

The reinterview fieldwork includes verifying the original interviewer's work in the listing of addresses in area segments, checking household composition in the sample households, and reinterviewing one person in each reinterview sample household.

The reinterview is scheduled for the week following the original interview and must be completed no later than 2 weeks after the date of the original interview. Since the questions on the HIS schedule refer to specific time periods, such as "last week or the week before," "a year ago," and "past 12 months," the reinterviewer, in asking these questions, must be certain to get information for the same time period used by the original interviewer. In order to do this, the reinterviewer must specify the exact dates of the reference period used in the original interview.

The reinterviewer makes a personal visit to each household selected for reinterview. The questions relating to coverage of persons within the household may be asked of any eligible respondent. For the health information for adults, the most acceptable respondent is the person who provided the data in the original interview. If he is not available, however, the sample person may be interviewed. (Before July 1, 1965, the only acceptable respondent was the sample person himself.) Information for children is obtained from parents or an adult responsible for the child's care.

Responses are entered on the reinterview

questionnaire and changes are not made after this part of the reinterview is completed. (Before January 1967, supervisors used a special questionnaire containing only the subjects covered in the reinterview. Since then supervisors use a blank HIS questionnaire for recording the reinterview results.)

In 80 percent of the reinterviews, differences in responses from the two interviews are reconciled immediately after completion of the reinterview. For personal characteristics, the reinterviewer transcribes the information he has obtained to the reconciliation questionnaire. He then compares these answers with the original responses and reconciles any that are different. Next, he compares the responses to the health questions on the reinterview questionnaire with the reconciliation questionnaire, which contains the information from the original interview. If the reinterviewer finds that differences exist, he attempts to determine from the respondent the proper response and any possible reasons for differences. The reconciliation questionnaire provides space for recording reasons given by the respondent for differences between the original interview and the reinterview on the reporting of illnesses and other health conditions and hospitalizations.

Table 2 shows the number of persons reinterviewed in fiscal years 1959 through 1967.

Table 2. Number and percent of persons interviewed and reinterviewed: Health Interview Survey, fiscal years 1959-67

Fiscal year	Number of completed interviews (persons)	Number of completed reinterviews (persons) <sup>1</sup>	Percent
1959 .....	126,841	3,478	2.7
1960 .....	118,068	3,061	2.6
1961 .....	112,086	3,206	2.9
1962 .....	118,432	2,839	2.4
1963 .....	139,055	2,995	2.2
1964 .....	129,801	2,391	1.8
1965 .....	139,152	2,081	1.5
1966 .....	139,486	2,053	1.5
1967 .....	133,916	1,933	1.4

<sup>1</sup>The decline in the number of completed reinterviews is the result of a cutback in the reinterview sample size.



## Quality Control of Interviewers' Work

One purpose of the supervisory reinterview program is quality control. Specifically, the program is designed to check on coverage and content errors. Errors in coverage of the population can occur because of incorrect listing of addresses in sample segments, failure to conduct interviews at the correct addresses, and incorrect application of definitions of housing unit and household member. Content errors are errors in the data obtained by the interviewer concerning personal and health characteristics of members of the sample household. Through the reconciliation of original interview and reinterview results, the supervisor tries to obtain the best answers to the HIS questions.

A second purpose of the reinterview program, that of obtaining measures of nonsampling errors and biases, is discussed in part II of this report.

After a reinterview assignment has been completed, the reinterviewer completes a summary report of the HIS reinterview (appendix VII) showing the number of differences for five categories of the interviewer's work: listing; household composition; personal characteristics; characteristics of conditions and hospitalizations; and number of conditions, hospitalization, and injuries. Tolerance limits are established for each category. The interviewer's work is required to meet the standards for each category separately. The tolerance limits are listed in a table of acceptability, which shows for each category separately the number of differences that are acceptable for a particular sample size. Only cases where the respondent was the same on both interviews are used in the table of acceptability. The acceptance numbers are set so that a difference rate at a 5-percent level will be accepted 95 percent of the time.

An interviewer's work is rejected if the number of differences in any classification is in excess of the numbers given in the table of acceptability. An analysis of reinterview assignments was carried out for the period July 1, 1962, through June 30, 1967. During this time, 1,554 original interview assignments were reinterviewed. Rejections were noted in 115 assignments in one or more categories. These

115 assignments were rejected on the following grounds:

Category of rejection	Number
All categories of rejection . . . . .	139
Listing . . . . .	18
Household composition . . . . .	7
Personal characteristics . . . . .	31
Characteristics of conditions and hospitalizations . . .	30
Number of conditions and hospitalizations . . . . .	53

Of the 115 assignments that were rejected, 95 were rejected on one category, 16 were rejected on two categories, and 4 were rejected on three categories. No assignments were rejected on more than three categories.

Supervisors in the regional offices initiate retraining, observations, etc. of interviewers whose work is rejected. A report of actions taken is made to headquarters in Washington, D.C. Table 3 presents the actions taken for those interviewers whose assignments were rejected in reinterview by reason for rejection for the period July 1, 1962, through June 30, 1967.

## EDITING AND CODING OF COMPLETED QUESTIONNAIRES

### Introduction

When completed assignments are received in the regional offices from interviewers, the questionnaires are edited for consistency and completeness. A systematic edit is carried out for a specified sample of assignments. The results of this edit are sent to the interviewers with identification of errors and specific references to sections of the interviewer's manual to review. Further editing is carried out during coding and processing operations at headquarters. The NCHS assumed responsibility for the coding and data preparation in 1968. A new questionnaire format and new coding procedures were adopted at that time. The coding and quality control procedures described in this report are those used by the Bureau of the Census before 1968.

About 800 household questionnaires are received each week for processing. After the

Table 3. Percent distribution of actions taken in cases of interviewer rejection by nature of rejection: Health Interview Survey, July 1, 1962-June 30, 1967

Action taken after rejection	Category of rejection				
	Listing	Household composition	Personal characteristics	Tables	Health conditions
	Percent distribution				
Total rejections . . . . .	100.0	100.0	100.0	100.0	100.0
Retrained . . . . .	27.8	14.3	3.2	3.3	3.8
Observed . . . . .	33.3	14.3	64.5	40.0	41.5
Retrained and observed . . . . .	5.6	14.3	12.9	30.0	15.1
Errors discussed . . . . .	22.2	14.3	9.7	3.3	9.4
Resigned . . . . .	0.0	0.0	0.0	0.0	1.9
Dismissed . . . . .	0.0	0.0	0.0	3.3	5.7
No action necessary <sup>1</sup> . . . . .	0.0	28.6	6.5	10.0	15.1
Action not reported . . . . .	11.1	14.3	3.2	10.0	7.5

<sup>1</sup>The supervisor may decide that no actions are necessary if, in his judgment, the differences are due to factors beyond the control of the interviewer. For example, one confused respondent may contribute all the differences because he misunderstood questions.

questionnaires are checked in, they are grouped into work units of approximately 25 questionnaires each. The questionnaires are assigned in work units to clerks who check the questionnaires for completeness, assign codes to the information on the questionnaires, and transcribe all of the information on the questionnaires to punch card transcription sheets. Questionnaires go through nonmedical coding and medical coding operations. Nonmedical coding assigns codes to the demographic items and items related to health conditions. Medical coding, which is a more complicated operation, assigns detailed diagnostic codes to the illnesses, injuries, and hospitalizations reported on the questionnaires. Diagnostic codes are assigned, with some modification, according to *International Classification of Diseases (ICD)*. To control the level of errors in these coding operations, specific quality control procedures are followed. These procedures are discussed in the section on quality control of clerical coding operations.

### Regional Office Edit

Specifications for carrying out a regional edit are sent to each office at the

beginning of a year. These specifications define the minimum editing that must be done. Additional editing is carried out on the basis of need, i.e., if previous edit results, observation results, or interview results show errors such as omissions and inconsistencies.

The specifications for editing the work of experienced interviewers generally provide for more editing at the beginning of the year when new items are added to the questionnaire. As interviewers become more experienced with new items, the amount of editing is reduced. However, the first four assignments of new interviewers are always edited.

There are two types of edits performed in the regional offices, diagnostic and nondiagnostic. The diagnostic edit must be done by the HIS supervisor. Errors are assigned for missing or inadequate entries for illnesses, injuries, or hospitalizations. The nondiagnostic edit can be done by a qualified clerk and consists of identifying omissions and incorrect entries in identification and control items on the questionnaire.

The results of the diagnostic and nondiagnostic editing are sent to the interviewers and provide some immediate feedback on errors. A copy of the results is retained in the regional

office for comparison with the more intensive edit and identification of errors made during the central office coding and processing operations.

### **Quality Control of Clerical Coding Operations**

There have been a number of changes over the years in the processing of HIS questionnaires. From the beginning of the survey in 1957 until November 1965, processing consisted of transcribing and coding information from questionnaires to document-sensing cards from which IBM punchcards were mechanically prepared. The assignment of diagnostic codes to illnesses, injuries, and hospitalizations was independently verified on a 100-percent basis. Two coders independently assigned diagnostic codes on the information in the questionnaire. These codes were compared, and differences were resolved by a supervisor. The coding and transcription of nonmedical entries was completely verified by a second coder's examining the entries on the document-sensing card to see if they had been correctly transcribed by the first coder.

In November 1965, a new schedule format was introduced into the survey. Entries on this schedule could be read directly by machine, thus bypassing a large amount of clerical transcription. In addition some of the codes for nonmedical items, such as age, were entered on the schedule by interviewers and required no further coding. However, a substantial amount of editing and coding was still required, particularly for diagnostic entries that had to be medically coded. At the time this new schedule was introduced, it was decided that sample verification to control the quality of coding would provide a better use of resources than 100-percent verification, particularly for medical coding.

Consequently, starting in November 1965, a sample verification plan was introduced into the medical coding operations of the survey. The plan provides for two stages of control in the medical coding operation: a training and qualification period during which the coders' work is independently verified 100 percent, and a post-training period during which the coder's work is independently verified on a 10-percent sample

basis. All errors detected during verification are corrected.

During the qualification period the new coder codes to a work sheet. Then the coding is done over again by a qualified coder independently on an HIS schedule. A comparison clerk matches the medical codes entered on the worksheet with the medical codes on the corresponding schedules. Differences in medical codes are reviewed by an adjudicator. The adjudicator assigns an error if, in his judgment, the original coder assigned the wrong code. If, however, the differences in codes are a matter of coder judgment, a decision concerning the proper code is made, but an error is not assigned.

In order to qualify for sample verification, a coder must code four consecutive work units out of a maximum of eight with an error rate of 4 percent or less for each work unit. If a coder fails to qualify within the first sequence of eight work units coded, a second sequence of eight for qualification is started. A coder has a maximum of three sequences in which to qualify. If a coder fails to qualify in the third sequence of eight work units, he is not considered for sample verification. Once a coder has qualified for sample verification, his work continues to be verified on a 10-percent sample basis. A record of verification is maintained for each medical coder. When the cumulative number of verified codes reaches 45, a decision is made to determine if the coder's work is still acceptable. If a coder's work is rejected three or more times in 10 decisions, he must requalify for sample verification. During the requalification period his work is verified on a 100-percent basis. If the coder fails to requalify, he is no longer considered for sample verification.

Additional changes have been made in the format of the questionnaire since the sample verification plan was introduced. However, essentially the same verification procedures continue to be used, i.e., independent verification of medical coding on a sample basis and 100-percent dependent verification of nonmedical coding.

Records for the period April 1, 1967, to March 31, 1968, show an average error rate of about 2 percent in assignment of medical codes for experienced coders on sample verification.

For the same period, the nonmedical coding error rate was also about 2 percent.

### Central Office Edit

As part of the coding operations described above, a comprehensive review of each questionnaire is carried out to identify omissions, inadequate entries, and inconsistencies. Error codes are entered on the processing record so that the number and identification of errors can be tabulated and summarized for each interviewer. In addition, specific descriptions of errors are provided on a separate document. These descriptions identify the number and type of errors for different sections of the questionnaire, for example, person page, condition page, hospitalization page, etc. These errors are divided into two main categories: diagnostic errors on conditions and hospitalizations, and nondiagnostic errors. The forms used to record the number and types of errors are the same used in the regional office edit. Weekly summaries of diagnostic errors are sent to regional offices, and quarterly summaries of both diagnostic and nondiagnostic errors are sent to the regional offices which in turn notify individual interviewers. The quarterly summaries also form the basis for computing an interviewer error rate, which is one of the measures used to evaluate interviewer performance as described in the next section.

Additional editing is done on the computer, which performs a series of adequacy and consistency edits. Individual records with errors are identified, the original questionnaires are located, and corrections made, as necessary, to the records.

## MEASURES OF INTERVIEWER PERFORMANCE

In the preceding sections of this report the activities for controlling the quality of survey results have been presented. Results from these quality control activities are combined with other data to provide an overall evaluation of interviewer performance.

The measurement of interviewer performance in the HIS is a combination of subjective ratings by supervisors and quantitative measures based

on an examination of an interviewer's completed work.

Minimum standards of performance on the quantitative measures are set up. A cumulative record of performance for each interviewer is maintained in the regional office. If, at any time, this record indicates that an interviewer's work has fallen below the minimum standard, corrective action is taken. This corrective action may consist of retraining, observation, or, in some cases, replacement of the interviewer. In practice the evaluation of interviewer performance is based on the pattern of performance over time and on different aspects of the interviewing job rather than performance on any single aspect.

In the HIS, three quantitative measures of performance are computed on a continuing basis. They are the error score, the noninterview rate, and the production ratio.

The error score is computed as follows:  $(\text{number of errors}) / (\text{total conditions} + \text{total accidents} + \text{total hospitalizations})$ . (See appendix I.) The numerator is the number of errors identified during processing. Errors include omitted entries, missed conditions, missed hospitalizations, and diagnostic errors. Missed conditions and missed hospitalizations are those identified in the early or probing section of the interview but not followed up for additional information in the latter section of the interview. Diagnostic errors occur when the interviewer fails to record sufficient information to allow a medical coder to assign diagnostic codes.

The noninterview rate is computed as follows:  $(\text{number of noninterview households}) / (\text{number of interviewed households} + \text{number of noninterview households})$ . The noninterview households are households eligible to be included in the HIS, but for which no interview was conducted. Included as noninterviews are those the interviewer has reported as "refusals," "no one at home," "temporarily absent," etc.

The production ratio is measured as follows:  $(\text{estimated time based on production standards}) / (\text{actual payroll time charged by the interviewer})$ . The numerator is estimated from a mathematical equation (appendix II) that takes into account such things as the average time per household, the number of assigned households, and the distance to area of assignment from interviewer's home.

In addition to quantitative measures used to evaluate interviewer performance, the results of supervisory reinterviews and observations are used as much as possible. Also, if specific individual interviewer errors are discovered during the processing operation at the central office, they are noted and forwarded to the regional supervisor. He in turn informs the interviewer of these errors and suggests means of eliminating them.

After a probationary period of 6 months, each interviewer receives a report on her performance over the past quarter. The report contains both a descriptive rating and a numerical score. The descriptive ratings are "Excellent," "Satisfactory," "Needs Improvement," or "Unsatisfactory." If an interviewer receives a rating of "Needs Improvement" or "Unsatisfactory," she will receive a warning notice

unless, in the judgment of her supervisor, there are extenuating circumstances.

In addition to the quantitative measures used in evaluating individual interviewer performance, other measures are used to provide an overall summary of performance. These include number of conditions per person,<sup>a</sup> number of missed conditions and hospitalizations, number of diagnostic errors, and proportion of reinterview assignments accepted. (See "Regional Office Edit" for a discussion of diagnostic errors.) Tables 4 and 5 show the average rates for HIS interviewers over a 4-year period for five of these rates and over a 7½-year period for three of these rates. The variation from quarter to quarter is small; the only apparent trend being in the number of conditions per person, which has steadily increased throughout the survey.

Table 6 shows average rates for interviewers

Table 4. Average interviewer performance on various measures by survey quarters: Health Interview Survey, January 1962-June 1965

Survey quarter	Number of interviewers	Average error rate (percent)		Average number of missed conditions per 100 persons		Average number of missed hospitalizations per 1,000 persons		Average production ratio		Average proportion of reinterview assignments accepted	
		Rate	N <sup>1</sup>	Rate	N	Rate	N	Ratio	N	Proportion	N
<b>1962:</b>											
Jan.-Mar. . . . .	107	4.6	105	.10	105	.64	105	1.09	100	.95	94
Apr.-June . . . . .	128	5.8	128	.25	127	.83	127	.91	114	.95	95
July-Sept. . . . .	120	10.0	119	.30	119	.45	118	.89	110	.95	92
Oct.-Dec. . . . .	117	8.3	116	.38	116	.68	115	.90	103	.91	94
<b>1963:</b>											
Jan.-Mar. . . . .	112	5.8	112	.32	112	.49	112	.99	91	.94	62
Apr.-June . . . . .	104	5.9	103	.23	103	.64	103	.97	87	.95	66
July-Sept. . . . .	99	5.0	98	.09	98	.24	98	1.01	91	.85	61
Oct.-Dec. . . . .	104	6.9	104	.31	104	.45	104	.97	98	.80	70
<b>1964:</b>											
Jan.-Mar. . . . .	98	7.3	98	.40	98	.42	98	1.06	92	.89	61
Apr.-June . . . . .	98	6.9	98	.33	98	.39	98	1.03	94	.95	64
July-Sept. . . . .	102	6.8	101	.28	101	<sup>2</sup> 4.46	101	1.00	100	.92	48
Oct.-Dec. . . . .	101	6.9	101	.42	100	.42	100	1.02	106	.89	65
<b>1965:</b>											
Jan.-Mar. . . . .	100	7.8	100	.16	100	.66	100	1.05	96	.90	68
Apr.-June . . . . .	97	6.4	97	.12	97	.58	97	1.03	96	.92	61

<sup>1</sup>N = number of interviewers included in the computations.

<sup>2</sup>This high rate is due to one interviewer who interviewed 10 persons but had 4 missed hospitalizations. Excluding the interviewers work, the measure is .54.

<sup>a</sup>Because of the differences from one assignment to another in the population covered, the number of conditions per person is not used as a performance measure for individual interviewers.

Table 5. Average interviewer performance on various measures by survey quarters: Health Interview Survey, January 1958-June 1965

Survey quarter	Number of interviewers	Average noninterview rate (percent)		Average number of conditions per person		Average number of diagnostic errors per 100 conditions	
		Rate	<i>N</i> <sup>1</sup>	Rate	<i>N</i>	Rate	<i>N</i>
<b>1958:</b>							
Jan.-Mar. . . . .	102	4.8	102	.94	102	4.8	102
Apr.-June . . . . .	103	4.3	102	.92	102	4.6	102
July-Sept. . . . .	104	5.6	104	.84	104	5.1	104
Oct.-Dec. . . . .	108	4.6	106	.90	106	4.2	106
<b>1959:</b>							
Jan.-Mar. <sup>2</sup> . . . . .	87	-	-	-	-	-	-
Apr.-June . . . . .	92	4.4	84	.91	84	4.4	84
July-Sept. . . . .	94	7.4	93	.86	92	4.2	91
Oct.-Dec. . . . .	88	4.7	85	.90	84	3.7	84
<b>1960:</b>							
Jan.-Mar. . . . .	85	4.0	82	.97	82	2.4	82
Apr.-June . . . . .	93	3.4	92	.93	93	2.1	93
July-Sept. . . . .	93	6.2	92	.95	92	2.1	92
Oct.-Dec. . . . .	98	3.8	98	.94	98	1.4	98
<b>1961:</b>							
Jan.-Mar. . . . .	103	4.1	103	1.00	99	2.3	99
Apr.-June . . . . .	108	4.3	108	.97	105	2.7	105
July-Sept. . . . .	109	5.7	109	.98	109	3.3	109
Oct.-Dec. . . . .	108	4.5	108	1.00	108	3.8	108
<b>1962:</b>							
Jan.-Mar. . . . .	107	4.7	105	1.07	105	3.4	105
Apr.-June . . . . .	128	4.5	128	1.02	128	5.0	128
July-Sept. . . . .	120	7.0	119	1.01	119	6.0	119
Oct.-Dec. . . . .	117	4.9	116	1.04	116	5.9	116
<b>1963:</b>							
Jan.-Mar. . . . .	112	3.6	112	1.09	112	4.2	112
Apr.-June . . . . .	104	4.3	103	1.04	103	4.1	103
July-Sept. . . . .	99	5.3	99	1.03	99	3.0	99
Oct.-Dec. . . . .	104	3.5	104	1.06	104	3.6	104
<b>1964:</b>							
Jan.-Mar. . . . .	98	3.7	98	1.08	98	3.9	98
Apr.-June . . . . .	98	3.9	98	1.06	98	3.6	98
July-Sept. . . . .	102	4.8	101	1.06	101	5.3	101
Oct.-Dec. . . . .	101	3.6	101	1.12	100	4.0	100
<b>1965:</b>							
Jan.-Mar. . . . .	100	4.0	100	1.12	100	4.1	100
Apr.-June . . . . .	97	4.2	97	1.14	97	3.7	97

<sup>1</sup>*N* = number of interviewers included in the computations.

<sup>2</sup>No information available for this quarter.

Table 6. Average interviewer performance on various measures by number of quarters of experience

Number of quarters of experience	Number of interviewers	Average error <sup>1</sup> rate (percent)		Average noninterview rate (percent)		Average number of conditions per person		Average number of diagnostic errors per 100 conditions		Average number of missed conditions per 100 persons		Average number of missed hospitalizations per 1,000 persons		Average production ratio		Average proportion of reinterview assignments accepted	
		Rate	N <sup>2</sup>	Rate	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate	N
1	97	12.3	48	5.2	97	1.01	95	6.9	95	.40	46	.76	48	.71	41	.79	19
2	94	12.9	46	4.1	91	.96	89	5.9	89	.26	46	1.51	46	.78	42	.83	35
3	90	9.4	46	4.4	89	.95	89	4.7	89	.21	48	.30	47	.90	42	.89	35
4	82	7.5	41	4.3	80	1.00	81	4.1	81	.26	44	.78	42	.95	37	.83	29
5	77	6.0	38	5.0	52	1.06	52	3.8	52	.20	40	1.51	40	1.04	33	.91	23
6	75	5.3	38	4.0	73	1.02	73	2.8	73	.14	40	1.00	53	1.05	34	.97	29
7	74	5.7	38	4.4	74	1.01	74	3.1	74	.10	40	.49	40	.99	42	.94	31
8	67	4.1	33	3.5	67	.99	67	2.4	67	.12	39	.28	40	1.00	37	1.00	29
9	63	4.4	33	3.8	63	1.01	63	2.3	63	.10	36	.15	36	1.05	33	.88	24
10	63	4.6	34	3.3	63	1.02	63	2.4	63	.12	40	.29	38	1.07	37	.89	36
11	60	4.9	32	3.7	60	1.02	60	2.2	60	.15	39	.12	36	1.05	36	.93	29
12	58	4.4	34	3.1	58	1.01	58	2.4	58	.16	39	.52	36	1.06	35	1.00	23
13	58	4.4	39	4.2	58	1.05	58	2.6	58	.14	42	.28	40	1.10	41	1.00	31
14	57	4.9	41	2.9	57	.97	57	2.7	57	.19	44	.49	43	1.05	42	.91	32
15	56	3.7	56	4.2	56	1.01	56	2.5	56	.16	48	.11	48	1.10	46	.94	36
16	55	4.2	55	3.8	55	1.05	55	2.9	55	.12	48	.20	48	1.05	46	1.00	34
17	48	4.4	47	4.1	47	1.08	47	2.6	47	.16	47	.40	47	1.10	47	.88	41
18	48	3.9	48	3.2	48	1.05	48	2.6	48	.09	48	1.13	48	1.10	48	.95	38
19	44	4.5	44	4.1	44	1.05	44	2.6	44	.14	44	.00	44	1.03	44	.95	37
20	41	4.7	41	3.6	41	1.03	41	2.8	41	.17	41	.37	41	1.01	40	.93	30
21	38	3.5	38	4.0	38	1.05	38	2.2	38	.28	38	.28	38	1.03	38	.87	30
22	37	3.4	37	3.9	37	1.05	37	2.0	37	.15	37	.13	37	1.07	37	.96	23
23	36	4.0	36	3.7	36	1.10	36	1.9	36	.24	36	.26	36	1.10	36	.96	25
24	34	4.3	34	3.5	34	1.06	34	2.2	34	.24	34	.19	34	1.06	34	.86	22
25	30	4.4	30	3.0	30	1.05	30	2.2	30	.24	30	.23	30	1.02	30	.95	20
26	29	4.4	28	2.8	28	1.12	28	2.2	28	.36	28	.07	28	1.05	28	1.00	19
27	28	4.3	28	5.3	28	1.06	28	2.3	28	.20	28	.59	28	1.06	28	1.00	18
28	24	4.2	24	2.3	24	1.14	24	2.1	24	.22	24	.42	24	1.05	23	.88	17
29	17	3.8	17	3.7	17	1.21	17	2.3	17	.03	17	.00	17	1.07	17	.90	10
30	15	3.5	15	3.2	15	1.27	15	2.2	15	.03	15	.00	15	1.12	15	1.00	10

<sup>1</sup> Before survey quarter July-Sept. 1961, the definition of error rate was actually an omission rate. Therefore rates for quarters of experience 1-14 exclude quarters before July-Sept. 1961.

<sup>2</sup> N = number of interviewers included in computations.

NOTE: Restricted to HIS interviewers employed during the period Apr.-June 1965.

by the number of quarters of experience in the HIS. As expected, the more experienced interviewers have a better performance, on the average, than new interviewers. From this table it appears that about eight quarters, or 2 years, of experience are necessary for interviewers to

achieve maximum performance in terms of error rates, noninterview rates, and production. However, the data in table 6 do not represent a pure learning curve since the same interviewers are not included in all quarters.

## PART II. MEASUREMENT OF NONSAMPLING ERROR

### INTRODUCTION

A sample survey must take into account nonsampling errors and methods of control as well as sampling errors. The allocation of resources between control of nonsampling errors and increase in sample size is a complicated question, an answer to which is not attempted here.

Estimates of total sampling variance for important statistics can be made more or less routinely. The estimation of response variances and variances contributed by other aspects of the survey process, e.g., editing and coding, is more difficult. Particularly difficult is the estimation of biases in the measurement process.

This part of the report describes two programs carried out in connection with the HIS to

obtain estimates of nonsampling error, including bias. One is the supervisory reinterview program described in part I, which, in addition to serving as a field quality control device, provides overall estimates of response variance and bias. The second is a study designed to measure the interviewer contribution to the variance of estimates from the survey.

## RESPONSE ERRORS AS DETERMINED BY A REINTERVIEW SURVEY

### Introduction

In the HIS, information is obtained by personal inquiry or a self-administered questionnaire on age, number of chronic conditions, number of hospital episodes, disability, and other characteristics. The set of measurements or observations recorded in the collection operation ordinarily is examined for internal consistency and acceptability, certain "corrections" are made, and some of the entries coded to identify them in a classification system. Results are then summarized into totals, averages, correlations, or other statistical measures. Taken together, the collection and processing operations constitute the measurement process and are the source of any measurement errors.

The interpretation of reinterview survey results or comparisons of results from a survey with case-by-case matched responses or measurements from some other source has been the subject of much research and study.<sup>2-9</sup> Some theory of measurement errors that may help in the interpretations of the results of two sets of measurements is presented in appendix III. The first set of measurements is obtained by the regular survey procedures. The second set is obtained from reinterviews or through matching of survey results, unit by unit, with records providing information similar to that obtained in the survey.

### HIS Reinterview Survey Results

The use of the reinterview program as a device for evaluating the reliability and accuracy of statistics of the HIS is a byproduct use. There

are two important respects in which the supervisory reinterviews do not meet the standards that are imposed for the original interviews. First, the supervisory reinterviews are by and large conducted by men, whereas it is a requirement that HIS interviewers be women. Second, there is a longer time interval between the reporting and occurrence of health-related events in the reinterviews than in the original interviews. The reinterviews occur at least a week later than the original interviews. There are, however, some offsetting factors. For 80 percent of the households selected for reinterview, the reinterviewer has the benefit of the results from the original interview. Where differences exist, the reinterviewer is to determine the proper answer and also possible reasons for the difference. It seems reasonable that in general better responses would be obtained from reconciliation of two interviews than from a single interview.

The original survey data can be compared with reinterview data under three procedures.

*Procedure I.*—The reinterview in 20 percent of the households in the reinterview sample is conducted without the results of the original interview being available to the reinterviewer. No reconciliation of results is carried out.

*Procedure II.*—The results of the original interview are available to the reinterviewer for 80 percent of the households in the reinterview sample. However, the reinterviewer is not to examine the results of the original interview until after a reinterview has been completed. Procedure II is a comparison of the results of the original interview with the reinterview before any reconciliation of responses in the two interviews is carried out. If the reinterviewer follows instructions, this comparison is the same one as procedure I.

*Procedure III.*—After conducting the reinterview in 80 percent of the households, the reinterviewer compares the responses obtained in the two interviews. Where differences exist, the reinterviewer tries, with the help of the respondent, to decide upon the proper response. Results of this reconciliation are compared with original results under procedure III.

*Summary measures.*—To analyze the data obtained from a case-by-case comparison of an



original and a reinterview survey, certain summary measures should be defined. Table 7 compares the results of an original survey with a reinterview survey. The total number of differences affecting the tabulated figure for a given class is equal to the number of cases included in that class in the original survey but not in the reinterview survey plus the number of cases included in the reinterview survey but not in the original survey. This sum is called the gross difference for the class in question. In terms of table 7,  $b + c$  is the gross difference, and  $(b + c)/n$  is the gross difference rate.

The net difference of the tabulated figure for a given class is the difference between the total for the class obtained in the reinterview and the original surveys. The gross difference usually includes differences in both directions that partly or substantially offset each other. The net difference is the nonoffsetting part of the gross difference. In table 7, the net difference is  $b - c$ , and  $(b - c)/n$  is the net difference rate.

*Net differences.*—Table 8 summarizes the net difference rates for procedure III for 7½-year averages. Since procedure III provided an opportunity for reconciliation of differences, the estimated net differences obtained from it are regarded as the best estimates of bias that the supervisory reinterview program can provide. Except for persons with one or more chronic conditions, the net difference rates would be regarded as small by almost any standard. However, as indicated in the table, all of the net difference rates are statistically significant; i.e., significantly greater than zero.

Many of the results from the HIS are published as rates per person. Table 9 presents rates

from the reinterview survey for the original interview and for the reinterview after reconciliation. The percent net differences shown in the table can be considered as an estimate of the relative bias of the original survey results. According to the reinterview, chronic conditions tend to be underreported by about 24 percent. Disability days are underreported by about 13 to 18 percent. Table 9 shows that hospital episodes and hospital days are better reported. Estimates made from 1959-61 reinterview survey results show percent net differences of about 8 percent for hospital episodes and about 5 percent for hospital days.

*Gross differences and the index of inconsistency.*—Gross differences are differences in individual classifications between the original interview and the reinterview. As discussed in appendix III the gross difference rate can be used to estimate the simple response variance of the original survey estimates, that is, the basic trial-to-trial variability in survey responses. (Appendix III also shows the derivation of an index of inconsistency based on the gross difference rate. This index provides a measure of the unreliability or inconsistency of classification and is defined as the ratio of the simple response variance to the total variance.)

Reinterview without reconciliation (procedure I) provides the best estimate of simple response variance. However, the data from procedure I were tabulated only for fiscal years 1959-61. The gross difference rates and indexes of inconsistency shown in table 10 are based on data from procedure III after reconciliation.

Table 11 shows consistent declines in moving from procedure I to procedure II to procedure

Table 7. General representation of results of original and reinterview surveys for identical persons

Results of reinterview survey	Results of original survey		
	Number having the characteristic	Number not having the characteristic	Total
Number having the characteristic . . . . .	<i>a</i>	<i>b</i>	<i>a + b</i>
Number not having the characteristic . . . . .	<i>c</i>	<i>d</i>	<i>c + d</i>
Total . . . . .	<i>a + c</i>	<i>b + d</i>	<i>n = a + b + c + d</i>

Table 8. Estimated proportions, net difference rates, and standard error of net difference rate for procedure III after reconciliation for a 7½-year quarterly average

Survey item, persons with:	Percent in class on original interview	Percent in class on reinterview	Net difference rate (percent)	Estimated standard error of average net difference rate	
				Underestimate	Overestimate
One or more chronic conditions . . . . .	42.3	49.2	-7.0	0.2	0.4
One or more hospital episodes in past 12 months . . . . .	9.3	10.0	-0.6	0.1	0.1
One or more restricted activity days in past 2 weeks . . . . .	10.6	12.1	-1.5	0.1	0.2
One or more bed days in past 2 weeks . . . . .	5.6	6.4	-0.8	0.1	0.2
One or more time-lost days in past 2 weeks . . . . .	3.4	4.2	-0.8	0.1	0.2

NOTE: Includes fiscal years 1959, 1960, 1961, 1963, 1964, 1965, one-half of fiscal year 1966 and all of fiscal year 1967. A fiscal year runs from July 1 to June 30.

Table 9. Estimated annual rates per 100 persons, original interview and reinterview, and percent net difference for procedure III after reconciliation

Characteristic	Original interview	Reinterview after reconciliation	Percent net difference <sup>1</sup>
	Rate per 100 persons		
Chronic conditions <sup>2</sup> . . . . .	82.0	107.4	-23.6
Restricted activity days <sup>2</sup> . . . . .	1,383.6	1,596.7	-13.3
Bed days <sup>2</sup> . . . . .	466.3	544.5	-14.4
Time-lost days <sup>2</sup> . . . . .	287.1	351.2	-18.3
Hospital episodes <sup>3</sup> . . . . .	9.9	10.7	-7.5
Hospital days <sup>3</sup> . . . . .	94.6	99.7	-5.1

<sup>1</sup>  $\frac{\text{Original} - \text{reinterview}}{\text{reinterview}} \times 100$ .

<sup>2</sup> 7½-year averages.

<sup>3</sup> 3-year averages.

Table 10. Estimated proportions, gross difference rates, and indexes of inconsistency for procedure III after reconciliation for a 7½-year quarterly average

Survey item, persons with:	Percent in class on original interview	Percent in class on reinterview	Gross difference rate X 100	Index of inconsistency X 100
One or more chronic conditions . . . . .	42.3	49.2	8.5	17.2
One or more hospital episodes in past 12 months . . . . .	9.3	10.0	0.9	5.5
One or more restricted activity days in past 2 weeks . . . . .	10.6	12.1	3.4	17.2
One or more bed days in past 2 weeks . . . . .	5.6	6.4	2.3	17.5
One or more time-lost days in past 2 weeks . . . . .	3.4	4.2	1.6	23.4

NOTE: Includes fiscal years 1959, 1960, 1961, 1963, 1964, 1965, one-half of fiscal year 1966, and all of fiscal year 1967. A fiscal year runs from July 1 to June 30.

Table 11. Estimated indexes of inconsistency by three procedures, 3-year averages, fiscal years 1959-61

Survey item, persons with one or more:	Procedure I (no recon- ciliation)	Procedure II (before rec- onciliation)	Procedure III (after recon- ciliation)
Chronic conditions in past 12 months . . . . .	30.9	22.2	17.4
Hospital episodes in past 12 months . . . . .	7.6	7.0	6.0
Restricted activity days in past 2 weeks . . . . .	44.5	28.6	18.3
Bed days in past 2 weeks . . . . .	41.1	26.6	15.8
Time-lost days in past 2 weeks . . . . .	37.6	32.9	21.4
Hospital days in past 2 weeks . . . . .	12.8	19.5	19.1

III in the estimated indexes of inconsistency. If procedures I and II were carried out as specified, then the expected difference between the indexes of inconsistency would be zero. The estimated indexes for procedure II, however, are about 20 percent smaller than the indexes for procedure I.

The differences between procedures II and III are in the direction that would be expected: reconciliation reduces the gross difference rate.

Thus, the estimates in table 10 are an understatement of the gross differences that would occur if repetitions of the HIS were carried out without reconciliation.

Some values of indexes of inconsistency for demographic items computed from other studies are provided in table 12 by size classes and compared with indexes for health items computed from the reinterview program of the HIS.

The index of inconsistency for hospital episodes in the past 12 months is in the same size class as the simpler demographic items such as sex, color, and age.

Time-lost days compare with the more difficult items to measure such as income and educational attainment.

*Comparison of self-respondents with proxy respondents.*—In the original interview for adults, the health questions are asked of the person himself if he is home at the time of the interview. If he is not at home, a related adult may provide the information. The person who is not present at the time of the interview is referred to as a proxy respondent since the information on such a person is obtained by proxy. However, in reinterviews all adults are self-respondents (in all reinterviews conducted during fiscal years 1959-67). Table 13 shows

3-year averages of proportions, net difference rates and indexes of inconsistency for six survey items as reported by self-respondents and proxy respondents in the original survey. The data are based on results after reconciliation (procedure III).

Comparison of self-respondents and proxy respondents are limited by the fact that the selection of the respondent on the original interview is not a random selection. Thus part of the differences in level may be attributed to inherent differences between respondents who are available to report for themselves and respondents who are not available at the time of interview and whose health conditions are reported by another member of the household.

For four of the six items, the reconciliation tends to bring the proportion in the class for proxy respondents closer to that of self-respondents, that is, the net difference rates are greater for proxy respondents.

The estimated prevalence rates for chronic conditions per person from the reinterview survey are presented in table 14 for self-respondents and proxy respondents. In attempting to estimate what effect the respondent has, certain assumptions were made about the differences. Specifically an assumption was made that for self-respondents the net difference between the original rate and the reinterview rate can be considered as the difference due to the second interview. For proxy respondents, the net difference consists of second-interview differences and differences due to the use of a proxy respondent and that these differences are additive. Furthermore, an assumption was made that the differences due to the second interview are the same for self-respondents and proxy

Table 12. Comparison of estimated indexes of inconsistency for Health Interview Survey items with demographic items

Size of index (X 100)	1960 Decennial Census Evaluation Program <sup>1</sup>	Current Population Survey Reinterviews 1961-66 <sup>2</sup>	HIS Reinterviews
<10 . . . . .	Sex Color Age	Employed In labor force	Hospital episodes
11-20 . . . . .	Labor force Mobility	Unemployed	Hospital days Chronic conditions Bed days Restricted activity days
>20 . . . . .	Educational attainment Income		Time-lost days

<sup>1</sup>U.S. Bureau of the Census: Evaluation and Research Program of the U.S. Censuses of Population and Housing, 1960: Accuracy of Data on Population Characteristics as Measured by Reinterviews. Series ER 60-No. 4. Washington, U.S. Government Printing Office, 1964.

<sup>2</sup>U.S. Bureau of the Census: The Current Population Survey Reinterview Program January 1961 through December 1966. Tech. Paper No. 19. Washington, U.S. Government Printing Office, 1968.

respondents. The last column of table 14 shows the net difference expressed as a proportion of the reinterview estimate, and the difference between these relative net differences is a measure of the effect of proxy respondents, that is, that about 16 percent of the relative net difference for persons reported for by proxy respondents can be attributed to the use of a proxy respondent.

*Effect of nonreporting on estimates of magnitude.*—Differences in reporting of the number of conditions, days, episodes, and so forth between the original interview and the reinterview are classified as follows: differences due to a change in the number of conditions, days, episodes, etc., reported on the two interviews or as differences due to a report of no conditions, days, episodes, etc., on one interview and a report of one or more conditions, days, episodes, etc., on the other interview (table 15).

The change from a report of none on one interview to a report of one or more conditions, days, episodes, etc., on the other interview has a relatively small effect on estimates of proportions, but with the exception of hospital days in the past 2 weeks it has a major impact on estimates of magnitude. This section presents estimates of the part of the net and gross

differences for estimates of magnitude that can be accounted for by a change from a report of none on one interview to a report of one or more on the other interview.

Table 16 shows estimates of the components of the total net difference and the ratio of each component to the total net difference.

Table 16 shows that for hospital episodes, restricted activity days, bed days, and time-lost days, the net increase on reinterview for estimates of magnitude is principally due to the change from a report of none on the original interview to a report one or more on reinterview. For hospital days the number of days accounted for by changes from a report of none on the original interview to a report of one or more on reinterview is about the same as the number of days involved in changes of a report of one or more on the original interview to a report of none on reinterview and thus cancel for estimates of net difference. For chronic conditions, the changes in the number of conditions reported for cases which are one or more on both interviews are close to the number of conditions accounted for by changes of a report of none on the original to a report of one or more on reinterview and increase the volume of conditions reported on reinterview. Changes

Table 13. Estimated proportions, net and gross difference rates, and indexes of inconsistency by subject and respondent on original interview compared with proxy respondents, procedure III, 3-year averages, fiscal years 1959-61

Survey item, subject and respondent on original interview, persons with:	Persons in class		Average net difference rate	Average gross difference rate	Index of inconsistency
	Original	Reinterview			
<b>One or more chronic conditions:</b>					
Adult, self-respondent . . . . .	59.4	64.8	-5.4	6.1	13.1
Adult, proxy respondent . . . . .	47.4	58.5	-11.1	14.9	30.3
(self-respondent - proxy respondent) . . . . .	12.0	6.3	5.7		
<b>One or more hospital episodes in past 12 months:</b>					
Adult, self-respondent . . . . .	13.2	13.5	-0.3	0.6	2.4
Adult, proxy respondent . . . . .	9.0	10.0	-1.0	1.3	7.3
(self-respondent - proxy respondent) . . . . .	4.2	3.5	0.7		
<b>One or more restricted activity days in past 2 weeks:</b>					
Adult, self-respondent . . . . .	13.5	14.3	-0.8	3.5	14.8
Adult, proxy respondent . . . . .	8.2	11.0	-2.8	5.0	28.9
(self-respondent - proxy respondent) . . . . .	5.3	3.3	2.0		
<b>One or more bed days in past 2 weeks:</b>					
Adult, self-respondent . . . . .	6.7	7.1	-0.4	1.7	13.4
Adult, proxy respondent . . . . .	4.7	5.5	-0.8	2.0	21.1
(self-respondent - proxy respondent) . . . . .	2.0	1.6	0.4		
<b>One or more time-lost days in past 2 weeks:</b>					
Adult, self-respondent . . . . .	3.1	3.5	0.4	0.8	11.8
Adult, proxy respondent . . . . .	4.3	4.7	-0.4	2.4	28.2
(self-respondent - proxy respondent) . . . . .	-1.2	-1.2	-		
<b>One or more hospital days in past 2 weeks:</b>					
Adult, self-respondent . . . . .	0.7	0.7	-	0.3	21.6
Adult, proxy respondent . . . . .	0.4	0.4	-	0.2	23.9
(self-respondent - proxy respondent) . . . . .	0.3	0.3	-		

Table 14. Estimated prevalence rate of chronic conditions per person by subject and respondent on original interview, original and reinterview estimates for a sample of identical persons, reconciled reinterviews, fiscal years 1959-61

Subject and respondent on original interview	Chronic conditions per person (12 months)			
	Original (a)	Reinterview (reconciled) (b)	Net difference (a) - (b)	(a) - (b) / (b)
Adult, self-respondent . . . . .	1.26	1.52	-.26	-.17
Adult, proxy respondent . . . . .	.84	1.25	-.41	-.33
Self-respondent - proxy respondent . . . . .				.16
Estimated sampling error of difference . . . . .				.02

NOTE: A similar comparison for a different time period and including all conditions, acute and chronic, is presented in table 15. The magnitude of effect that the type of respondent has is about the same.

Table 15. Estimated rate of conditions per person by subject and respondent on original interview, original and reinterview estimates for a sample of identical persons, reconciled reinterviews, fiscal years 1963-67

Subject and respondent at original interview	Conditions per person			
	Original (a)	Reinterview (reconciled) (b)	Net difference (a) - (b)	$\frac{(a) - (b)}{(b)}$
Adult, self-respondent . . . . .	1.61	1.74	-.13	-.07
Adult, proxy respondent . . . . .	1.00	1.31	-.31	-.24
Self-respondent - proxy respondent . . . . .				.17
Estimated sampling error of difference . . . . .				.01

Table 16. Estimated total net difference between original interview results and reinterview results and components of net difference, reconciled reinterviews, fiscal years 1959-61

Survey item	Total net difference (x - y) <sup>1</sup>	Components of total net difference			Ratio of components to total net difference	
		Due to change in reporting from presence on original to absence on reinterview	Due to change in reporting from absence on original to presence on reinterview	Due to change in reporting of magnitude when present on both interviews <sup>2</sup>	0,1 difference $\frac{ (2)  -  (3) }{(1)}$	Magnitude difference $\frac{(4)}{(1)}$
	(1)	(2)	(3)	(4)	(5)	(6)
Chronic conditions in past 12 months . . . . .	-26,700	964	-12,541	-15,123	.43	.57
Hospital episodes in past 12 months . . . . .	-881	220	-969	-132	.85	.15
Hospital days in past 2 weeks . . . . .	185	584	-552	153	.16	.83
Restricted activity days in past 2 weeks . . . . .	-13,908	7,244	-17,003	-4,149	.70	.30
Bed days in past 2 weeks . . . . .	-3,592	1,533	-4,921	-204	.94	.06
Time-lost days in past 2 weeks . . . . .	-3,361	1,327	-4,684	-4	1.00	( <sup>3</sup> )

<sup>1</sup>x is the estimate of magnitude from the original interview, and y is the estimate of magnitude from the reinterview.

<sup>2</sup>Algebraically this component is [column (1)] - [column (2) + column (3)]. A minus sign indicates a net increase on reinterview.

<sup>3</sup>Less than 0.005.

NOTE: The tabulations for hospital days, restricted activity days, bed days and time-lost days are in terms of 2-day intervals. The components of the net difference were estimated by using midpoints of the 2-day intervals. Changes in response that did not result in a change of class interval have no effect on the estimates.

from a report of one or more on the original to a report of none on reinterview do not have much effect on the estimates of chronic conditions.

A large proportion of the gross differences in estimates of magnitude is accounted for by

changes from a report of none to a report of one or more in both directions. The following index is an estimate of the proportion of the total response variance that is accounted for by cases which either change from a report of none on

the original interview to a report of one or more on reinterview or from a report of one or more on the original interview to a report of none on reinterview:

$$\hat{G} = \frac{\sum_{x=1}^w f_{x0}(x-0)^2 + \sum_{y=1}^w f_{0y}(0-y)^2}{\sum_{y=0}^w \sum_{x=0}^w f_{xy}(x-y)^2}$$

where  $x$  is the value on the original interview,  $y$  is the value on reinterview,  $f_{x0}$  is the number of persons with  $x$  value on original and 0 on reinterview,  $f_{0y}$  is the number of persons with 0 on original and  $y$  value on reinterview, and  $f_{xy}$  is the number of persons with  $x$  value on original interview and  $y$  value on reinterview.

Table 17 shows that except for chronic conditions most of the response variance for estimates of magnitude can be accounted for by changes in the reporting of the presence or absence of the characteristic.

Tables 18-22 present estimates by year of the summary measures discussed in previous sections. All of these results are for procedure III, that is, a comparison of the original interview with reinterview after reconciliation. The yearly estimates are subject to large sampling errors since the reinterview sample in any one year is relatively small. One additional summary measure, the index of net shift, is presented. The

index of net shift is simply the ratio of the net difference rate to the percent in class on reinterview.

## INTERVIEWER VARIABILITY STUDY

### Introduction

The joint effects of sampling and nonsampling errors determine the accuracy of survey results. The mathematical model of response errors in surveys presented in appendix III shows how the mean square error of a statistic is divided into its various components: sampling variance, response variance, interaction, and square of bias.

The response variance can be further divided into simple response variance and correlated response variance. In the preceding section, estimates were presented of the simple response variance and of response bias as measured by reinterviews. The usual estimates of sampling variance include the simple response variance and possibly a small part of the correlated response variance due to field interviewers. However, the major part of the interviewer contribution to response variability is not included in the estimates of sampling variance. This section describes an interviewer variance study designed to measure the contributions of interviewers to the variability of health statistics.

Significant between-interviewer variance in the reporting of health data has been observed in a number of studies. Data from other studies also indicate that interviewer effects may operate differently for different statistics.

Table 17. Proportion of total response variance due to changes in reporting of presence or absence of characteristic procedure III, reconciled results

Characteristic	G
Chronic conditions in past 12 months . . . . .	.41
Hospital episodes in past 12 months . . . . .	.92
Hospital days in past 2 weeks . . . . .	.96
Restricted activity days in past 2 weeks . . . . .	.88
Bed days in past 2 weeks . . . . .	.80

NOTE: Hospital days, restricted activity days, bed days, and time-lost days for the tabulations are in terms of 2-day intervals. Midpoints of the 2-day intervals were used for the  $x$  and  $y$  values. Changes in response which did not result in a change of class interval have no effect on the estimates.

### Design of the Interviewer Variance Study

The interviewer variance study was conducted over the 4-year period 1960-63. For the first 2 years of the study, randomization of interviewer assignments was carried out in eight large SMSA's where there were two or more HIS interviewers. The study included 10 SMSA's during the second 2-year period. The assignments (within each pair or triplet) of interviewers within an SMSA were randomized in an interpenetrated design so that each interviewer of a pair would have produced results with the same expected value if there were no between-interviewer variability.

Table 18. Estimated proportions, net difference rates, indexes of net shift, gross difference rates, and indexes of inconsistency for procedure III after reconciliation for persons with one or more chronic conditions in the past 12 months, by year

Fiscal year	Percent in class on original interview	Percent in class on reinterview	Net difference rate X 100	Index of net shift <sup>1</sup> X 100	Gross difference rate X 100	Index of inconsistency X 100
1959	38.5	45.2	-6.8	-15.0	8.6	17.9
1960	42.5	49.3	-6.7	-13.8	7.9	16.2
1961	41.7	49.2	-7.5	-15.3	8.9	18.1
1962	NA <sup>2</sup>	NA	NA	NA	NA	NA
1963	41.5	48.2	-6.7	-13.8	8.3	16.8
1964	42.8	50.5	-7.7	-15.2	9.5	19.3
1965	43.7	51.3	-7.6	-14.8	8.7	17.6
1966 <sup>3</sup>	48.5	56.2	-7.7	-13.8	8.9	17.9
1967	46.3	51.9	-5.5	-10.7	6.7	13.4

<sup>1</sup>  $\frac{\text{Net difference rate}}{\text{Percent in class on reinterview}}$

<sup>2</sup> Not available.

<sup>3</sup> 2 quarters only (July 1, 1965-Dec. 1965).

Table 19. Estimated proportions, net difference rates, indexes of net shift, gross difference rates, and indexes of inconsistency for procedure III after reconciliation for persons with one or more hospital episodes in the past 12 months, by year

Fiscal year	Percent in class on original interview	Percent in class on reinterview	Net difference rate X 100	Index of net shift <sup>1</sup> X 100	Gross difference rate X 100	Index of inconsistency X 100
1959	8.4	8.6	-0.1	-1.2	0.9	5.5
1960	9.4	10.1	-0.7	-6.9	0.9	5.2
1961	8.0	9.1	-1.1	-12.1	1.2	7.4
1962	NA	NA	NA	NA	NA	NA
1963	9.6	10.9	-1.4	-12.8	1.5	8.3
1964	11.1	11.8	-0.7	-5.9	0.8	3.6
1965	11.9	12.1	-0.2	-1.7	0.4	1.6
1966 <sup>2</sup>	7.3	7.5	-0.1	-1.3	0.1	1.0
1967	8.7	9.1	-0.4	-4.8	1.1	6.9

<sup>1</sup>  $\frac{\text{Net difference rate}}{\text{Percent in class on reinterview}}$

<sup>2</sup> 2 quarters only (July 1, 1965-Dec. 1965).

For the first 2 years of the study, calendar years 1960 and 1961, the data cover the work in 25 interviewer assignment areas. Six of the eight SMSA's had a pair of interviewers, Los Angeles had a triplet, and the New York SMSA had five pairs of interviewers.

For the second 2 years, calendar years 1962 and 1963, the data cover the work in 30 interviewer assignment areas for two quarters

and the work in 28 interviewer assignment areas for the remaining six quarters. (The HIS sample was redesigned in 1962, and one interviewer pair was dropped in the New York SMSA.) Assignments in Chicago and Los Angeles were randomized among three interviewers during the second 2-year period.

During the 4-year period, a total of 6,415 segments of six to nine households were in-



Table 20. Estimated proportions, net difference rates, indexes of net shift, gross difference rates, and indexes of inconsistency for procedure III after reconciliation for persons with one or more restricted activity days in the past 2 weeks, by year

Fiscal year	Percent in class on original interview	Percent in class on reinterview	Net difference rate X 100	Index of net shift <sup>1</sup> X 100	Gross difference rate X 100	Index of inconsistency X 100
1959	10.4	11.9	-1.4	-11.8	4.0	20.6
1960	10.5	12.8	-2.3	-17.9	4.4	22.0
1961	12.4	14.1	-1.7	-12.1	3.3	14.6
1962	NA	NA	NA	NA	NA	NA
1963	9.5	10.0	-0.5	-5.0	2.5	14.2
1964	10.9	11.9	-1.1	-9.2	2.3	11.1
1965	11.1	12.3	-1.3	-10.6	3.0	15.0
1966 <sup>2</sup>	6.4	7.5	-1.1	-14.7	1.8	13.9
1967	10.9	13.6	-2.7	-19.9	4.5	23.1

<sup>1</sup> Net difference rate  
Percent in class on reinterview

<sup>2</sup> 2 quarters only (July 1, 1965-Dec. 1965).

cluded in the assignments. Of these segments, 1,204 were excluded from the analysis for the following reasons:

Reason for exclusion	Percent of total segments
Total assigned segments not used in analysis	18.8
Segments completed by "other than assigned interviewers"	12.4
Segments in non-self-representing PSU's	3.1
Segments where it could not be determined who completed the assignments	1.2
Segments containing "special dwelling places"	2.0

The remaining 5,211 segments used in the analysis contained about 34,000 households with 110,000 persons.

### Method of Analysis

For this analysis, ratios of two variables were used at all times for two reasons. First, most HIS data are presented as rates or proportions of the total population; and, second, this method minimizes the effect of the variability in size of interviewer assignment on the analysis.

The starting point for the analysis was a computer tape containing quarterly totals for

each of 84 health and demographic characteristics for each of the interviewer assignment areas.

The mathematical model used to compute the total variance is basically a comparison of results between a pair of interviewers, extended to the whole study area. The task was to estimate the expected value of the difference between two interviewers' findings for a specified period of time. In the model, the total relvariance for the study area is

$$V_T^2 = \frac{1/4 E(r_a - r_b)^2}{E r^2} \quad (1)$$

where  $r_a$  is the ratio computed from a random half of the interviewers and  $r_b$  is the ratio computed from the other random half and the expected value is taken over all possible half-samples. An estimate of this expected value was made by assigning each interviewer in a pair to  $a$  or  $b$  at random and then averaging over all pairs of interviewers.<sup>b</sup> Different permutations of the pairs give other estimates. Twenty-five permutations were used to give the estimator:

<sup>b</sup>Strictly speaking, it is interviewer assignment area instead of interviewer. When there was a change in interviewers due to resignation, illness, or other administrative reason other than a temporary substitution, the work of the replacement interviewer was treated as part of the same interviewer assignment area.

Table 21. Estimated proportions, net difference rates, indexes of net shift, gross difference rates, and indexes of inconsistency for procedure III after reconciliation for persons with one or more bed days in the past 2 weeks, by year

Fiscal year	Percent in class on original interview	Percent in class on reinterview	Net difference rate X 100	Index of net shift <sup>1</sup> X 100	Gross difference rate X 100	Index of inconsistency X 100
1959	5.6	6.1	-0.5	-8.2	3.8	15.8
1960	5.5	6.4	-0.9	-14.1	2.1	18.3
1961	5.4	6.3	-0.9	-14.3	1.7	15.8
1962	NA	NA	NA	NA	NA	NA
1963	5.3	6.0	-0.6	-10.0	2.1	19.9
1964	6.0	6.4	-0.5	-7.8	1.6	13.8
1965	5.1	6.0	-1.0	-16.7	1.2	12.7
1966 <sup>2</sup>	4.5	5.0	-0.5	-10.0	1.7	22.7
1967	6.8	8.8	-1.9	-21.6	3.4	25.6

<sup>1</sup> Net difference rate

Percent in class on reinterview

<sup>2</sup> 2 quarters only (July 1, 1965-Dec. 1965).

Table 22. Estimated proportions, net difference rates, indexes of net shift, gross difference rates, and indexes of inconsistency for procedure III after reconciliation for persons with one or more time loss days in the past 2 weeks, by year

Fiscal year	Percent in class on original interview	Percent in class on reinterview	Net difference rate X 100	Index of net shift <sup>1</sup> X 100	Gross difference rate X 100	Index of inconsistency X 100
1959	4.2	4.9	-0.7	-14.3	1.4	19.3
1960	3.7	4.9	-1.2	-24.5	1.7	24.1
1961	3.3	3.8	-0.5	-13.2	2.0	29.5
1962	NA	NA	NA	NA	NA	NA
1963	3.1	3.8	-0.7	-18.4	1.1	15.8
1964	2.6	3.1	-0.5	-16.1	1.6	31.5
1965	3.4	4.2	-0.8	-19.0	1.2	15.0
1966 <sup>2</sup>	3.0	3.1	-0.1	-3.2	0.6	10.7
1967	3.6	5.2	-1.6	-30.8	2.6	37.2

<sup>1</sup> Net difference rate

Percent in class on reinterview

<sup>2</sup> 2 quarters only (July 1, 1965-Dec. 1965).

$$\hat{V}_T^2 = \frac{\frac{1}{25} \sum_{j=1}^{25} \frac{1}{4}(r_{ja} - r_{jb})^2}{r^2} \quad (2)$$

where  $j$  denotes the permutation and  $r$  the estimated ratio computed from the work of all interviewers.

This estimator has two components that must be identified separately: the between-interviewer relvariance and a sampling relvariance arising from the fact that each interviewer of a pair

interviewed a separate random sample of households. Estimates of  $V_T^2$  were made for a single quarter of data, two quarters combined, three quarters, up to an estimate based on eight quarters of data.

In the analysis, the results were treated as if they were two independent studies of 2 years each. One reason for treating the results as two observations was to minimize the effect of interviewer turnover. Another reason was strictly practical; 2 years of data could be handled more easily than 4 years.

If it is assumed that the sampling variance is a function of sample size but that the estimate of the between-interviewer variance is a function only of the number of interviewers, then

$$\hat{V}_T^2 = \hat{V}_I^2 + \frac{\hat{V}_E^2}{n} \quad (3)$$

where  $\hat{V}_I^2$  is the estimate of the between-interviewer relvariance and  $\hat{V}_E^2/n$  is the estimate of the sampling relvariance for a single quarter divided by the number of quarters used in the estimate. The parameters of this function were estimated in terms of  $V_T^2$  by the method of least squares (appendix IV). This least-squares solution was then used to determine  $\hat{V}_I^2$  and  $\hat{V}_E^2$ . Figure 1 shows an example of the expected behavior of  $\hat{V}_T^2$  as the sample size increases.

As the number of quarters included in the estimate increases, the sampling component of the variance decreases and the estimate of total variance approaches the between-interviewer variance asymptotically.

The assumptions of equation 3 are undoubtedly not fully warranted. There is evidence from other studies conducted by the Bureau of the Census that the response variance cannot be viewed as a constant even if, as is not the case in the present study, the interviewers did not change over the 2-year period. To illustrate further that the assumptions are not completely true, it can be shown that the response variance is the sum of two terms.

The first is a simple response variance, which expresses the variability in repeated measures (interviews) on the same persons. This quantity varies inversely with the sample size and thus

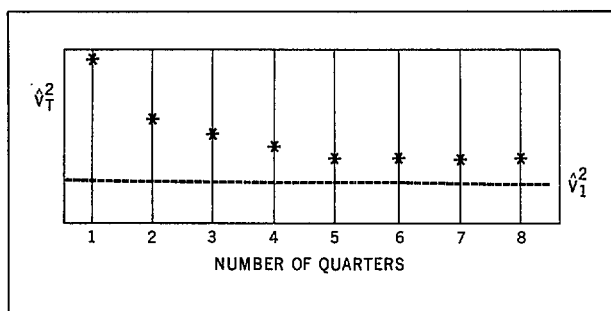


Figure 1. Expected reduction in  $V_T^2$  as sample size increases.

depends on the number of quarters of data. In the estimation scheme used in this study, the simple response variance has been treated as part of the sampling variance and subtracted out. Thus, the estimator  $\hat{V}_I^2$  is somewhat of an underestimate.

The second term is the product of two factors: the simple response variance and a correlation expressing the extent to which each interviewer tends to introduce her own systematic response errors in her assignment (see appendix III). An assumption of this study is that this correlation is a constant over the 2-year period, although there is evidence from other programs that the correlation may decline with an increase in experience because of training, increased proficiency, and the increasing heterogeneity in the population included in the assignment.

## Results

Tables 23 and 24 contain the results of this study. These results are presented in two tables, one for each 2-year period. Each table shows results for 67 items.

The estimated relvariances shown in the tables relate to annual estimates prepared from the work of approximately one-fourth of the interviewer staff. For some items the estimates of between-interviewer relvariances are negative. These are items which presumably have a very low interviewer variability.

The sample size is too small to place much reliance on the specific estimates of the relvariances; however, the last column of the tables is probably sufficiently reliable to provide a general ranking of the characteristics. This last column expresses the between-interviewer relvariance as a proportion of the total relvariance. Discussion of the results shown in tables 23 and 24 is based on this last column.

The results shown in the tables indicate that the reporting of chronic conditions and activity restriction associated with such conditions have the highest ratios of between-interviewer variance to total variance. In addition, as might be expected, reporting of income also has a fairly high ratio.

As has been observed in other studies of between-interviewer variance, reported in papers

Table 23. Interviewer variance study of estimates of components of reliability for annual estimates of selected characteristics based on 25 interviewer assignment areas in eight SMSA's: United States, 1960-61

Numerator	Denominator (total number of the following)	Ratio	Total re- liability $\hat{V}_T^2$	Between- interviewer reliability $\hat{V}_I^2$	Sampling reliability $\hat{V}_E^2$	$\frac{\hat{V}_I^2}{\hat{V}_T^2}$
<b>Health characteristics (Magnitude items):</b>						
Conditions	Households	2.563	.00395	.00369	.00026	.934
Chronic conditions for females	Females	.769	.00483	.00442	.00041	.915
Chronic conditions for males	Males	.612	.00434	.00370	.00064	.854
Chronic conditions with 1 or more bed days in last 12 months	Persons	.115	.00476	.00404	.00072	.848
Restricted activity days for chronic conditions in last 2 weeks	Chronic conditions	.533	.01328	.01045	.00283	.787
Restricted activity days in last 2 weeks	Persons	.602	.00411	.00296	.00115	.720
Acute conditions	Persons	.115	.00285	.00202	.00083	.708
Chronic conditions with 1 or more bed days in last 2 weeks	Persons	.024	.00861	.00604	.00256	.702
Disability days in last 2 weeks from all accidents	Accidents	1.182	.01289	.00842	.00447	.653
Restricted activity days in last 2 weeks for acute conditions	Acute conditions	3.119	.00273	.00135	.00138	.494
Restricted activity days in last 2 weeks for acute conditions for males	Acute conditions for males	2.996	.00524	.00244	.00281	.465
Bed days for chronic conditions in last 2 weeks	Persons	.136	.00823	.00361	.00462	.439
Bed days in last 2 weeks	Persons	.227	.00268	.00115	.00153	.430
Bed days for chronic conditions in last 12 months	Chronic conditions	4.245	.00575	.00243	.00332	.423
Days lost from school or work in last 2 weeks	Persons currently employed and persons aged 6-16 years	.217	.00359	.00135	.00224	.376
Days lost from work in last 2 weeks	Persons currently employed	.206	.00517	.00133	.00385	.259
Bed days for acute conditions in last 2 weeks	Acute conditions	1.261	.00203	-.00007	.00210	-.036
Days lost from school in last 2 weeks	Persons aged 6-16 years	.239	.01041	-.00113	.01154	-.109
Hospital discharges in last 1 month	Persons	.103	.00049	-.00007	.00056	-.138
Hospitalizations in last 12 months	Households	.333	.00045	-.00011	.00056	-.256
Hospital days in last 12 months	Hospitalization in last 12 months	10.732	.00236	-.00133	.00369	-.563
Hospital days for all discharged in last 12 months	Hospital discharges in last 12 months	10.456	.00183	-.00170	.00353	-.926
<b>Health characteristics (Attribute items):</b>						
Persons with 1 or more chronic conditions	Persons	.389	.00196	.00174	.00022	.886
Persons with 1 or more conditions	Persons	.450	.00165	.00146	.00019	.886
Males with 1 or more chronic conditions	Males	.369	.00230	.00193	.00037	.839
Males with 1 or more conditions	Males	.428	.00198	.00165	.00033	.832
Persons limited in kind or amount of activities	Persons	.068	.00283	.00152	.00132	.535
Acute conditions medically attended	Acute conditions	.731	.00031	.00009	.00022	.283
New cases acute respiratory conditions, 1 or more bed days	Persons	.026	.00424	.00108	.00317	.254
Hospitalizations for tonsillectomy or adenoidectomy for males in last 12 months	Hospitalizations for operations, males	.147	.01540	.00369	.01171	.240
Hospitalizations for operations on the female genital system in last 12 months	Hospitalization for operations, females, exclusive of delivery	.346	.00360	-.00107	.00467	-.298
Persons unable to carry on major activity	Persons	.018	.00233	-.00081	.00313	-.346
<b>Socioeconomic characteristics:</b>						
Families with income > \$5000	Families	.521	.00115	.00077	.00039	.665
Persons in families with income > \$5000	Persons	.606	.00099	.00066	.00033	.664
Families with income < \$2000	Families	.117	.00371	.00127	.00244	.342
Persons who are not employed and not keeping house	Persons aged 17 years and over	.075	.00133	.00033	.00100	.246
Employed persons	Persons aged 17 years and over	.561	.00006	.00001	.00005	.116
Persons in families with income > \$2000	Persons	.065	.00356	.00031	.00326	.086
Employed females	Females aged 17 years and over	.330	.00040	-.00003	.00042	-.069

Table 23. Interviewer variance study of estimates of components of reliability for annual estimates of selected characteristics based on 25 interviewer assignment areas in eight SMSA's: United States, 1960-61—Con.

Numerator	Denominator (total number of the following)	Ratio	Total re- variance $\sigma_T^2$	Between- interviewer reliability $\sigma_I^2$	Sampling reliability $\sigma_E^2$	$\frac{\sigma_I^2}{\sigma_T^2}$
<b>Nonresponse Items:</b>						
Persons with amount of education unknown . . . . .	Persons aged 17 years and over	.021	.01961	.01535	.00426	.783
Heads of households with amount of education unknown . . . . .	Households	.026	.02727	.02064	.00663	.757
Families with unknown family income . . . . .	Families	.065	.01275	.00798	.00477	.626
Conditions from accidents, unknown if motor vehicle . . . . .	Accidents	.003	.37186	.34642	.02544	.932
Conditions from accidents, unknown location . . . . .	Accidents	.002	.53790	.58952	-.05162	1.096
<b>Demographic characteristics (including health characteristics by age groups):</b>						
Chronic conditions with 1 or more bed days, persons aged 5-14 years . . . . .	Chronic conditions	.018	.00883	.00545	.00337	.618
Acute conditions, persons aged 25-44 years . . . . .	Acute conditions	.239	.00133	.00036	.00098	.267
Chronic conditions with 1 or more bed days, persons aged 25-44 years . . . . .	Chronic conditions	.049	.00251	.00050	.00201	.200
Acute conditions, persons aged 15-24 years . . . . .	Acute conditions	.102	.00520	.00068	.00452	.131
Females, married, spouse present . . . . .	Females, aged 17 years and over	.643	.00013	.00001	.00011	.108
Persons of other races . . . . .	Persons	.007	.03511	.00200	.03311	.057
Chronic conditions with 1 or more bed days, persons aged under 5 years . . . . .	Chronic conditions	.007	.01386	.00076	.01310	.055
Persons of Negro race . . . . .	Persons	.108	.01216	-.00011	.01227	-.009
Acute conditions, persons aged 5-14 years . . . . .	Acute conditions	.241	.00167	-.00008	.00175	-.050
Chronic conditions with 1 or more bed days, persons 65 years and over . . . . .	Chronic conditions	.028	.00376	-.00024	.00400	-.064
Acute conditions, persons aged 65 years and over . . . . .	Acute conditions	.075	.00756	-.00066	.00822	-.087
Males aged 17 years and over . . . . .	Persons aged 17 years and over	.465	.00005	-.00001	.00006	-.184
Persons aged under 1 year . . . . .	Persons	.020	.00161	-.00033	.00194	-.203
Persons aged 1 year and over . . . . .	Persons	.980	.00000	-.00000	.00000	-.214
Females aged 17 years and over . . . . .	Persons aged 17 years and over	.535	.00003	-.00001	.00004	-.222
Acute conditions, persons aged 45-64 years . . . . .	Acute conditions	.170	.00235	-.00074	.00309	-.316
Acute conditions, persons aged 5 years and over . . . . .	Acute conditions	.173	.00282	-.00107	.00389	-.380
Persons . . . . .	Households	3.167	.00008	-.00005	.00013	-.677
Chronic conditions with 1 or more bed days, persons aged 15-24 years . . . . .	Chronic conditions	.011	.00629	-.00430	.01058	-.683
Chronic conditions with 1 or more bed days, persons aged 45-64 years . . . . .	Chronic conditions	.053	.00130	-.00092	.00223	-.708
Persons aged 17 years and over . . . . .	Persons	.667	.00005	-.00004	.00009	-.848
Persons aged under 17 years . . . . .	Persons	.333	.00020	-.00018	.00038	-.896

by Eckler and Hurwitz,<sup>10</sup> and Hurley, Jabine, and Larson,<sup>11</sup> there are considerable between-interviewer variances in nonresponse rates. Note, for example, that the ratio of between-interviewer variance to the total variance is about .8 for the number of persons with education unknown.

It is also of interest to note that the demographic differentials in morbidity rates (distributions of acute and chronic conditions by age groups) are not subject to any significant between-interviewer variance.

The estimates of interviewer variability from the two periods (1960-61 and 1962-63) differ considerably for some items. The material for the first 2 years was investigated to determine the cause of the higher estimates of interviewer variability for these items. During the 1960-61 period, one interviewer of the 25 in the study contributed a disproportionate amount to the estimates of between-interviewer variability. However, the response variance study of the 1960 census<sup>12</sup> demonstrated that the distribution of individual interviewer contributions to

Table 24. Interviewer variance study of estimates of components of reliability for annual estimates of selected characteristics based on 28 interviewer assignment areas in 10 SMSA's: United States, 1962-63

Numerator (total number of the following)	Denominator (total number of the following)	Ratio	Total rel- variance $\hat{\sigma}_T^2$	Between- interviewer reliability $\hat{\sigma}_I^2$	Sampling reliability $\hat{\sigma}_E^2$	$\frac{\hat{\sigma}_I^2}{\hat{\sigma}_T^2}$
<b>Health characteristics (Magnitude items):</b>						
Conditions . . . . .	Households	2.850	.00064	.00024	.00039	.384
Chronic conditions for females . . . . .	Females	.848	.00117	.00068	.00048	.586
Chronic conditions for males . . . . .	Males	.667	.00093	.00029	.00064	.312
Chronic conditions with 1 or more bed days in last 12 months . . . . .	Persons	.132	.00142	.00064	.00077	.455
Restricted activity days for chronic conditions in last 2 weeks . . . . .	Chronic conditions	.563	.01089	.00839	.00250	.770
Restricted activity days in last 2 weeks . . . . .	Persons	.610	.00314	.00204	.00110	.649
Acute conditions . . . . .	Persons	.120	.00054	-.00012	.00066	-.230
Chronic conditions with 1 or more bed days in last 2 weeks . . . . .	Persons	.028	.01029	.00734	.00295	.713
Disability days in last 2 weeks from all accidents Restricted activity days in last 2 weeks for acute conditions . . . . .	Accidents	1.022	.00680	.00353	.00327	.519
Restricted activity days in last 2 weeks for acute conditions for males . . . . .	Acute conditions	2.812	.00118	.00015	.00103	.126
Bed days for chronic conditions in last 2 weeks . . . . .	Acute conditions for males	2.716	.00232	.00042	.00190	.180
Bed days in last 2 weeks . . . . .	Persons	.172	.01242	.00552	.00690	.445
Bed days for chronic conditions in last 12 months . . . . .	Persons	.253	.00245	.00065	.00180	.265
Days lost from school or work in last 2 weeks . . . . .	Chronic conditions	4.677	.00273	-.00006	.00279	-.021
Days lost from work in last 2 weeks . . . . .	Persons currently employed and persons aged 6-16 years	.231	.00219	.00005	.00214	.021
Bed days for acute conditions in last 2 weeks . . . . .	Persons currently employed	.217	.00342	.00012	.00330	.036
Days lost from school in last 2 weeks . . . . .	Acute conditions	1.286	.00172	.00004	.00168	.023
Hospital discharges in last 12 months . . . . .	Persons aged 6-16 years	.240	.00712	-.00270	.00981	-.379
Hospitalizations in last 12 months . . . . .	Persons	.071	.00102	.00034	.00068	.332
Hospital days in last 12 months . . . . .	Households	.382	.00061	.00017	.00044	.281
Hospital days for all discharges in last 12 months . . . . .	Hospitalizations in last 12 months	10.845	.00297	.00004	.00292	.014
	Hospital discharges in last 12 months	11.384	.00766	.00327	.00438	.428
<b>Health characteristics (Attribute items):</b>						
Persons with 1 or more chronic conditions . . . . .	Persons	.408	.00034	.00016	.00018	.475
Persons with 1 or more conditions . . . . .	Persons	.468	.00026	.00011	.00014	.446
Males with 1 or more chronic conditions . . . . .	Males	.387	.00046	.00017	.00029	.362
Males with 1 or more conditions . . . . .	Males	.444	.00036	.00013	.00023	.354
Persons limited in kind or amount of activities . . . . .	Persons	.096	.00211	.00131	.00080	.621
Acute conditions medically attended . . . . .	Acute conditions	.766	.00015	.00006	.00010	.358
New cases acute respiratory conditions, 1 or more bed days . . . . .	Persons	.030	.00272	.00016	.00256	.058
Hospitalizations for tonsillectomy or adenoidectomy, males in last 12 months . . . . .	Hospitalizations for operations, males	.149	.01129	-.00173	.01302	-.153
Hospitalizations for operations, female genital system in last 12 months . . . . .	Hospitalizations for operations, females, exclusive of delivery	.347	.00235	-.00020	.00255	-.084
Persons unable to carry on major activity . . . . .	Persons	.018	.00253	.00003	.00250	.012
<b>Socioeconomic characteristics:</b>						
Families with income > \$5000 . . . . .	Families	.573	.00035	.00009	.00026	.260
Persons in families with income > \$5000 . . . . .	Persons	.657	.00027	.00001	.00026	.044
Families with income < \$2000 . . . . .	Families	.115	.00268	.00108	.00160	.403
Persons who are not employed and not keeping house . . . . .	Persons aged 17 years and over	.079	.00085	.00023	.00062	.269
Employed persons . . . . .	Persons aged 17 years and over	.560	.00004	.00000	.00004	.122
Persons in families with income < \$2000 . . . . .	Persons	.064	.00351	.00078	.00272	.224
Employed females . . . . .	Females aged 17 years and over	.324	.00015	-.00011	.00025	-.721

Table 24. Interviewer variance study of estimates of components of relvariance for annual estimates of selected characteristics based on 28 interviewer assignment areas in 10 SMSA's: United States, 1962-63—Con.

Numerator (total number of the following)	Denominator (total number of the following)	Ratio	Total relvariance $\hat{\sigma}_T^2$	Between-interviewer relvariance $\hat{\sigma}_I^2$	Sampling relvariance $\hat{\sigma}_E^2$	$\frac{\hat{\sigma}_I^2}{\hat{\sigma}_T^2}$
<b>Nonresponse Items</b>						
Persons with amount of education unknown . . . . .	Persons aged 17 years and over	.016	.02338	.01950	.00388	.834
Heads of households with amount of education unknown . . . . .	Households	.019	.02767	.02218	.00549	.802
Families with unknown family income . . . . .	Families	.056	.01244	.00884	.00360	.711
Conditions from accidents, unknown if motor vehicle . . . . .	Accidents	.008	.08156	-.00321	.08477	-.039
Conditions from accidents, unknown location . . . . .	Accidents	.004	.18992	.08211	.10781	.432
<b>Demographic characteristics (including health characteristics by age groups):</b>						
Chronic conditions with 1 or more bed days, persons aged 5-14 years . . . . .	Chronic conditions	.017	.00401	.00040	.00361	.100
Acute conditions, persons aged 25-44 years . . . . .	Acute conditions	.246	.00109	.00023	.00086	.208
Chronic conditions with 1 or more bed days, persons aged 25-44 years . . . . .	Chronic conditions	.052	.00168	.00015	.00153	.091
Acute conditions, persons aged 15-24 years . . . . .	Acute conditions	.123	.00207	-.00053	.00260	-.257
Females, married, spouse present . . . . .	Females, aged 17 years and over	.633	.00011	.00002	.00009	.208
Persons of other races . . . . .	Persons	.011	.06787	.01118	.05669	.165
Chronic conditions with 1 or more bed days, persons aged under 5 years . . . . .	Chronic conditions	.008	.00896	-.00147	.01043	-.164
Persons of Negro race . . . . .	Persons	.118	.01480	.00543	.00937	.367
Acute conditions, persons aged 5-14 years . . . . .	Acute conditions	.231	.00134	.00016	.00118	.118
Chronic conditions with 1 or more bed days, persons aged 65 years and over . . . . .	Chronic conditions	.029	.00279	-.00112	.00391	-.404
Acute conditions, persons aged 65 years and over . . . . .	Acute conditions	.064	.00630	.00076	.00555	.120
Males aged 17 years and over . . . . .	Persons aged 17 years and over	.466	.00002	.00000	.00002	.103
Persons aged under 1 year . . . . .	Persons	.020	.00210	.00051	.00159	.241
Persons aged 1 year and over . . . . .	Persons	.980	.00000	.00000	.00000	.275
Females aged 17 years and over . . . . .	Persons aged 17 years and over	.534	.00002	.00000	.00002	.152
Acute conditions, persons aged 45-64 years . . . . .	Acute conditions	.171	.00252	.00053	.00199	.210
Acute conditions, persons aged under 5 years . . . . .	Acute conditions	.168	.00270	.00025	.00245	.093
Persons . . . . .	Households	3.231	.00006	-.00001	.00007	-.224
Chronic conditions with 1 or more bed days, persons aged 15-24 years . . . . .	Chronic conditions	.014	.00587	-.00009	.00596	-.015
Chronic conditions with 1 or more bed days, persons aged 45-64 years . . . . .	Chronic conditions	.052	.00119	-.00004	.00123	-.037
Persons aged 17 years and over . . . . .	Persons	.657	.00004	-.00000	.00004	-.024
Persons aged under 17 years . . . . .	Persons	.343	.00015	-.00001	-.00015	-.038

the between-interviewer variance is highly skewed. For example, only about 5 percent of the Census enumerator pairs produced high estimates of response variance for four or more of six nonresponse items.

### SUMMARY

In addition to the programs described in this report, three other approaches have been employed in efforts to assess the reliability and accuracy of the statistics produced by the HIS.

The first is estimates of accuracy through record checks. Comparison of survey responses

with records have been made in a number of special studies designed to assess the accuracy of reporting chronic conditions, frequency of hospitalizations, and frequency of visits to doctors.<sup>13-18</sup> The samples have been limited to persons whose names appear on designated groups of records, e.g., patrons of the Health Insurance Plan of New York City and patients at designated hospitals in Detroit. The check starts from the records and goes back to a set of interviews.

A second approach is comparison of the statistics of the HIS with statistics from other sources and examination of the internal consis-

tency and reasonableness of the HIS statistics. This is a continuing activity. The results, however, have not been published.

Third, experimental studies have been designed, in effect, to measure the difference in accuracy between the HIS interviews as conducted and other alternative data collection techniques. The criterion of the more, the better has been explicit in this type of study. That is, a procedure that gives higher estimates of morbidity, hospitalizations, etc., is regarded as having produced more accurate statistics than the one with which it is being compared. Thus the differences between the estimates obtained by the HIS procedure and the estimates obtained by alternative procedures that give higher estimates are regarded as lower bound estimates of the biases of the HIS procedure.

None of the methods, singly or in combination, has as yet produced an estimate of the total mean-square error of any HIS statistic. This is a task of formidable proportions that prob-

ably has not been accomplished for any statistical program. Such an estimate requires not only the assessment of the accuracy of reporting by the respondent but also the assessment of the effect on statistics of such factors as errors of coverage, nonresponse, recording, coding, and other processing errors.

The attainable goals of a program of measurement of the reliability and accuracy must, for the foreseeable future, be regarded as rather modest ones. The chief benefit to be hoped for is that of providing a basis for detecting and correcting shortcomings in the data-collection and data-processing programs. The second goal is the rather vague one of increasing the awareness by the user of the limitations of the statistics. In this way, informed judgments, rather than estimates, of the orders of magnitudes of total mean-square errors can be made at least for some of the HIS statistics. It is the purpose of the research on measurement of error to improve the quality of these judgments.

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**APPENDIX I**  
**FORMULA FOR COMPUTING ERROR RATE**

$$\text{Error rate} = \frac{(A + B + C + \dots + G)}{TC + TA + TH} \times 100$$

where

- A* is omissions from table I of questionnaire,
- B* is omissions from table II of questionnaire,
- C* is omissions from table A of questionnaire,
- D* is missed conditions from questions 6-12 multiplied by 4,

- E* is missed conditions from table II multiplied by 4,
- F* is missed hospitalizations multiplied by 3,
- G* is diagnostic errors (inconsistencies or other omissions) multiplied by 2,
- TC* is total conditions,
- TA* is total accidents, and
- TH* is total hospitalizations.

The weights assigned to the types of error reflect the seriousness of the errors.

## APPENDIX II

### TIME AND COST MODEL FOR HIS INTERVIEWING

#### GENERAL

Interviewer assignments in the HIS are classified as either resident or nonresident assignments. Nonresident assignments require the interviewer's staying away from home one or more nights; resident assignments do not. For convenience, separate models were developed for resident and nonresident assignments.

#### MODELS FOR HIS ASSIGNMENTS

The time  $T$  required for a resident HIS assignment, listing and/or interviewing, is expressed as

$$T = nt_1 + (\lambda_1 S_1 + S_2 - \lambda_2) d_1 r_1 + 2\lambda_2 d_2 r_2 + S_1 d_3 r_3 + S_2 t_2$$

For nonresident assignments,

$$T = nt_1 + (\lambda_1 S_1 + S_2 - 2) d_1 r_1 + S_1 d_3 r_3 + S_2 t_2 + 2d_2 r_2$$

where

- $T$  is total time in minutes for an interview assignment;
- $n$  is number of interviewed households;
- $t_1$  is time per completed interview, including interview waiting, homework, telephone, and time for non-interviews;
- $t_2$  is time per segment for listing;
- $\lambda_1$  is average number of visits per interview segment;
- $\lambda_2$  is number of days on which travel is required;
- $S_1$  is number of interview segments;

- $S_2$  is number of list segments;
- $d_1$  is average distance between segments;
- $d_2$  is average distance from home to a segment;
- $d_3$  is average distance traveled within a segment (including all visits);
- $r_1$  is travel speed between segments (minutes per mile);
- $r_2$  is travel speed from home to segments; and
- $r_3$  is travel speed within segments.

Values of the parameters in both models are identical. Some of these values depend on the particular assignment:  $n$ ,  $S_1$  and  $S_2$ . Other values are estimated from accumulated data and are assumed to be constants in the model:  $\lambda_1$ ,  $d_3$ ,  $r_1$ ,  $r_2$ ,  $r_3$ ,  $t_1$ ,  $t_2$ . These estimates are prepared separately for five subuniverses that are defined by degree of urbanization and population density. The remaining values, except for  $\lambda_2$ , are functions of the home address of a particular interviewer and the location of the PSU's where she works. The number of days on which travel is required  $\lambda_2$  applies to resident assignments only and is a function of other terms in the equation.

To use the preceding equations for each interview assignment becomes very cumbersome and time consuming. Some simplification is needed so that the clerical computations can be handled routinely. When the expression for  $\lambda_2$  is substituted in the resident model and terms are collected, the equation reduces to

$$T = (CA_1)S_1 + (CA_2)n + (CA_3)S_2$$

where  $CA$  is the computation allowance, so that

$$CA_1 = \lambda_1 d_1 r_1 + d_3 r_3 + \frac{2d_2 r_2 d_3 r_3}{280} - \frac{d_1 r_1 d_3 r_3}{280}$$

$$CA_2 = \frac{2d_2 r_2 t_1}{280} - \frac{d_1 r_1 t_1}{280} + t_1$$

$$CA_3 = \frac{2d_2 r_2 t_2}{280} - \frac{d_1 r_1 t_1}{280} + d_1 r_1 + t_2$$

The nonresident model reduces to

$$T = (CA_1)S_1 + (CA_2)n + (CA_3)S_2 + CA_4$$

where

$$CA_1 = \lambda_1 d_1 r_1 + d_3 r_3$$

$$CA_2 = t_1$$

$$CA_3 = d_1 r_1 + t_2$$

$$CA_4 = 2d_2 r_2 - 2d_1 r_1$$

If the subuniverse parameters  $\lambda_1$ ,  $d_3$ ,  $r_1$ ,  $r_2$ , and  $r_3$  are known (they are actually estimated from data), the computation allowances ( $CA$ ) are functions of  $d_1$  and  $d_2$  only. Since an interviewer may treat a PSU assignment as resident one time and nonresident another, both sets of computation allowances are computed for each interviewer. The  $d_1$  and  $d_2$  values are flexible and can be changed when circumstances warrant, such as the interviewer moves or gets a new assignment, a replacement interviewer is hired, etc.

Regional offices compute the computation allowances and keep a cumulative record (appendix VIII) of assignments for each interviewer.

## APPENDIX III

### SOME THEORY OF MEASUREMENT ERRORS<sup>c</sup>

#### SOME DEFINITIONS

The term "survey" is used to refer either to complete censuses or sample surveys. In considering measurement errors we shall regard a survey as being conceptually repeatable, that is, repetitions relate to the same point in time so that carrying through the operation once does not influence results obtained through repetitions. The particular data obtained in a survey are the result of one trial. This concept provides the basis for defining variance and bias due to response, processing, or other sources of measurement errors. Such a postulate can reasonably approximate actual conditions for a single survey regarded as a sample of one from such a set of surveys, even though in practice independent repetitions of a survey may be impracticable or impossible.

#### THE DESIRED MEASURE OR TRUE VALUE

We conceive of some desired measure or goal to be estimated from a survey. For simplicity, the assumption is made that the desired or true value to be measured is represented as a proportion of the population having a specified characteristic. Although ordinarily there will be many such values to be estimated from a survey, one will be considered. Thus, it is assumed that the population consists of  $N$  persons, each of whom can be regarded as having the value of 1 if the person has one or more chronic conditions (or has some specified characteristic) or as having the value of 0 if the person does not have one or more chronic conditions (or does not have the specified characteristic). The desired or true

proportion of persons having the characteristic is said to be estimated, even for a complete survey of the population under consideration, because only observations or responses, which are subject to errors, can be recorded.

#### THE GENERAL CONDITIONS THAT MAY AFFECT THE RESULTS OF A SURVEY

Measurement errors have many different causes and depend on the general conditions under which a survey is taken. Some of these general conditions may be beyond the control or specification of the survey designer as, for example, the general political, economic, and social situation at the time of the survey. Uncontrolled conditions also include many temporary chance situations appearing at the time a response is obtained. Some conditions can be controlled to influence the quality of survey results in the sense that various aspects of the conduct of the survey are specified. These specifications are typically made in the effort to insure adequate quality and include questionnaire design and survey procedures, personnel qualifications, pay system and rates, training, operating methods, inspection, and controls in the survey. Such conditions, which may be only partially subject to the sponsor's control, are usually indicated in the form of fixed rules under which the survey is to be taken. Other controllable conditions that may be varied by design, or may be regarded as varying between the conceived repetitions of the survey, are the particular choice of interviewers and other personnel chosen to do various aspects of the work, the specific assignments, and other similar variable factors.

Actually, a survey sponsor is unable to specify all of the factors, controlled or uncontrolled, that may affect the survey results. He can introduce certain chance factors explicitly or

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<sup>c</sup>The discussion in this appendix is based on material in references 2 and 4.

implicitly, he can impose certain specifications or conditions, but he must accept the effects of other uncontrolled factors.

### AN ESTIMATE FROM A SURVEY (OR TRIAL) TAKEN UNDER A SET OF GENERAL CONDITIONS

For simplicity, it is assumed that the survey is either a complete census or a sample in which all units have been given an equal probability of selection, but without, at this time, any other restriction on the sample design. In accordance with the definitions in the previous sections, this particular survey is regarded as one trial, i.e., one survey from among the possible repetitions of the survey under the same general conditions. An observation on a person or other unit in the survey has the value 1 if the unit is assigned to a particular class under consideration or the value 0 otherwise. A repetition of the survey on the same or different units would constitute a second trial. The general conditions, both controlled and uncontrolled, under which the sample has been taken will have an effect on the observations made in a trial.

In repetitions of the survey it is assumed that the response actually observed for any individual in the survey can be regarded as having been drawn by a random process from the possible answers he might have given under the same general conditions. (In practice a survey cannot be repeated independently under the same general conditions because respondents have been exposed to the original survey and because of other reasons. However, the initial survey can be properly regarded as a sample of one from a set of independent replications.) Thus, we are dealing with a random variable  $x_{jt}$ , whose value is 1, if element  $j$  is classified as having some characteristic on trial  $t$  of a survey ( $x$  may denote the class "one or more chronic conditions") or 0, if  $j$  is not so classified.

The estimate obtained from a survey, i.e., a trial, is the proportion classified as having the specified characteristic in trial  $t$  of a survey of  $n$  elements:

$$p_t = \frac{1}{n} \sum_j^n x_{jt}$$

For example, in measuring the proportion of persons with one or more chronic conditions,  $x = 1$  in a particular survey (or trial) if the person is classified as having one or more chronic conditions; otherwise  $x = 0$ . Then

$$p_t = \frac{1}{n} \sum_j^n x_{jt}$$

is the estimated proportion of persons with one or more chronic conditions.

### THE MEAN SQUARE ERROR OF AN ESTIMATE FROM A SURVEY (OR TRIAL)

Continuing the illustration,  $p_t$  is the survey estimate of the proportion of the population with one or more chronic conditions and  $\bar{U}$  is the true proportion in the population. While we generally cannot determine in practice the true value  $U_j$  for any person, we can postulate that the goal of the survey is the true value of the proportion of the population having one or more chronic conditions. Thus,  $\bar{U}$ , the desired true proportion, is estimated by the statistics actually obtained in the survey where

$$\bar{U} = \frac{1}{N} \sum_j^N U_j \quad (1)$$

For  $p_t$ , the mean square error (MSE) is

$$\text{MSE}(p_t) = E(p_t - \bar{U})^2 \quad (2)$$

where the expected value is taken over all trials.

The mean square error can be divided into its two main components:

$$\text{MSE}(p_t) = E(p_t - P)^2 + (P - \bar{U})^2 \quad (3)$$

where  $P$  is the average of the estimates  $p_t$  taken over all trials and over all possible samples. The first term in equation 3 is the total variance of  $p_t$  and the second term is the square of the bias of  $p_t$ . In practice, we are not able to measure the bias,  $P - \bar{U}$ , but sometimes we can define and estimate useful approximations to it. For example, a superior procedure or measurement may

be identified as a standard. If  $s$  represents the value obtained from such a superior measurement, then  $(p_t - s)$  may be used as an approximate estimate of bias.

The total variance of  $p_t$  can be divided into the response variance and the sampling variance:

$$\text{MSE}(p_t) = \text{Response variance} + \text{sampling variance} \\ + \text{interaction} + \text{square of bias.}$$

Expressing the response variance of  $p_t$  in terms of response deviations where  $d_{jt} = (x_{jt} - P_j)$  is the deviation of the response recorded for person  $j$  on trial  $t$  from the average value of the responses for person  $j$  over all trials, the response variance can be expressed as

$$\sigma_d^2 = \frac{\sigma_d^2}{n} [1 + \rho_{d_{jt}d_{kt}}(n - 1)]$$

where  $\sigma_d^2$ , the simple response variance, is the basic trial-to-trial variability in response averaged over all persons. The correlation term  $\rho_{d_{jt}d_{kt}}$  reflects the effect of correlated errors introduced into the survey process by interviewers, supervisors, coders, and by persons engaged in other operations.

If the intraclass correlation among response deviations is zero, the total response variance of  $p_t$  is  $1/n \sigma_d^2$ . On the other hand if the product  $(n - 1)\rho$  is large, the total response variance may be large even if the simple response variance is relatively small. Thus, this model of errors in surveys permits the partitioning of the MSE ( $p_t$ ) into a set of components. These various components may be estimated by means of special surveys and experiments.

## GROSS AND NET DIFFERENCES

In comparing the case-by-case results of two sets of measurements, the total number of differences affecting the tabulated figure for any given class of a population is equal to the number of cases included in that class in the first trial but not in the second trial, plus the number of those included in that class in the second trial but not in the first trial. This sum may be termed the gross difference for the population in question.

The net difference of the tabulated figure for the given class is the difference between the total for the class obtained in the first and the second trials. Usually the gross difference will include differences in both directions, partly or substantially offsetting, and the net difference is the nonoffsetting part of the gross difference.

For example, suppose that the survey identifies each person as having or not having one or more chronic conditions, and that a total of  $n$  persons have been sampled with equal probability and included in both a first and second trial. Table I shows that  $a$  of the individuals were classified as having one or more chronic conditions in both the first and second trials,  $a + c$  were classified as having one or more chronic conditions in the first trial, and  $a + b$  in the second trial. The gross difference in the classification is  $b + c$  and the net difference is  $(a + c) - (a + b) = c - b$ .

Now let  $x_{jt}$  represent the result recorded for a particular person in the first trial and  $x_{jt}'$  the observation recorded for that same person in the second trial. Furthermore,  $x_{jt}$  is assigned the value 1 if the person is recorded as having a particular characteristic, and 0 otherwise, and similarly for  $x_{jt}'$ . Then the response difference for a particular person in the two surveys is represented as  $e_j = x_{jt} - x_{jt}'$ .

The sum of the values of  $e_j$  over the  $n$  observations is the net difference between the two results.

$$\sum^n e_j = c - b$$

Table I. General representation of results of two sets of measurements on identical persons

Results of second trial	Results of first trial		
	$x_{jt} = 1$	$x_{jt} = 0$	Total
$x_{jt}' = 1$	$a$	$b$	$a + b$
$x_{jt}' = 0$	$c$	$d$	$c + d$
Total	$a + c$	$b + d$	$n = a + b + c + d$

and

$$\bar{e} = \frac{\sum_{j=1}^n e_j}{n} = \frac{c-b}{n}$$

is the net difference rate.

Similarly,  $b+c$  is the gross difference and is equal to  $\sum_{j=1}^n e_j^2$ . This follows since  $e^2 = 1$  whenever the response obtained in the first and second trials are different, that is,  $(0-1)^2 = 1$ . The gross difference rate is

$$g = \frac{(b+c)}{n}.$$

### GROSS AND NET DIFFERENCES AS EVIDENCE OF RESPONSE VARIANCE AND BIAS

The estimated variance of the individual response difference is

$$\begin{aligned} s_e^2 &= \frac{\sum_{j=1}^n (e_j - \bar{e})^2}{n-1} = \frac{b+c}{n-1} - \frac{(c-b)^2}{n(n-1)} \\ &= (g - \bar{e}^2) \frac{n}{n-1} \end{aligned}$$

where

$$\bar{e} = \frac{\sum_{j=1}^n e_j}{n} = \frac{c-b}{n}.$$

Often  $\bar{e}^2$  is small enough that  $s_e^2$  will be very nearly equal to  $g$ , and it is then convenient to use the gross difference rate  $g$  as the measure of the variance of the response differences. In any event,  $g$  is the mean squared difference for the original and reinterview survey results and provides a useful measure of the consistency or reliability of the measurement process. It can be an exceedingly useful measure of reliability of response with a well-designed evaluation study or reinterview survey.

If the individual response differences were uncorrelated from one unit to another, the estimated standard error of the net difference rate would be

$$s_{\bar{e}} = \sqrt{\frac{s_e^2}{n}}.$$

In practice, the individual response differences will not be independent from one unit to another but will tend to be positively correlated. Under these circumstances,  $\sqrt{s_e^2/n}$  gives a lower bound for  $s_{\bar{e}}$ . Given certain conditions, an overestimate of  $s_{\bar{e}}$  can also be obtained. These conditions, would be met if, for example, a survey is repeated over time or over different areas or population groups and if the reinterview survey is conducted on different units in each of these repetitions of the survey. This is the situation for the HIS, which is taken each week. The HIS reinterview survey is taken on a distinct set of HIS households each week and summarized quarterly. From the group of quarterly repetitions an overestimate can be obtained of the standard error of the average net difference. (It will be an overestimate of the standard error of the difference obtained by repetitions of the two surveys taken for different samples but with the same personnel.) Thus, from the HIS reinterview survey, results of both net differences and net difference rates are obtained for each  $m$  quarters. If  $\bar{e}_u$  is the net difference rate for quarter  $u$ , and  $n_u$  is the number of persons in the reinterview sample in that quarter, then for the  $m$  quarters involved, the average net difference rate can be expressed as

$$\bar{e} = \frac{\sum_{u=1}^m n_u \bar{e}_u}{n}$$

where  $n = \sum n_u$  is the total number of reinterviews over the  $m$  quarters. Then

$$\sqrt{\frac{\sum_{u=1}^m n_u (\bar{e}_u - \bar{e})^2}{n(m-1)}}$$

will be an overstatement of  $s_{\bar{e}}$ , the estimated standard error of the average difference rate.



Thus an overestimate and an underestimate of  $s_{\bar{d}}$  can be obtained. If these are not too different, they yield a measure of the standard error of the average net difference between the original and reinterview survey results.

### INDEX OF INCONSISTENCY

An index of the reliability of measurement, called the index of inconsistency, can be constructed using the gross difference rate. The index of inconsistency is the ratio of the simple response variance, estimated by  $g/2$ , to the maximum value it could take on, estimated by the binomial variance  $p(1-p)$ .

In terms of the table, let  $p_1 = (a+c)/n$ ; that is,  $p$  is the proportion, based on the original survey, of the population in the specified class and  $p_2 = (a+b)/n$  is the proportion based on the reinterview survey. Then,

$$\hat{I} = \frac{g}{p_1(1-p_1) + p_2(1-p_2)}.$$

The estimated maximum value for the gross difference rate between the survey and reinterview is  $p_1(1-p_1) + p_2(1-p_2)$ . This maximum value is obtained on the assumption that the survey and reinterview were conducted independently or that the results are positively

correlated to the extent that they were not conducted independently. A second assumption is that the reinterview is a repetition of the survey process and the expected value obtained in the survey. Under these assumptions,  $p_1(1-p_1) + p_2(1-p_2)$  is very nearly equal to  $2p(1-p)$  where  $p$  is the average proportion in the original survey and reinterview having the specified characteristic.

The index of inconsistency lies between 0 and 1 if the assumptions given above hold. However, the estimator can be greater than 1.

A simple interpretation of  $\hat{I}$  follows. Assume that a sample of  $n$  elements is drawn with equal probability and with replacement. Also, assume that the between-element covariance of response deviations is zero; that is, that the quality of response of one person is independent of the quality of response for any other person. Then the total variance defined in the first term of equation 3 of the statistic  $p_t$  reduces to the sum of the simple response variance and the single random sampling variance. The simple response variance is equal to or less than  $p(1-p)$ .

As the measurement of the specified characteristic becomes less reliable, but remains unbiased, the simple response variance increases and the sampling variance decreases; the total variance remains constant. A high index of inconsistency is associated with a high level of response error.

## APPENDIX IV LEAST-SQUARES SOLUTION

The variance model used in the study is

$$V_T^2 = V_I^2 + \frac{V_E^2}{n} \quad (1)$$

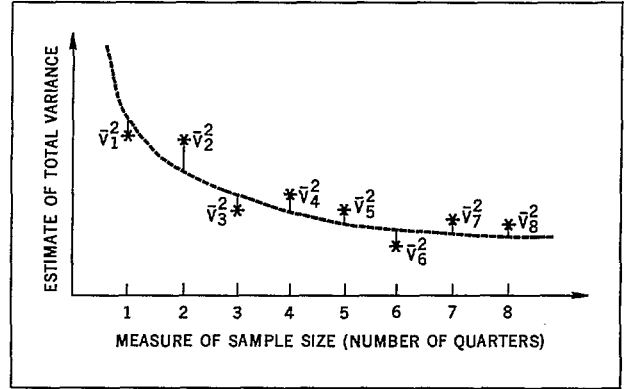
In this model, the interviewer variance  $V_I^2$  is assumed to be dependent only on the number of interviewers, which remained constant over the study period. On the other hand, the sampling variance term  $V_E^2/n$  is a function of sample size. In equation 1,  $n$  is the number of quarters of data used to compute the individual estimates of total variance.

The data used are sets of estimates  $V_T^2$  for  $n = 1, \dots, 8$ . Each  $V_T^2$  is an average of the estimates based on  $n$  quarters. The  $V_T^2$  are estimates of  $V_{T(n)}^2$  for  $n = 1, \dots, 8$ . The model given above represents the functional relationship existing between the variables  $V_T^2$ ,  $V_I^2$ , and  $V_E^2$  as  $n$  varies. The problem, then, is to estimate the parameters of this function so that the estimates of  $V_I^2$  and  $V_E^2$  can be identified separately.

There are several ways of estimating these parameters. The goal is to estimate  $V_T^2$  so that the estimates of  $V_{T(n)}^2$  are as close as possible to the observed values  $\bar{V}_n^2$ . The method used was that of least squares. The criterion for the least-squares estimate is to make the sum of the squares of the difference between the estimate of  $\hat{V}_{T(n)}^2$  and the observed values  $\bar{V}_n^2$  as small as possible, that is, to minimize the value of  $\phi$ , where

$$\phi = \sum_{n=1}^8 (\hat{V}_{T(n)}^2 - \bar{V}_n^2)^2 \quad (2)$$

These differences can be seen graphically as follows:



As required by the model, a hyperbolic function, rather than a straight line, was fitted to the data. No boundaries were placed on the value of  $\hat{V}_T^2$ ; it can become negative as  $n \rightarrow \infty$ .

Using the method of least squares, the partial derivatives of equation 1 are taken

$$\hat{V}_T^2 = \frac{\hat{V}_I^2}{1} + \frac{\hat{V}_E^2}{n} \quad (3)$$

If

$$\begin{aligned} \phi &= \sum_{n=1}^8 (V_{T(n)}^2 - \bar{V}_n^2)^2 \\ &= \sum_{n=1}^8 \left( \frac{\hat{V}_I^2}{1} + \frac{\hat{V}_E^2}{n} - \bar{V}_n^2 \right)^2, \end{aligned} \quad (4)$$

then

$$\frac{d\phi}{d\hat{V}_I^2} = 2 \sum_{n=1}^8 \left( \frac{\hat{V}_I^2}{1} + \frac{\hat{V}_E^2}{n} - \bar{V}_n^2 \right) (1) = 0 \quad (5)$$

and

$$\frac{d\phi}{d\hat{V}_E^2} = 2 \sum_{n=1}^8 \left( \frac{\hat{V}_I^2}{1} + \frac{\hat{V}_E^2}{n} - \bar{V}_n^2 \right) \left( \frac{1}{n} \right) = 0. \quad (6)$$

Equation 5 becomes

$$8\hat{V}_I^2 + \hat{V}_E^2 \sum_{n=1}^8 \frac{1}{n} - \sum_{n=1}^8 \bar{V}_n^2 = 0. \quad (7)$$

Equation 6 becomes

$$\hat{V}_I^2 \sum_{n=1}^8 \frac{1}{n} + \hat{V}_E^2 \sum_{n=1}^8 \frac{1}{n^2} - \sum_{n=1}^8 \frac{\bar{V}_n^2}{n} = 0. \quad (8)$$

Since

$$\sum_{n=1}^8 \frac{1}{n} \approx 2.718$$

and

$$\sum_{n=1}^8 \frac{1}{n^2} \approx 1.527,$$

the two partial derivatives  $\hat{V}_E^2$  and  $\hat{V}_I^2$  can be simplified to

$$\begin{aligned} \hat{V}_E^2 &= \frac{\sum \bar{V}_n^2 - \frac{2.718}{8} \sum \bar{V}_n^2}{1.527 - \frac{(2.718)^2}{8}} \\ &= 1.655 \sum \frac{\bar{V}_n^2}{n} - 0.562 \sum \bar{V}_n^2 \quad (9) \end{aligned}$$

and

$$\begin{aligned} \hat{V}_I^2 &= \frac{\sum \bar{V}_n^2 - \frac{2.718}{8} \hat{V}_E^2}{8} \\ &= 0.125 \sum \bar{V}_n^2 - 0.340 \hat{V}_E^2. \quad (10) \end{aligned}$$

By substituting in the value for  $\hat{V}_E^2$ ,

$$\hat{V}_I^2 = 0.316 \sum \bar{V}_n^2 - 0.562 \sum \frac{\bar{V}_n^2}{n}. \quad (11)$$

These estimates of  $\hat{V}_I^2$  and  $\hat{V}_E^2$  for one quarter were used to compute the values of  $\hat{V}_T^2$  for one to eight quarters. The values shown in tables 23 and 24 are estimates for a sample covering four quarters.

## APPENDIX V

### HIS OBSERVATION REPORT (NHS-HIS-406)

FORM HIS-406 (3-7-69)		U.S. DEPARTMENT OF COMMERCE BUREAU OF THE CENSUS		1. Regional Office			2. PSU					
<b>HEALTH INTERVIEW SURVEY OBSERVATION REPORT</b>				3. Name of interviewer			Code					
4. Date observed		5. Time observed From _____ To _____		6. Date of last observation								
7. Type of observation												
<input type="checkbox"/> Systematic		<input type="checkbox"/> Reinterview rejection		<input type="checkbox"/> Initial - First assignment		<input type="checkbox"/> Initial - Second assignment		<input type="checkbox"/> Other - <i>Specify</i> _____				
8. Reference notes for special attention - e.g., reinterview results, notes from last observation, etc.				Sample	Error rate	Type A rate	Production					
				B-								
				B-								
9. Segment coverage												
Tally of households observed	Interviewed	Type A or callback	Type B or C	Segment number and type	B		TA		NTA			
Item	<i>Explain each "No" answer below</i>			Yes	No	N/A	Yes	No	N/A	Yes	No	N/A
	Did interviewer correctly -											
A	Use maps, locate segments, locate sample addresses?											
B	Check area segment boundaries?											
C	Canvass area segments and look for concealed units?											
D	Fill area segment listing sheets?											
E	Determine "year built" when required?											
F	Fill Cols. 8, 9, and 13 of B segment address lists?											
G	Fill extension sheets in B segment?											
10. GENERAL PERFORMANCE				Excel- lent	Satis- factory	<i>Explain below</i>		Not applicable				
Evaluate each point for the entire day's observation						Needs im- provement	Unsatis- factory					
1. Asking probe questions when needed and only when needed												
2. Neutral probing												
3. Allowing respondent reasonable time for answering questions												
4. Maintaining a business-like attitude and rapport with respondent												
5. Listening carefully to respondent												
6. Accurately recording respondent's answers and completing all required entries on questionnaire ( <i>Evaluate this item on the basis of respondent's answers and your edit of the questionnaires after the interview.</i> )												
7. Accepting suggestions and criticisms												
8. Applying housing unit definition												
9. Listing and interviewing within special dwelling places												
10. Planning itinerary												
ASK INTERVIEWER DURING THE DAY:												
Is there any particular part of the procedure you feel unsure about or would like to have covered by further training?												
Remarks												

Last name									Handled correctly? If "No," explain			
Person No.	1	2	3	4	5	6	7	8				
Name												
Age												
PROBE PAGES	Person	Question							Yes	No		
CONDITION PAGE(S)  <input type="checkbox"/> None	Person	Condition			Yes	No	Person	Condition		Yes	No	
HOSPITAL PAGE(S)  <input type="checkbox"/> None	Person	Page								Yes	No	
		1										
		2										
		3										
DOCTOR VISITS  <input type="checkbox"/> None	Person				Yes	No	SUPPLEMENT  <input type="checkbox"/> None	Person			Yes	No
PERSON PAGE(S)	Person				Yes	No	HOUSEHOLD PAGE (Esp. year built and coverage items)	Question			Yes	No
	1											
	2											
	3											
	4											
	5											
6												
COMMENTS (including edit)												

**RESULTS OF OBSERVATION**

Overall evaluation on all phases of work

Excellent

Satisfactory

Needs improvement

Unsatisfactory

Comments on general performance

Recommendations for next observation

*OBSERVER: Note any area of the questionnaire or interviewer's instructions which in your view require modification or clarification.*

Observer's signature

Date

*To be completed if observer recommends termination, probation, or other administrative action*

Comments of the Regional Director

Regional Director's signature

Date

# APPENDIX VI

## HIS RECONCILIATION FORM (NHS-HIS-R-IX-T)

**A. RECONCILIATION SECTION FOR BED DAYS, RESTRICTED ACTIVITY DAYS, AND TIME LOST DAYS IN PAST TWO WEEKS**  
 The original questionnaire showed . . . and I have . . . which is the correct information?

**B. RECONCILIATION SECTION FOR CONDITIONS AND HOSPITALIZATIONS REPORTED IN ONE INTERVIEW**  
 We are interested in finding out more about conditions (hospitalizations) which were reported at one time but not at

Original	Reconciliation	Explanation	Explanation
5b. Bed days <input type="checkbox"/> None	Bed days <input type="checkbox"/> None		
5a. Cut down days <input type="checkbox"/> None	Cut down days <input type="checkbox"/> None		
5f. Work days <input type="checkbox"/> None	Work days <input type="checkbox"/> None		
5g. School days <input type="checkbox"/> None	School days <input type="checkbox"/> None	<input type="checkbox"/> Sustained <input type="checkbox"/> Deleted	<input type="checkbox"/> Sustained <input type="checkbox"/> Deleted

**C. RECONCILIATION SECTION FOR DIFFERENCES WITHIN MATCHED CONDITIONS - The original questionnaire showed . . . and I have . . . , which is the correct i**

1		2		3		4	
Match	Reinterview condition No. 1. Person No.	Match	Reinterview condition No. 1. Person No.	Match	Reinterview condition No. 1. Person No.	Match	Reinterview condition No. 1. Person No.
Original	Reconciliation	Original	Reconciliation	Original	Reconciliation	Original	Reconciliation
2. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	2. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	2. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	2. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
3a.		3a.		3a.		3a.	
3b.		3b.		3b.		3b.	
3c.		3c.		3c.		3c.	
3d.		3d.		3d.		3d.	
3e.		3e.		3e.		3e.	
Original	Reconciliation	Original	Reconciliation	Original	Reconciliation	Original	Reconciliation
9a. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	9a. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	9a. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	9a. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
9b. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	9b. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	9b. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	9b. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
10. Days	Days	10. Days	Days	10. Days	Days	10. Days	Days
11. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	11. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	11. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	11. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None
12. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	12. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	12. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	12. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None
13. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	13. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	13. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	13. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None
14a. <input type="checkbox"/> During 3 mos. <input type="checkbox"/> Before 3 mos.	<input type="checkbox"/> During 3 mos. <input type="checkbox"/> Before 3 mos.	14a. <input type="checkbox"/> During 3 mos. <input type="checkbox"/> Before 3 mos.	<input type="checkbox"/> During 3 mos. <input type="checkbox"/> Before 3 mos.	14a. <input type="checkbox"/> During 3 mos. <input type="checkbox"/> Before 3 mos.	<input type="checkbox"/> During 3 mos. <input type="checkbox"/> Before 3 mos.	14a. <input type="checkbox"/> During 3 mos. <input type="checkbox"/> Before 3 mos.	<input type="checkbox"/> During 3 mos. <input type="checkbox"/> Before 3 mos.
14b. <input type="checkbox"/> Past 2 wks. <input type="checkbox"/> Before 2 wks.	<input type="checkbox"/> Past 2 wks. <input type="checkbox"/> Before 2 wks.	14b. <input type="checkbox"/> Past 2 wks. <input type="checkbox"/> Before 2 wks.	<input type="checkbox"/> Past 2 wks. <input type="checkbox"/> Before 2 wks.	14b. <input type="checkbox"/> Past 2 wks. <input type="checkbox"/> Before 2 wks.	<input type="checkbox"/> Past 2 wks. <input type="checkbox"/> Before 2 wks.	14b. <input type="checkbox"/> Past 2 wks. <input type="checkbox"/> Before 2 wks.	<input type="checkbox"/> Past 2 wks. <input type="checkbox"/> Before 2 wks.
14c. <input type="checkbox"/> Last week <input type="checkbox"/> Week before	<input type="checkbox"/> Last week <input type="checkbox"/> Week before	14c. <input type="checkbox"/> Last week <input type="checkbox"/> Week before	<input type="checkbox"/> Last week <input type="checkbox"/> Week before	14c. <input type="checkbox"/> Last week <input type="checkbox"/> Week before	<input type="checkbox"/> Last week <input type="checkbox"/> Week before	14c. <input type="checkbox"/> Last week <input type="checkbox"/> Week before	<input type="checkbox"/> Last week <input type="checkbox"/> Week before
15. <input type="checkbox"/> 3 - 12 mos. <input type="checkbox"/> Before 12 mos.	<input type="checkbox"/> 3 - 12 mos. <input type="checkbox"/> Before 12 mos.	15. <input type="checkbox"/> 3 - 12 mos. <input type="checkbox"/> Before 12 mos.	<input type="checkbox"/> 3 - 12 mos. <input type="checkbox"/> Before 12 mos.	15. <input type="checkbox"/> 3 - 12 mos. <input type="checkbox"/> Before 12 mos.	<input type="checkbox"/> 3 - 12 mos. <input type="checkbox"/> Before 12 mos.	15. <input type="checkbox"/> 3 - 12 mos. <input type="checkbox"/> Before 12 mos.	<input type="checkbox"/> 3 - 12 mos. <input type="checkbox"/> Before 12 mos.
20. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	20. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	20. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	20. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
21. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	21. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	21. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	21. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
22. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	22. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	22. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	22. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
23. Times <input type="checkbox"/> None	Times <input type="checkbox"/> None	23. Times <input type="checkbox"/> None	Times <input type="checkbox"/> None	23. Times <input type="checkbox"/> None	Times <input type="checkbox"/> None	23. Times <input type="checkbox"/> None	Times <input type="checkbox"/> None
24. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	24. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	24. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	24. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None
25a. <input type="checkbox"/> Great deal <input type="checkbox"/> Some <input type="checkbox"/> Very little <input type="checkbox"/> Not at all <input type="checkbox"/> Other - Specify	<input type="checkbox"/> Great deal <input type="checkbox"/> Some <input type="checkbox"/> Very little <input type="checkbox"/> Not at all <input type="checkbox"/> Other - Specify	25a. <input type="checkbox"/> Great deal <input type="checkbox"/> Some <input type="checkbox"/> Very little <input type="checkbox"/> Not at all <input type="checkbox"/> Other - Specify	<input type="checkbox"/> Great deal <input type="checkbox"/> Some <input type="checkbox"/> Very little <input type="checkbox"/> Not at all <input type="checkbox"/> Other - Specify	25a. <input type="checkbox"/> Great deal <input type="checkbox"/> Some <input type="checkbox"/> Very little <input type="checkbox"/> Not at all <input type="checkbox"/> Other - Specify	<input type="checkbox"/> Great deal <input type="checkbox"/> Some <input type="checkbox"/> Very little <input type="checkbox"/> Not at all <input type="checkbox"/> Other - Specify	25a. <input type="checkbox"/> Great deal <input type="checkbox"/> Some <input type="checkbox"/> Very little <input type="checkbox"/> Not at all <input type="checkbox"/> Other - Specify	<input type="checkbox"/> Great deal <input type="checkbox"/> Some <input type="checkbox"/> Very little <input type="checkbox"/> Not at all <input type="checkbox"/> Other - Specify
25b. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	25b. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	25b. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	25b. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
25c. <input type="checkbox"/> Cured <input type="checkbox"/> Under control <input type="checkbox"/> Other - Specify	<input type="checkbox"/> Cured <input type="checkbox"/> Under control <input type="checkbox"/> Other - Specify	25c. <input type="checkbox"/> Cured <input type="checkbox"/> Under control <input type="checkbox"/> Other - Specify	<input type="checkbox"/> Cured <input type="checkbox"/> Under control <input type="checkbox"/> Other - Specify	25c. <input type="checkbox"/> Cured <input type="checkbox"/> Under control <input type="checkbox"/> Other - Specify	<input type="checkbox"/> Cured <input type="checkbox"/> Under control <input type="checkbox"/> Other - Specify	25c. <input type="checkbox"/> Cured <input type="checkbox"/> Under control <input type="checkbox"/> Other - Specify	<input type="checkbox"/> Cured <input type="checkbox"/> Under control <input type="checkbox"/> Other - Specify
25d. Month(s)   Year(s)	Month(s)   Year(s)	25d. Month(s)   Year(s)	Month(s)   Year(s)	25d. Month(s)   Year(s)	Month(s)   Year(s)	25d. Month(s)   Year(s)	Month(s)   Year(s)

FORM NHS-HIS-R-IX-T (6-8-67)

**BUT NOT IN BOTH INTERVIEWS**

another. Can you think of any explanation for . . . not having been reported in the (original interview/our interview today)?

Condition	Date of hospitalization	Condition	Date of hospitalization	Condition	Date of hospitalization
Explanation		Explanation		Explanation	
<input type="checkbox"/> Sustained <input type="checkbox"/> Deleted		<input type="checkbox"/> Sustained <input type="checkbox"/> Deleted		<input type="checkbox"/> Sustained <input type="checkbox"/> Deleted	

**Information?**

5		6		7		8	
Match	Reinterview condition No. 1. Person No.	Match	Reinterview condition No. 1. Person No.	Match	Reinterview condition No. 1. Person No.	Match	Reinterview condition No. 1. Person No.
Original		Reconciliation		Original		Reconciliation	
2. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	2. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	2. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	2. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
3a.		3a.		3a.		3a.	
3b.		3b.		3b.		3b.	
3c.		3c.		3c.		3c.	
3d.		3d.		3d.		3d.	
3e.		3e.		3e.		3e.	
Original		Reconciliation		Original		Reconciliation	
9a. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	9a. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	9a. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	9a. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
9b. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	9b. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	9b. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	9b. <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
10. Days	Days	10. Days	Days	10. Days	Days	10. Days	Days
11. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	11. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	11. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	11. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None
12. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	12. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	12. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	12. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None
13. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	13. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	13. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None	13. Days <input type="checkbox"/> None	Days <input type="checkbox"/> None
14a. <input type="checkbox"/> During 3 mos. <input type="checkbox"/> Before 3 mos.	<input type="checkbox"/> During 3 mos. <input type="checkbox"/> Before 3 mos.	14a. <input type="checkbox"/> During 3 mos. <input type="checkbox"/> Before 3 mos.	<input type="checkbox"/> During 3 mos. <input type="checkbox"/> Before 3 mos.	14a. <input type="checkbox"/> During 3 mos. <input type="checkbox"/> Before 3 mos.	<input type="checkbox"/> During 3 mos. <input type="checkbox"/> Before 3 mos.	14a. <input type="checkbox"/> During 3 mos. <input type="checkbox"/> Before 3 mos.	<input type="checkbox"/> During 3 mos. <input type="checkbox"/> Before 3 mos.
14b. <input type="checkbox"/> Past 2 wks. <input type="checkbox"/> Before 2 wks.	<input type="checkbox"/> Past 2 wks. <input type="checkbox"/> Before 2 wks.	14b. <input type="checkbox"/> Past 2 wks. <input type="checkbox"/> Before 2 wks.	<input type="checkbox"/> Past 2 wks. <input type="checkbox"/> Before 2 wks.	14b. <input type="checkbox"/> Past 2 wks. <input type="checkbox"/> Before 2 wks.	<input type="checkbox"/> Past 2 wks. <input type="checkbox"/> Before 2 wks.	14b. <input type="checkbox"/> Past 2 wks. <input type="checkbox"/> Before 2 wks.	<input type="checkbox"/> Past 2 wks. <input type="checkbox"/> Before 2 wks.
14c. <input type="checkbox"/> Last week <input type="checkbox"/> Week before	<input type="checkbox"/> Last week <input type="checkbox"/> Week before	14c. <input type="checkbox"/> Last week <input type="checkbox"/> Week before	<input type="checkbox"/> Last week <input type="checkbox"/> Week before	14c. <input type="checkbox"/> Last week <input type="checkbox"/> Week before	<input type="checkbox"/> Last week <input type="checkbox"/> Week before	14c. <input type="checkbox"/> Last week <input type="checkbox"/> Week before	<input type="checkbox"/> Last week <input type="checkbox"/> Week before
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25d. Month(s) Year(s)	Month(s) Year(s)	25d. Month(s) Year(s)	Month(s) Year(s)	25d. Month(s) Year(s)	Month(s) Year(s)	25d. Month(s) Year(s)	Month(s) Year(s)

USCB-MDC



## APPENDIX VII

### SUMMARY REPORT OF NHS-HIS REINTERVIEW (NHS-HIS-R-401)

FORM NHS-HIS-R-401 U.S. DEPARTMENT OF COMMERCE (8-5-66) BUREAU OF THE CENSUS  <b>SUMMARY REPORT OF NHS-HIS REINTERVIEW</b>		1. Interviewer's name		Code	Telephone No.		2. Regional Office					
		3. Reinterviewer's name		Code	Job title		4. PSU					
		5. Reinterview date		<input type="checkbox"/> Program Supervisor <input type="checkbox"/> Alternate <input type="checkbox"/> Senior Interviewer <input type="checkbox"/> Other _____		6. Sample						
<b>Section I - COVERAGE CHECK OF HOUSING AND OTHER UNITS</b>							<b>Section II HOUSEHOLD COMPOSITION CHECK</b>					
Reinterview segment		Part A - Area Segments			Part B		Part C	Segment No. (1)	Household serial No. (2)	Number of persons		
Number (1)	Type (2)	Number of sample units before reinterview (3)	Number of units			B Segment Check				Number of wrong households interviewed (9)	Before reinterview (3)	Added (4)
			Listed before reinterview <sup>1</sup> (4)	Added (5)	Deleted (6)	Extension sheet entries						
						Correct (7)	Incorrect (8)					
Total this reinterview												
Previous cumulative total												
New cumulative total												
<sup>1</sup> Exclude units in special dwelling places in NTA segments and in "large" special dwelling places. If the most recent listing for an NTA segment was performed by another person, enter name in "Explanation of Differences" and prepare separate form NHS-HIS-R-401 reporting columns (4), (5), and (6) data for the segment.												
Explanation of differences in sections I and II (Give reference to section and segment, numbers of added or deleted units, and to segment and serial numbers of added or deleted persons. Describe type of error if column (8) is checked. Explain changes in classification of "year built" here also.)												
							Total this reinterview					
							Previous cumulative total					
							New cumulative total					

**Section III – CONTENT CHECK**

Segment No. (1)	Household serial No. (2)	Part A – Personal Characteristics				Part B – Characteristics Within Conditions and Hospitalizations				Part C – Number of Conditions and Hospitalizations			
		Different respondent		Same respondent <sup>1</sup>		Different respondent		Same respondent <sup>1</sup>		Different respondent		Same respondent <sup>1</sup>	
		Number of persons (3)	Differences (4)	Number of persons (5)	Differences (6)	Number of (✓) checks * (7)	Differences (8)	Number of (✓) checks * (9)	Differences (10)	Acceptability base <sup>2</sup> (11)	Differences <sup>3</sup> (12)	Acceptability base <sup>2</sup> (13)	Differences <sup>3</sup> (14)
Total this interview													
Previous cumulative total													
New cumulative total													

- <sup>1</sup> Includes adults responding for children under 19.
- <sup>2</sup> (✓) check conditions and hospitalizations plus sustained conditions and hospitalizations plus number of conditions and hospitalizations added and sustained to reconciliation form.
- <sup>3</sup> Number of original conditions and hospitalizations deleted from reconciliation form plus number of conditions and hospitalizations added and sustained to reconciliation form.

**\* Definitions**  
 (✓) checks: Each check represents one condition or hospitalization reported on both interviews. Sustained conditions or hospitalization are those which are reported only on one interview and retained after reconciliation.

**Section IV – ACTION TAKEN**

Note: This section must be filled if the interviewer has been rejected in any of the preceding sections. Explain action taken or planned to retrain interviewer if her work has been rejected (R). (If more space is required, use additional sheet.)

**Section V PERFORMANCE**

Section (1)	Decision A – Accept R – Reject (2)
I – A	
I – C	
II	
III – A	
III – B	
III – C	

## APPENDIX VIII PRODUCTION GUIDE FOR NHS (11-102C)

FORM 11-102C (10-7-63)										U.S. DEPARTMENT OF COMMERCE BUREAU OF THE CENSUS				1. REGIONAL OFFICE			2. SAMPLE B-	
PRODUCTION GUIDE FOR NHS										3. INTERVIEWER			4. INTERVIEWER CODE					
LINE NO.	WEEK	PSU	INTERVIEW SEGMENTS		HOUSEHOLDS INTERVIEWED		LIST SEGMENTS		CA 4	SUPPLEMENT		THIS ASSIGNMENT		CUMULATIVE				
			NUMBER	CA 1	NUMBER	CA 2	NUMBER	CA 3		NUMBER	ALLOWED MINUTES	ALLOWED MINUTES	PAYROLL MINUTES	ALLOWED MINUTES	PAYROLL MINUTES	PRODUCTION RATIO		
(a)	(b)		(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)		
1																		
2																		
3																		
4																		
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6																		
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10																		
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15																		
REMARKS																		

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# INSTRUCTIONS FOR COMPLETING FORM 11-102C

## GENERAL

Maintain a Form 11-102C for each interviewer on a three month (NHS Sample) basis. At the end of the three month period send the yellow copy to Chief, Field Division, retain the original in your files and start a new 11-102C for each interviewer. One line of the 11-102C should be completed for each interview and/or listing assignment.

### Columns (a)-(p)

Enter the week in column (a) and the PSU in column (b).

Post the computation allowances to columns (d), (f), (h), and (i), using Production Standards Memorandum No. 5 (Formerly GAM No. 70) and your knowledge (from payroll records) of whether the assignment was overnight or non-overnight. Enter the workload associated with each allowance in columns (c), (e), and (g).

Enter the number of current supplements (if any) completed in column (j), and the allowance per unit, as given in Operations Memorandums, in column (k).

Multiply each allowance by its workload and add the results to obtain the total allowance. (Be sure to add in CA 4.) Enter this total in column (l).

Enter the payroll minutes in column (m).

Revise the cumulative production ratio in columns (n), (o), and (p).

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