

DATA QUALITY IN THE NATIONAL HOSPITAL DISCHARGE SURVEY

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ABSTRACT

Since 1965, the National Center for Health Statistics has conducted the National Hospital Discharge Survey (NHDS), a national probability sample survey of discharges from non-Federal, short-stay and general hospitals. A major aspect of the NHDS redesign in 1988 was to use electronic data from abstracting service organizations and State data systems. This paper will present an overview of the development of the NHDS and the 1988 redesign. Survey methodologies will be reviewed in light of the data collection and processing issues arising from the combination of "manually" abstracted data and "automated" data. Methods for assessing the overall quality and accuracy of the NHDS data will be discussed for both data collection modes. These methods include procedures to ensure that incoming data meet established standards and that abstracted data are processed and coded according to strict quality control procedures. They will be presented in the context of issues and findings from the broader literature about the quality of hospital administrative data sets.

KEY WORDS: inpatient data, quality control

1. INTRODUCTION

The National Center for Health Statistics (NCHS) is responsible for measuring the health of the population of the United States. NCHS is the repository of vital statistics for the United States and its data collection portfolio includes a national health nutrition and examination survey, and a national household interview survey. NCHS also conducts a family of national probability sample surveys, collectively referred to as the National Health Care Survey (NHCS), that collect data from health care establishments, institutions, and providers in the U.S. (McLemore, 2000). The primary purpose of the NHCS is to measure the utilization of the U.S. health care delivery system. The NHCS includes the following components:

- National Ambulatory Medical Care Survey (NAMCS) - visits to physicians' offices;
- National Hospital Ambulatory Medical Care Survey (NHAMCS) - visits to hospital emergency and outpatient departments;
- National Nursing Home Survey (NNHS) - nursing home care;
- National Home and Hospice Care Survey (NHHCS) - home health and hospice care;
- National Survey of Ambulatory Surgery (NSAS) - visits to hospital-based and freestanding ambulatory surgery centers;
- National Hospital Discharge Survey (NHDS) - hospital inpatient care.

Information about NCHS and the NHCS may be obtained at the NCHS website: <http://www.cdc.gov/nchs/>.

While NCHS surveys are national in scope, each survey is unique in many respects. This produces differences in statistical design, survey operation and quality control. The purpose of this paper is to provide an overview

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of the various aspects of quality control in the National Hospital Discharge Survey. This will be done in the context of the survey's design and operation.

In 1965, NCHS initiated the National Hospital Discharge Survey to collect and disseminate data on inpatient utilization of short-stay non-Federal hospitals in the U.S. The importance of measuring inpatient care made the NHDS the first survey of medical care delivery conducted by the NCHS. Inpatient care continues to be a major sector of the health care delivery system. The NHDS has been conducted annually since its inception. Variables collected in the survey include patient information (age, sex, race, geographic region, ZIP code), hospital information (size, ownership location), event information (dates of admission and discharge, admission type and status, expected source of payment, and discharge status and disposition), and from 1-7 diagnoses and from 0-4 procedures using the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM).

Data from the NHDS are publically available. The latest data available are for 1999. Data for 2000 will be available in late 2001. NHDS data are used by Federal agencies, hospitals, universities, the press, medical product manufacturers, states and individuals. These data are used in a variety of applications that include health policy, health services research, establishing national health goals, epidemiology, public health research, and market modeling. A valuable source of information on the NHDS is its website <http://www.cdc.gov/nchs/about/major/hdasd/nhds.htm> which includes a bibliography of research papers that use data from the survey.

2. SURVEY DESIGN

During the 35-year history of the NHDS, two survey designs have been used. From 1965-87, the NHDS utilized a 2-stage design in which the first stage was a national probability sample of hospitals and the second stage was a subsample of discharges (inpatients) from participating hospitals (Simmons, 1970). During this period, the survey was based almost entirely on manual abstraction of data from medical records.

The NHDS was redesigned in 1988 based on a three-stage sample design of Primary Sampling Units (Metropolitan Statistical Areas or groups of counties); hospitals within these geographic areas; and discharges from participating hospitals (Dennison, 2000). From an operational perspective, a major feature of the redesign was the inclusion of data from available electronic sources such as States, commercial firms, hospital associations and individual hospitals.

An analytical study was conducted to compare estimates from the two NHDS designs (Haupt, 1992). The analysis used data collected during the first three months of 1988 from both survey designs. For most estimates for variables in the survey, there were no statistical differences. However, there were differences in estimates for a few diagnostic categories, such as cataracts and alcohol dependence syndrome, and by hospital bedsize.

The target population of the current NHDS is discharges from noninstitutional hospitals exclusive of Federal, military, and Department of Veterans Affairs hospitals, located in the 50 States and the District of Columbia. Short-stay hospitals (hospitals with an average length of stay for all patients of less than 30 days) or those whose specialty is general (medical or surgical) or children's general (regardless of length of stay) are included in the survey. Also, a hospital must have six or more beds staffed for patient use to be in-scope for the survey.

The 1988 NHDS sampling frame consisted of hospitals that were listed in the April 1987 SMG Hospital Market Database and that began to accept inpatients by August 1987. The hospital sample was updated in 1991, 1994 and 1997 to account for hospitals that opened or changed their eligibility status since the previous sample update. There are about 500 hospitals included in the sample each year. About 470 of these hospitals participate and provide data for about 300,000 sample discharges annually. About 300 hospitals provide data

for 75,000 sample discharges in a manual mode, and about 170 hospitals provide data for about 225,000 sample discharges in electronic form.

Quality control procedures for the manual data are present throughout the survey process including record sampling, data abstraction, document receipt and control, medical coding and data entry. Electronic records go through a set of automated and manual procedures to ensure data quality. Records collected in both manual and automated form are subject to rigorous computer edits. Missing values for sex and age are imputed. Following this, the file is “weighted,” that is, values are calculated and then appended to each record to allow estimation. The final procedure for quality control is a thorough comparison of estimates with those from previous years. These processes are described below.

3. MANUAL DATA COLLECTION

3.1 Overview

The Bureau of the Census has served as the agent for the manually collected data in the NHDS since its inception in 1965. The Census Bureau is composed of a Headquarters and twelve Regional Offices. In collaboration with NCHS, Census Headquarters staff developed the survey operation procedures; wrote, printed and distributed all field manuals and forms for the NHDS; made modifications to these documents as variables were introduced or changed; and, generally oversaw operations of the manual data collection. Regional Office staffs are responsible for daily operations of the survey, training new field staff, and supplying survey forms and materials to hospital staff. The major elements of NHDS field operations consist of inducting sampled hospitals into the survey, sampling discharges, and abstracting data from medical records.

There are three options for manual data collection: primary, alternate, and printout. In the primary method, hospital personnel in the medical records department sample discharges for inclusion in the survey and abstract data from the sampled medical records onto the survey form. This is the preferred method of data collection because hospital staffs are more familiar with their medical records and data, than are Census staff. In the primary method, hospital staffs are given field manuals, detailed instructions and trained by Census personnel to perform the sampling and abstracting. In 1999, about 30 percent of all manual hospitals in the NHDS provided data using the primary method.

The alternate method is used when hospitals are unwilling or unable to have their staff perform the sampling and abstracting. In this method, a Census Field Representative (FR) selects the sampled discharges, arranges with the hospital medical records staff to have the medical records pulled for abstracting, and the FR abstracts data from the records. Every effort is made to select experienced FRs who have an understanding of medical terminology and are familiar with working with medical records professionals. About 50 percent of manual hospitals participated in this mode of manual data collection for the 1999 NHDS.

Hospitals also provide data in the “manual” mode by supplying computerized printouts of information for sampled discharges. This is considered manual data collection because data on these forms requires manual data entry. Hospitals using this mode provide definitions for coded variables (i.e., 1 = male, 2 = female) to ensure correct data entry. Computerization of inpatient data has made printouts more common in the NHDS; this method of data collection accounted for about 8 percent of manual data collection in 1988 rising to more than 20 percent in 1999. The major aspect of quality control in using printouts is that these forms are reviewed for general acceptability by NCHS staff. Printouts from which data cannot be abstracted without ambiguity are not accepted.

3.2 Sampling Discharges for Manual Data Collection

Discharges within hospitals are selected using systematic random sampling with the sampling intervals based on the statistical design of the survey as specified by NCHS. This is usually accomplished using daily or monthly discharge lists and selecting discharges with specified terminal digits of medical record numbers. In some cases an admission number, billing number, or other patient number is used. If patient specific numbers suitable for sampling are not available, discharges are selected by using a random starting number and then physically counting through a discharge list and selecting every k^{th} discharge thereafter. In some hospitals discharges are sampled using the terminal digits of the medical record numbers on in-house computer files.

Information necessary to identify sample discharges is recorded on a Sample Listing Sheet. A Sample Listing Sheet is completed for each month's sample of records. It includes information such as medical record numbers and dates of discharges which allows medical records to be identified and pulled for abstracting. Sampling schemes that require a physical count of discharges (as described above) are kept continuous by tracking on the Sample Listing Sheet where the sample selection process stopped in the previous period.

4. QUALITY CONTROL - MANUAL DATA

4.1 Field Operations

Two major processes are of interest in the field: sampling of discharges and abstraction of data from the sampled medical records. The quality of the sampling is monitored at NCHS by comparing the observed with the expected number of sampled records per month within each hospital, and by examining the terminal digit of the medical record numbers of sampled cases. Sampling procedures are designed so that the number of sampled discharges per month per hospital is not less than five or more than 50. Sampling out of this range is flagged for further examination. Information about incorrect sampling is provided to the Bureau of the Census to be corrected at the hospital level.

The primary means of ensuring reliable abstraction of data from medical records is to use whenever possible qualified medical records personnel in the hospital to abstract information from the sampled medical records to the NHDS survey form. This allows persons with knowledge of the hospital's medical records and the data that they contain to conduct the primary data collection. If this is not possible, Census FRs perform this abstraction. FRs for the NHDS are chosen based on experience with this type of data and specialized training is provided to ensure their quality of work.

For many years the NHDS included a procedure for reabstracting a sample of medical records to monitor the work of field staff. This procedure was discontinued because the reabstraction could not be performed in the automated hospitals and because results could not be provided in a timely fashion. Often by the time results were available, new hospital staff or Census FRs were conducting the manual abstraction.

Manually collected data are sent from the hospitals to one of the twelve Census Regional Offices where staff monitor the flow and completeness of abstracts. Sample listing sheets and abstracts are then sent to our data processing contractor. The contractor records and tracks the data through a receipt and control process to monitor data flow and completeness. This process also includes checking for duplicate records and missing discharges. During this process, batches consisting of approximately 1,000 abstracts are created to aid the tracking of the medical coding, data entry, and quality control process.

4.2 Medical Coding and Data Entry

Field instructions for the NHDS direct that information on diagnoses and procedures be transcribed in narrative on the survey form. Trained personnel code diagnoses and procedures from these forms using the ICD-9-CM. A minimum of one diagnosis, up to a maximum of seven, is coded for each sample abstract. A maximum of four surgical or diagnostic procedures is coded. As codes are entered into the computer, they are checked against a valid code list provided each year by NCHS. The valid code list is updated annually to include addenda and to keep track of out-of-date codes. This allows invalid entries to be corrected by reexamination of the survey form.

The medical coding and data entry process is monitored by a 10 percent independent sample verification procedure of each batch of 1,000 records. Abstracts in the 10 percent sample are independently coded by a second coder, with discrepancies adjudicated by a chief coder. Additionally, new coders are subject to a 100 percent verification of their first three batches and to 20 percent verification of subsequent batches for their first year of coding. Batches which exceed error rates of 5 percent for medical data or 0.5 percent for non-medical data (data entry) are rejected and the entire batch recoded. The overall error rate for records manually coded for the 2000 data was 0.7 percent for final diagnoses, 0.5 for surgical and diagnostic procedures, and 0.2 percent for non-medical data entry. When data entry and quality control at this stage are completed, a file of records is sent to NCHS for editing, estimation and further processing.

5. AUTOMATED DATA COLLECTION

A major aspect of the 1988 redesign was to include methods for collecting inpatient data that exist in electronic form. The change to actively pursue and collect data in electronic form was not just a change in design, it required major changes to the daily operations of the NHDS, including implementing quality control checks throughout the process.

The concept of collecting data on health encounters through existing electronic systems was formalized at NCHS in the 1970s as part of the Cooperative Health Statistics System (CHSS). The CHSS operated under the legislative authority of the Health Services Research, Health Statistics, and Medical Libraries Act of 1974 (Public Law 93-353). A major emphasis of the CHSS was national data collection through a "bottom-up" cooperative arrangement, a system in which data would be collected once, processed initially at the State level, and submitted to the Federal level in machine-readable form to provide national data (Task Force, 1977). During the 1970s, under the CHSS, NCHS funded hospital discharge demonstration projects in 12 States. NCHS activities under the CHSS were terminated by the Department of Health, Education, and Welfare in February 1979 (Final Report, 1980).

A general evaluation study (Lissler, 1977) of the NHDS conducted in the mid-1970s recommended that the NHDS collect data from three frames: (1) hospitals covered by the CHSS; (2) non-CHSS hospitals that were members of a private abstracting system; and (3) all other hospitals for which no special data source was available. In order to implement a plan that incorporated automated data collection, two major issues needed to be addressed: the availability and quality of data from these sources. The evaluation study concluded that all NHDS data items, with the exception of marital status, were widely available from automated sources.

Studies conducted in the late 1970s on the reliability of hospital discharge abstract service data (Institute of Medicine, 1977) and on the reliability of NHDS data (Institute of Medicine, 1980) showed that data collected from hospitals for discharges by abstract services met and in some cases exceeded standards of data quality traditionally held by NCHS. More recently there has been evidence of improvement in the general quality of hospital discharge data files as this information became important for determining reimbursement by Medicare and other payers (Fisher, 1992; Green, 1993; Hsia, 1992).

NCHS funded two studies on the operational aspects of collecting data in electronic form from commercial abstract services. The first study (Duggar, 1981), initiated in 1980, focused on the suitability of purchasing and using data from discharge abstract services in the NHDS. One of the findings from this study was that the purchase of data could greatly reduce, but not eliminate, the need for direct data collection. In 1981 approximately 60 percent of hospitals in the U.S. subscribed to discharge abstract service systems that serviced 10 or more hospitals. Without covering the universe of hospitals, these systems could not provide a representative sample of all hospitals in the U.S.

Under the second study (Miller, 1984), NCHS initiated a demonstration project in 1984 to develop procedures for acquiring, processing and validating the quality of existing discharge data in electronic form. Under this contract automated data were collected from commercial abstract services for 76 hospitals that participated in the NHDS. Estimates from the NHDS based on manual and automated data collection produced comparable results. The study also demonstrated that abstracting service organizations could comply with data delivery schedules necessary for the NHDS. Based on the results of this study, NCHS began to use data in automated form in the 1985 NHDS.

During 1985-87, NCHS acquired existing automated inpatient data for some NHDS hospitals under a contract with the Center for Health Policy Studies (CHPS). CHPS provided NCHS with a census file for all discharges for 78, 77 and 74 hospitals respectively for years. NCHS sampled records from the files based on the sample design for manual data collection.

Beginning in 1988 under the redesign, the use of automated data collection increased to include about 170 hospitals annually. In addition, the design specifications provided for a greater number of sample discharges from hospitals that submit data in machine-readable form.

6. QUALITY CONTROL - AUTOMATED DATA

There are two major aspects of quality control for automated data. The first is to check the completeness and quality of data on the electronic file and the second consists of computer edits. The computer edits for manual and automated files are described later. Procedures for checking electronic files have evolved. We will describe the methods used for the NHDS in broad terms.

The NHDS is a voluntary survey. NCHS does not have the authority to require hospitals to participate in the NHDS or to mandate the submission of electronic data, its structure, or the form of its submission for the NHDS. We have a recommended file layout with variable structures and processing procedures for submission of automated data. But to keep the hospital response rate as high as possible, NCHS accepts electronic files on various media (cartridge tapes, reel tapes, CD-ROM, diskettes, and as E-mail attachments); in ASCII or EBCDIC; in various layouts and blocking factors; for varying time frames (quarterly, semiannually and annually); and often with unique variable structures. In addition, automated data files are accepted as a census or a sample of discharges. Census files contain all discharges from hospitals and sampling is performed by NCHS. Sample files consist of discharges which are sampled by the automated source prior to submission to NCHS based on sampling specifications provided by NCHS.

Annually, NCHS receives approximately 2,000,000 discharges in automated form each year from about 35 different sources on approximately 60 physical files. Each file goes through a number of processing steps. First, it must be physically useable in the electronic sense. If it is not, a replacement file is requested. Files that do not conform to our layout are reformatted into a standard layout and code structure for all variables. At this point files are examined to detect and remove duplicate records within hospitals. Also, the number of records that should be sent for each hospital is independently verified by querying each hospital for information about their numbers of discharges and newborns by month.

All records are checked for invalid or missing variables, inaccuracies, and outliers. Further, a detailed review is conducted for most variables for each hospital. For diagnoses and procedure codes, the review process generates a list of invalid ICD-9-CM codes, and the distribution of discharges for all patients by chapters of the ICD-9-CM. For these and all other variables the review involves a comparison of distributions for the current year with data from the previous year. This review detects potential problems. If the problems cannot be corrected at NCHS, a replacement file is requested.

The final products of these processing operations are files in a standard format with identical variable structures, valid survey-year ICD-9-CM codes, and data of acceptable quality. Using these files, data from hospitals which provide a census of discharges are merged to form a single file for sampling.

7. PROCESSING FOR MANUAL AND AUTOMATED DATA

At this stage, extensive computer edits are used for all records in the NHDS, both automated and manual. Edits are applied to each record. These include validity and range checks for non-medical variables, and consistency checks for dates of admission, discharge and birth. The medical data (diagnoses and procedures) are again verified against a list of valid ICD-9-CM codes. The edit performs a series of consistency tests from decision logic tables for sex-specific and age-specific ICD-9-CM codes. When the sex or age of a patient is incompatible with the recorded medical information, priority is given to the medical information.

The computer edits are augmented by a manual review of selected records that are rejected by the edit program, e.g., records with ICD-9-CM codes that are not valid as first-listed or single-listed codes; records with lengths of stay longer than one hundred days; records that indicate a delivery with a length of stay more than thirty days; and records with age equal to or greater than 100 years. A nosologist at NCHS manually examines these records (about 300-500 records each year) and makes changes as appropriate to eliminate gross inconsistencies.

We impute missing values for two variables: age and sex. These variables are missing in less than 1 percent of records. Imputations for age and sex are based on the known distribution of the first listed diagnosis for known values of age and sex respectively. This preserves the age and sex distributions for first-listed diagnoses.

8. QUALITY CONTROL - MANUAL AND AUTOMATED DATA

We have developed a fairly extensive procedure to compare year-to-year estimates from the NHDS. This process was initially developed because of the uncertainty introduced by processing vast amounts of data in electronic form, but it has been extremely useful to highlight potential changes in hospital utilization for further study. "Data Checking," as we refer to this process, involves a cadre of analysts who examine differences in estimates from the current survey year with estimates from the prior year's value. Programs have been written which generate tables for study by NHDS analytic staff. This process cannot be fully automated because it requires a familiarity with the NHDS, inpatient data, potential trends in health care, and factors that may influence health care delivery.

An example of how this process has assisted to improve the quality of the NHDS is illustrative. During the data checking process for the 1993 survey year, we detected a decrease in the numbers and rates of discharges for children less than 15 years of age. Any number of events can contribute to a change in hospitalization: a broad change in insurance coverage; a change in incidence of a childhood illness; or, a change in technology that results in a procedure moving to the ambulatory setting (i.e., myringotomy). However, before we consider external causes, we first investigate whether a change could be due to an artifact

of the survey. This particular investigation revealed that of the children's speciality hospitals in the survey, 50 percent refused to participate during 1993. Unfortunately, although we adjust for hospital non-response within strata, children's hospitals are not a sampling stratum. Upon seeing the effect this particular non-response had to NHDS estimates for children, we made a concerted effort to re-induct these hospitals into the NHDS and in 1994. Since 1994, all sampled children's hospitals have responded to the NHDS. We continue to track this set of hospitals for potential non-response problems.

9. FUTURE DIRECTIONS AND CHALLENGES

9.1 Introduction

The implementation in the U.S. in 1983 of a prospective payment system (PPS) using Diagnostic Related Groups (DRGs) for inpatients covered under our Medicare program raised concerns about the program's effects on the quality of medical coding, and hence the usefulness of these data for research. For example, it was thought that medical coding for reimbursement would result in "DRG creep," that is, upcoding to enhance reimbursement. While problems with the reliability of ICD coding remain, the increased importance of medical coding for reimbursement has placed more importance on this activity in hospitals. The reliability of medical coding may have even improved across the DRG boundary (Fisher, 1992). The implementation of PPS was a major change in the collection and use of medical record information. It is in the context of major changes to the NHDS or to national programs that we will address several future challenges.

9.2 Pharmaceutical Data in the NHDS

NCHS has become increasingly interested in mining deeper into data that might be collected by means of its health care surveys. As part of this process, during 2000 we met with numerous Federal health agencies, including the National Institutes of Health, the Department of Veterans Affairs, the Agency for Healthcare Research and Quality, the Food and Drug Administration, the Health Resources and Services Administration, and the Centers for Disease Control and Prevention, to discuss their interests in expanding the NHDS to include additional information. There were several crosscutting themes of interest to these agencies, but an overriding theme was the desire to collect pharmaceutical data. This interest in pharmaceutical data is also reflected in the establishment of an antimicrobial task force that includes representation of agencies across the Department of Health and Human Services.

In 2001 funds were provided to evaluate the potential to collect pharmaceutical data for inpatients in the NHDS and this project is currently underway. At this point we have conducted some preliminary fact-finding activities and have met with researchers at the Maryland School of Pharmacy and professional staff of the American Society of Health System Pharmacists. One of our initial goals is to identify the best source or sources of pharmaceutical data for inpatients that can be linked with data collected in the NHDS. This information will be used to develop initial forms, procedures, and training materials that will be used in a field test.

9.3 Health Insurance Portability and Accountability Act

Recently enacted legislation will be significant to the conduct of the NHDS over the coming years. This legislation entitled the Health Insurance Portability and Accountability Act (HIPAA) was enacted in 1996. It is intended to improve the portability and continuity of health insurance coverage, to combat waste, fraud, and abuse in health insurance and health care delivery, to promote the use of medical savings accounts, and to improve access to long-term care services and coverage. Included in the Act are provisions to reduce costs and administrative burdens of health care by making possible the standardized, electronic transmission of many administrative and financial transactions, and provisions to protect the privacy and confidentiality of patient

information. It is this provision of the HIPAA regulations that concerns people working in the field of health statistics. The level of uncertainty about the regulations to protect patient information may affect the response rates of the health care provider-based surveys at NCHS. While this is not a quality control issue itself, reduced response rates will affect the reliability of NHDS estimates.

9.4 Transition from ICD-9-CM to ICD-10-CM

The ICD-9-CM continues to be the standard for morbidity coding in the U.S. NCHS in collaboration with the Centers for Medicare and Medicaid Services, formerly the Health Care Financing Administration, participates in the ICD Coordination and Maintenance Committee. Through this committee we keep track of the general status of the proposed transition to ICD-10 for morbidity. Implementation of ICD-10 is expected no sooner than 2005. Regardless of when the change takes place, the transition to ICD-10 will require a tremendous outlay of resources to develop and modify inpatient information systems from enterprises using these data including hospitals, insurance companies, State information systems and the Federal Government. Similarly, virtually every aspect of the NHDS will be affected by this transition. Fortunately, there is a two-year period from notification of this change to actual implementation. With proper resources this period will allow the NHDS to prepare.

10. SUMMARY

Many studies have highlighted the need to improve the quality of data from medical records. While there is continuous education of hospital medical records personnel and good communication about annual changes to the ICD-9-CM, there are not any national efforts to improve the quality of basic information in medical records. At NCHS we have procedures to ensure the quality of data collected in the NHDS, but it should be recognized that the NHDS data are entirely dependent on existing medical documentation. In an editorial in the *Journal of American Medical Association* (Jencks, 1992), Dr. Jencks may have put it best: "The information contained in the average medical record costs a great deal of medical effort, patient suffering, and money. We have some obligation to make sure that it is recorded well enough to contribute to improving future care." An effort at the national level to improve these data would be beneficial to all Federal and States data systems as well as retrospective studies that use medical records.

Clearly, the future will bring changes to the collection and utilization of hospital discharge data and these in turn will affect the NHDS. New reporting and processing requirements will dramatically affect how we conduct the NHDS. Additional efforts will be required to measure and ensure the quality of these data. Quality control has always been an essential component of NHDS operations, but it will be even more critical as we face these major new activities in the coming years.

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