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EXECUTIVE SUMMARY

This report compares statistics calculated from the Nationwide Inpatient Sample (NIS) with estimates from databases with similar populations to assess potential biases. Discharge, length of stay and mortality statistics of the NIS are compared with the National Hospital Discharge Survey, the Medicare Provider Analysis and Review (MedPAR) and the American Hospital Association (AHA) Annual Survey data.

The NIS was established as part of the Healthcare Cost and Utilization Project (HCUP) to provide analyses of hospital utilization across the United States. For each calendar year, the NIS universe includes all acute-care discharges from all community hospitals in the United States; the NIS comprises all discharges from a sample of hospitals in this target universe. However, the NIS sampling frame was constructed from the subset of universe hospitals in 24 states that released their discharge data for research use. The 1999 NIS is composed of all discharges from a sample of hospitals from these frame states for calendar year 1999.

The NIS is a stratified probability sample of discharges from hospitals in the frame, with sampling probabilities calculated to select 20 percent of the universe contained in each stratum. Five hospital variables define sampling strata: geographic region (Midwest, Northeast, West, and South), type of ownership, location (urban or rural), teaching status, and bed size.

This report includes both discharge and hospital-level statistics. Discharge statistics include discharge counts, inpatient charges, in-hospital mortality, and average length of stay. These measurements of utilization and outcomes were selected because they are common in health services research and important for health policy and resource planning analyses. Hospital statistics include items such as number of beds, occupancy rates and staffing levels.

The report is divided into four main sections. The first section includes a discussion of the data sources used in the analysis. The second section explains the methodology used to compare the NIS, NHDS, and other data sources. The third section includes a presentation of the results. The final section offers some conclusions and recommendations for analyses of the 1999 NIS.

The 1999 NIS data were drawn from a frame of 24 states and include approximately 7.2 million discharges from 984 hospitals. Benchmark statistics for 1999 were compared with statistics from the **National Hospital Discharge Survey** (NHDS), the **Medicare Provider Analysis and Review** (MedPAR), and the **AHA Annual Survey of Hospitals** (AHA). The 1999 NHDS includes approximately 300,000 discharges from 458 hospitals. The NHDS includes discharges from short-stay U.S. hospitals (hospitals with an average length of stay under 30 days), general-specialty (medical or surgical) and children's hospitals. Federal, military, and Veteran's Affairs hospitals are excluded from the survey.

The 1999 MedPAR data include records for Medicare discharges from Medicare-certified, short-stay U.S. hospitals. To ensure that the hospital makeup of the MedPAR file was consistent with the NIS universe, only community hospitals as defined by the American Hospital Association (AHA) were selected for the comparisons. Analyses suggested that the MedPAR data underreport total Medicare discharges by omitting most discharges for managed care. In 1999, 16.7% of Medicare enrollees were in managed care (HCFA, 1999). As will be discussed throughout the report, this omission has significant implications for the various uses of the MedPAR and NIS data files.

The AHA Annual Survey of Hospitals, 1999, contains one record for every hospital in the NIS universe, making it a convenient source for calculating various statistics based on both the population of hospitals and the NIS sample of hospitals.

Each data source has unique strengths and weaknesses corresponding to their data collection methods. Compared to the NHDS, the NIS includes nearly 25 times the discharges and more than

double the number of hospitals. Further, all discharges are selected from NIS hospitals while the NHDS selects a sample of discharges within each hospital. As a result of these sampling differences, the NHDS may not provide valid estimates in many instances due to small cell sizes. For example, low incidence procedure or diagnosis estimates may be based on fewer than a dozen cases in the NHDS, while the same estimate from the NIS would likely be based on hundreds of discharges. Statistics from the NHDS are assumed to be representative geographically, because the sampling frame is relatively unrestricted, encompassing all federal, acute-care general U.S. hospitals with six or more beds. The NIS sampling frame is limited to 24 states that made their data available for research purposes. Discharges from these 24 states comprise approximately 70% of all U.S. discharges.

No significant differences in estimated counts of regional or national discharges were found between the NIS and NHDS. Because of the underreporting of managed care patients in the MedPAR, the NIS estimate of the Medicare population was consistently higher than MedPAR counts. The NIS also consistently found lower means for length of stay than did the MedPAR data. It is possible that these discrepancies may be due to differences in the managed care population. No significant differences in total charges emerged between MedPAR and NIS.

Comparisons by ownership and bed size show that the NIS consistently reports a higher estimate of discharges from larger hospitals and a lower estimate of discharges from smaller hospitals than does the NHDS. This is clearly a result of the NIS sampling design, which has a disproportionate number of the most populous states. While the NIS produces an overestimate of extremely large hospitals, the NHDS produces an underestimate. For example, the NHDS estimate for discharges from large non-profit hospitals (more than 500 beds) is zero, yet there are seven such hospitals included in the NIS, with thousands of discharges each year.

Regardless of the categorical breakdown – region, age group, gender, hospital ownership, bed size and so on – two conclusions were repeatedly evident in the NIS-NHDS comparisons and NIS-MEDPAR comparisons. First, there were almost no significant differences in mortality estimates. Second, the rank order, in terms of mortality, length of stay and charges was nearly identical in all cases, regardless of category. If a researcher was interested in identifying the type of hospital with highest charges, most common procedure, which region had the longest average length of stay, etc. all three data sources generate the same answer.

The few substantial differences that were found existed between the NIS and NHDS and are easily explainable by differences in coding – the NHDS reorders some diagnosis codes while the NIS does not. For example, in the NIS, the normal delivery category is listed as the principal diagnosis only, when this is the code given by the hospital. The normal delivery population in the NIS represents deliveries where no complications were present. In contrast, deliveries in the NHDS ‘normal’ delivery category include women who have had episiotomies as well as a variety of minor birth complications. It is not surprising then, that both the average length of stay and mortality would be higher for the NHDS normal category, as it represents a somewhat higher risk population.

The key difference between the NIS and the databases to which it was compared is geographic. While both the NHDS and the MedPAR data are gathered from a sampling frame of all 50 states, the 1999 NIS is limited to 24 states. There are some significant differences between the states excluded and included in the NIS that offer likely explanations for some of the differences observed.

The NIS states are disproportionately the more populous ones. Of the ten states with the highest population density, all but two are included in the NIS. Given this difference in geographic sampling, it is not surprising that the NIS underestimates discharges from the smallest hospitals. While discharges are weighted by rural versus urban, weighting the discharges from rural states does not adequately account for the remote areas of the country, which account for a disproportionate number of the smallest hospitals and are not included in the sample. Similarly, it would be expected that the NIS would overestimate the number of discharges from the larger hospitals.

One impact of the specific subset of states selected for the NIS is an overrepresentation of Medicare patients in managed care. Those states with the highest penetration of managed care are disproportionately represented in the NIS. For those regions that have a high proportion of managed care enrollees, such as the West, MedPAR counts of total discharges are substantially lower than NIS estimates. In contrast, for those areas such as the Midwest and South, which have a low proportion of managed care enrollees, the NIS estimates are much closer to MedPAR counts.

While the above discussion focuses on the differences between the NIS and other data sources, it should be noted that these differences only are of concern when there is a reason to expect geographic region might relate to the variable of interest. There is no rationale for proposing that the same diagnoses or procedures would differ in frequency in urban versus rural areas. In fact, very few differences are found in these dimensions. In such cases, where there is no relationship between the variable of interest and geographic region, the NIS provides a large enough sample size to yield estimates with much smaller standard errors than a smaller sample such as the NHDS. Without a sample of several million, such as in the NIS, estimates for the less common procedures and diagnoses are unreliable. Similarly, while the NIS does over-sample highly urbanized areas, this very over-sampling allows data to be available on less common hospital combinations, e.g., large non-profit hospitals, which are unusual enough not to be picked up at all in a smaller sample such as the NHDS.

The NIS provides a large sample of Medicare discharges both in managed care and fee-for-service plans, thus it would be the choice of researchers who desired to include all discharges regardless of type of payment. The NIS is clearly the choice for researchers interested in managed care enrollees in the aging population, as these individuals are sampled at a proportional rate for the NIS.

There were changes between the 1997 and 1999 NIS in sampling design. The previous sampling plan ensured that hospitals drawn for the sample in one year had a high probability of being drawn for the sample in the following year. In the 1999 NIS, probability of selection was unrelated to inclusion in prior years. Rehabilitation hospitals were included in prior years but eliminated from the 1999 NIS. Changes were also made in the definition of the stratification variables of bed size, type of ownership and teaching hospitals.

Relative to the previous comparison report, using the 1997 NIS, fewer significant differences between the NIS and NHDS were found. This is to be expected, as the NIS sampling strategy has been redesigned and the sample expanded to include two more states, both expected to increase its representativeness. Similar to the 1997 comparison, the NIS consistently reports more discharges than MedPAR, as in both years the MedPAR data did not include the managed care enrollees who are part of the NIS sample. NIS estimates closely match the AHA survey results, with eleven of the eighteen estimates differing by 1% or less.

INTRODUCTION

HCUP and NIS Background

The Healthcare Cost and Utilization Project (HCUP) is a Federal-State-industry partnership to build a standardized, multi-state health data system. In September 2000, the Agency for Healthcare Research and Quality (AHRQ) provided funding for The MEDSTAT Group (MEDSTAT) to continue existing development efforts and to expand this health data system through data year 2003. The 1999 NIS was established as part of HCUP to provide analyses of hospital utilization across the United States. For each calendar year, the NIS universe includes all acute-care discharges from all community hospitals in the United States; the NIS comprises all discharges from a sample of hospitals in this target universe. However, the NIS sampling frame was constructed from the subset of universe hospitals that released their discharge data for research use. Currently, the Agency for Healthcare Research and Quality (AHRQ) has agreements with 25 data sources that maintain statewide, all-payer discharge data files. Data from 24 of these states were included for the 1999 release. These 24 states represent the addition of two more states to the existing 22 states in the 1998 release and thirteen more states than the first release. The 1999 NIS is composed of all discharges from a sample of hospitals from these frame states for calendar year 1999. The states included in each NIS release from 1988 through 1999 are given in Table 1.

Table 1. States in the Frame for NIS Releases

Years	States in the Frame
1988	California, Colorado, Florida, Iowa, Illinois, Massachusetts, New Jersey, and Washington
1989-1992	Add Arizona, Pennsylvania, and Wisconsin
1993	Add Connecticut, Kansas, Maryland, New York, Oregon, South Carolina
1994	No new additions
1995	Add Missouri, Tennessee
1996	No new additions
1997	Add Georgia, Hawaii, and Utah
1998	No new additions
1999	Add Maine and Virginia

Creation of the NIS was subject to certain restrictions.

- The Illinois Health Care Cost Containment Council stipulated that no more than 40 percent of Illinois discharge data could be included in the database for any calendar quarter. Consequently, approximately 70 percent of the Illinois community hospital universe were randomly selected for the frame each year.
- Hospitals in Missouri were allowed to withhold their data from the NIS. Thirty-three Missouri hospitals from a state total of 119 that provided data to HCUP for 1999 chose not to participate in the NIS.

- Georgia, Hawaii, South Carolina, and Tennessee all imposed “small strata/cell restrictions,” requiring the NIS to exclude hospitals, when only one hospital appears in a sampling stratum. Six of 58 South Carolina hospitals and three of 19 Hawaii hospitals were excluded. In the other two states, these restrictions had minimal impact on the sample. One of 153 hospitals from Georgia was excluded; no Tennessee hospital met the exclusion criteria.

NIS Redesign

The NIS is a stratified probability sample of hospitals in the frame, with sampling probabilities calculated to select 20 percent of the universe contained in each stratum.

The 1999 NIS differs from previous years of the NIS due to a sampling redesign. Some elements of the new sampling design were determined in advance by MEDSTAT and AHRQ. Other features of the sampling design required analysis of alternatives using the 1997 NIS and the 1997 AHA hospital survey.

Sampling features determined in advance

Similarities to prior NIS strategy

- We continue to sample 100 percent of all discharges for each hospital drawn into the NIS. This feature distinguishes the NIS from other discharge samples (such as the National Hospital Discharge Survey) and permits patient outcomes from individual hospitals to be estimated without sampling error.

- To assure geographic dispersion of the sample within the HCUP states, we continue to sort hospitals within strata by the first 3 digits of their ZIP Code before selecting a systematic sample.

- We continue to sample a number of hospitals equal to 20 percent of the universe within each stratum. In any given year, there will be about 5,000 hospitals in the universe and about 1,000 hospitals for the NIS.

- We continue to produce two non-overlapping 10-percent sub-samples that allow researchers to test programs and perform preliminary analyses. If desired, the two sub-samples can be combined to form a single 20 percent sub-sample of NIS discharges.

Differences from prior NIS strategy

Longitudinal Cohort – To maintain a longitudinal cohort, the previous sampling plan ensured that hospitals drawn for the sample in one year had a high probability of being drawn for the sample in the following year. Including the same hospitals across years improved the precision of trend analyses, although it may have introduced some form of bias into one or more years of the hospital sample. MEDSTAT and AHRQ decided to discontinue any sampling scheme that increased the chance that hospitals would be included in successive years of the NIS.

To test the impact of this change, we calculated the 1997 sample with and without the longitudinal weighting component. For this analysis we drew 500 samples using the old sampling design with and without the longitudinal preference. A comparison of each distribution of each of the 500 samples showed that removing the longitudinal component shifts the estimate very slightly and increases variation around the estimated mean. That is, after dropping the longitudinal component, the expected mean changes fractionally while the variance around that mean increases because more hospitals become "eligible" to be drawn into the sample.

Analysis of selected sampling features

MEDSTAT performed three major sets of analyses to define the specifications of the new NIS sampling strategy. First, because the HCUP NIS has expanded from 8 states to 24 states, we re-evaluated whether differences between hospitals in HCUP states and non-HCUP states were

substantial enough to require stratified sampling for the NIS. Second, we identified variables that should be used for stratification, changing some variable definitions to minimize small cell sizes in the NIS. Finally, we compared alternative weighting schemes to determine which would provide the most precise estimates of the target population for selected outcome variables.

Differences between HCUP and non-HCUP states – The main objective of a stratified sample is to ensure that the sample is representative of the target universe. Stratification becomes advantageous when the sampling frame (HCUP states) differs substantially from the target universe (all states). HCUP hospitals tend to be larger than non-HCUP hospitals. As a result, HCUP hospitals have more beds and higher occupancy rates overall, suggesting a need for sample stratification. These differences are more pronounced in the Northeast and West, and HCUP states in these regions also tend to have higher Medicare managed care penetration and more discharges than their non-HCUP counterparts. HCUP hospitals in the Northeast also tend to have longer average lengths of stay (ALOS) than do non-HCUP hospitals in the Northeast. Although the number of differences between HCUP and non-HCUP hospitals in the Northeast and West are greater than in other regions, the impact of these differences is lower because HCUP hospitals represent almost all discharges in those regions.

Review of stratification variables – In previous NIS designs, we developed strata for geographic region, hospital ownership, urban/rural location, and teaching status. We re-evaluated our selection of stratification variables to reaffirm whether these or other strata explained significant differences in selected outcome variables, and also to identify strata that could be nested or collapsed to avoid small cells in the final sample. The changes described below reduced the number of NIS strata from 108 to 60.

In the course of analyzing stratification variables, we found that patients treated in rehabilitation hospitals tend to have lower mortality rates and longer lengths of stay than patients in other community hospitals, and the completeness of reporting for rehabilitation hospitals is very uneven across the states. Therefore, we decided to eliminate rehabilitation hospitals from the NIS (and the target universe) rather than retain this distinction as a stratification variable.

Bed size continues to be an important stratification variable, but the range of bed sizes varies across other strata, making it difficult to define a single set of cutpoints to define hospitals of various sizes. In the previous NIS, bed size categories were defined only within location/teaching status. However, even within these location/teaching categories, the bed size distributions still varied widely by geographic region. We decided to define small, medium, and large bed size categories nested within region and location/teaching category such that approximately one-third of the hospitals would be allocated to each category, as shown in Table 2 below.

The distributions of U.S. hospitals by type of ownership (public, voluntary, and proprietary) varied significantly by geographic region, making it undesirable to stratify ownership consistently for all regions. Therefore, we decided to nest ownership strata within certain regions. We use three ownership categories for rural hospitals in the South and for urban non-teaching hospitals in the South and West. We stratify on ownership for rural hospitals in the West and Northcentral regions, but only after collapsing the proprietary and voluntary hospitals into a new “private” ownership category.

Finally, we redefined teaching hospitals. In prior versions of the NIS, a hospital was designated a teaching hospital only if it had some interns or residents and it was either a member of the Council of Teaching Hospitals or it had an AMA-approved residency program. The new definition still defines these same hospitals as teaching hospitals. However, it also includes all hospitals with a ratio of interns and residents to beds of .25 or higher. This intern-to-bed ratio is similar to a component of the Centers for Medicare & Medicaid Services (CMS, formerly the Health Care Financing Administration) definition of teaching hospitals for Medicare payments.

Review of weighting strategies – The discharge sample weights for previous versions of the NIS were calculated within each sampling stratum as the ratio of discharges in the universe to discharges in the sample. The discharge sample weights were constant for all discharges within each stratum. We decided to test an alternative weighting strategy that would yield four weights per stratum, with separate weights for Newborns, Medicare discharges (non-newborns), Medicaid discharges (non-newborns), and Other discharges (non-newborns). We compared estimates using a single weight per stratum to estimates using four weights per stratum using 1,000 simulated NIS hospital samples from the 1997 AHA and 1997 SID data. The two weighting schemes produced very similar average estimates for all outcomes except for the total number of discharges for each payer. We also found little difference by region between the two weighting strategies. Finally, we applied the two sampling strategies to the universe of HCUP states to compare their precision. Both schemes produced very precise estimates, with no clear difference in precision between schemes. Therefore, we will continue the previous strategy of one weight per stratum.

NIS Sampling

The overall sampling objective was to select a sample of hospitals that could be generalized to the target universe, including hospitals outside the frame (which had a zero probability of selection). To improve the generalizability of the NIS estimates, five hospital sampling strata were used:

1. Geographic Region – Midwest, Northeast, West, and South.
2. Ownership – public, private non-profit, and proprietary (private or investor-owned).
3. Location – urban and rural.
4. Teaching status – teaching and non-teaching.
5. Bed size – small, medium, and large. Bed size categories are based on hospital beds, and are specific to the hospital's location and teaching status, as shown in Table 2. Bed size cutpoints were chosen so that approximately one-third of the hospitals in a given region*location/teaching combination would be in each bed size category. Different cutpoints for rural, urban non-teaching, and urban teaching hospitals were used because hospitals in those categories tend to be small, medium, and large, respectively. For example, a medium-sized teaching hospital would be considered a rather large rural hospital. Further, the size distribution is different among regions for each of the urban/teaching categories. Using differing cutpoints in this manner avoids strata with small numbers of hospitals in them. Rural hospitals were not split according to teaching status, because rural teaching hospitals are rare.

To ensure further proportional geographic representation, hospitals were sorted by state and the first three digits of their zip code prior to systematic sampling. See Design report: HCUP Nationwide Inpatient Sample 1999 for more details on the sampling design.

Table 2. Bedsize Categories			
Location and Teaching Status	Hospital Bedsize		
	Small	Medium	Large
NORTHEAST			
Rural	1-49	50-99	100+
Urban, non-teaching	1-124	125-199	200+
Urban, teaching	1-249	250-424	425+
NORTHCENTRAL			
Rural	1-29	30-49	50+
Urban, non-teaching	1-74	75-174	175+
Urban, teaching	1-249	250-374	375+
SOUTH			
Rural	1-39	40-74	75+
Urban, non-teaching	1-99	100-199	200+
Urban, teaching	1-249	250-449	450+
WEST			
Rural	1-24	25-44	45+
Urban, non-teaching	1-99	100-174	175+
Urban, teaching	1-199	200-324	325+

NIS Weights

Sample weights were developed for the NIS to obtain national estimates of the hospital and inpatient parameters. For example, with these weights it should be possible to estimate diagnosis-specific average lengths of stay over all U.S. hospitals, using weighted average lengths of stay from the NIS.

Purpose of Report

This report compares statistics calculated from the NIS with estimates from databases with similar populations to assess potential biases. Discharge, length of stay and mortality statistics of the NIS are compared with the National Hospital Discharge Survey, the Medicare Provider Analysis and Review (MedPAR) and the American Hospital Association (AHA) Annual Survey data.

Ideally, relationships among outcomes and their correlates estimated from the NIS should hold across all U.S. hospitals. However, because only 24 states contributed data to the 1999 NIS, there is a possibility that some estimates may be biased. In this report, we compare estimates based solely on the NIS against estimated values from other data sources. This report compares the NIS with other data sources using both discharge and hospital-level statistics. Discharge statistics include discharge counts, inpatient charges, in-hospital mortality, and average lengths of stay. Hospital statistics include items such as number of beds, occupancy rates, and staffing levels.

The remainder of this report is divided into four sections. The first section includes a discussion of the data sources used in the analysis. The second section explains the methodology used to compare the NIS and NHDS. The third section includes a presentation of the results. The final section offers some conclusions and recommendations for analyses of the 1999 NIS.

Data Sources

Benchmark statistics for 1999 from several data sources were compared to the 1999 NIS. The NIS data were drawn from a frame of 24 states and included approximately 7.2 million discharges from 984 hospitals. NIS statistics were compared with those calculated from three other sources, each of which is described below.

National Hospital Discharge Survey (NHDS), 1999.

Conducted by the National Center for Health Statistics, the NHDS includes approximately 300,000 discharges from 458 hospitals. The NHDS covers discharges from U.S. hospitals categorized as short-stay (hospitals with an average length of stay under 30 days), including both general-specialty (medical or surgical) and children's hospitals. Federal, military, and Veteran's Affairs hospitals are excluded from the survey.

Table 3 summarizes some of the key differences in hospitals and discharges represented by the NIS and NHDS data files. Sampling error can be expected in both the NHDS and the NIS. The NIS includes nearly 25 times the discharges as the NHDS and more than double the number of hospitals. Further, all discharges are selected from NIS hospitals while the NHDS selects a sample of discharges within each hospital. As a result of these sampling differences, the NIS can be expected to have much smaller standard errors than the NHDS. In addition, the NHDS may not provide valid estimates in many instances due to small cell sizes. For example, low incidence procedures and diagnoses estimates may be based on fewer than a dozen cases in the NHDS while the same cell would have hundreds of discharges in the NIS. Statistics from the NHDS are assumed to be representative geographically, because the sampling frame is relatively unrestricted, encompassing all federal, acute-care general U.S. hospitals with six or more beds, while the NIS sampling frame is limited to 24 states that made their data available for research purposes.

Medicare Provider Analysis and Review (MedPAR), 1999.

The MedPAR data obtained from the Center for Medicare and Medicaid Services (CMS, formerly HCFA) include all records for each fee-for-service Medicare discharge from a Medicare-certified, short-stay U.S. hospital. Federal fiscal year records for 1999 and 2000 were used to create a calendar year 1999 MedPAR file with 11.8 million discharge records. To ensure that the hospital makeup of the MedPAR file was consistent with the NIS universe, community hospitals as defined by the American Hospital Association (AHA) were identified and selected. Only AHA-defined community hospitals were kept in the MedPAR-derived file for this study. In the MedPAR data, same-day stays (admission and discharge on the same day) are assigned a length of stay of one day. Consequently, in comparisons of average lengths of stay between the NIS and MedPAR data, same-day stays in the NIS were recoded from zero to one for this analysis.

Table 4 summarizes some of the key differences in hospitals and discharges represented by the NIS and MedPAR data files. Medicare discharge statistics from MedPAR have no sampling error associated with them because this file represents a census of 1999 fee-for-service Medicare discharges. Analyses, however, suggest that the MedPAR data underreport total Medicare discharges by omitting most discharges for managed care. In 1999, 16.7% of Medicare enrollees were in managed care, including HMOs (HCFA,1999). However, only 0.8% of calendar year 1999 MedPAR discharges were identified as managed care enrollees, suggesting that approximately 16% of the Medicare population may have been excluded (16.7% in the population - 0.8% in the MEDPAR file = 15.9%) . As will be discussed throughout the report, this omission has significant implications for the various uses of the MedPAR and NIS data files.

Table 3. Comparison of 1999 NIS and NHDS Data Files

Characteristics	1999 NIS	NHDS
Number of Hospitals	**984**	**458**
Number of discharges	**7,198,929**	**300,460**
Intended universe	Discharges from community hospitals as defined by AHA – non-federal, short-term general or other specialty hospitals that are not a hospital unit of an institution	SAME
Bedsize	No restriction was placed on bedsize in creating the file, but no hospitals in the sample have fewer than six beds.	Must have at least six beds staffed for patient use to be included.
Sample or Universe	Sample	Sample
Sampling frame	24 states	50 states and the District of Columbia
Sample design - hospitals	By geographic region, control/ownership, location, teaching status and bedsize	Includes all hospitals with ≥ 1,000 beds or ≥ 40,000 discharges annually, plus an additional sample of hospitals in two stages. A sample of 112 PSUs was selected. These PSUs were a probability sample of the counties or metropolitan areas used in the 1985-1994 National Health Interview Survey. A sample of hospitals was selected within these PSUs.
Sample design – discharges	All discharges from sampled hospitals were included.	A systematic random sample of discharges was selected from each hospital.
Reassignment of diagnosis codes	None	For women discharged after delivery, a code of V27 is entered as the first-listed code. If a symptom appears as a first-listed code and a diagnosis listed as a secondary code, the diagnosis replaces the symptom. If acute myocardial infarction is listed with other circulatory conditions, it is reordered to the first entry.

Table 4. Comparison of 1999 NIS Medicare Discharges and MedPAR Data Files

Characteristic	1999 NIS (Medicare Only)	MedPAR
Number of Hospitals	**979**	
Number of discharges	**2,642,150**	**11,812,698**[1]
Intended universe	Discharges from community hospitals as defined by AHA – non-federal, short-term general or other special hospitals that are not a hospital unit of an institution	All Medicare discharges. *Only discharges from community hospitals are included for comparison purposes.*
Bedsize	No restriction was placed on bedsize in creating the file, but no hospitals in the sample have fewer than six beds.	No restriction was placed on bedsize in creating the file, but no hospitals in the sample have fewer than six beds.
Sample or Universe	Sample	Universe
Sampling frame	24 states	50 states and the District of Columbia
Sample design - hospitals	By geographic region, control/ownership, location, teaching status and bedsize	All hospitals included.
Sample design – discharges	All discharges from sampled hospitals were included.	All fee-for-service discharges were included.
Reassignment of diagnosis codes	None	None

[1] Discharges from community hospitals

METHODS

Variables Compared in the Report

The following measures were chosen to compare the NIS and NHDS databases:

- Total number of discharges
- Average length of stay
- In-hospital mortality rate.

These measures of utilization and outcomes were selected because they are common in health services research and important for health policy and resource planning analyses.

The NIS-MedPAR comparison included total hospital charges in addition to the three variables noted above. When comparing NIS records to MedPAR, only the NIS discharges for which Medicare was the expected primary or secondary payer were used.

Statistical Testing

Estimates derived from both the NIS and NHDS are based on weighted discharge records from stratified samples. Because the sampling error in a stratified sample is the sum of the stratum-level sampling errors (Lehtonen & Pahkinen, 1995), a simple estimate of standard error would be inaccurate for these comparisons. Both NIS and NHDS use cluster sampling, where discharge records are selected from randomly sampled hospitals. The SAS software PROC SURVEYMEANS was used to compute standard errors for the NIS. The stratifier variable included in the NIS (NIS_STRATUM) was specified as the stratum and the unique hospital identifier (HOSP_ID) was specified as the cluster variable. The stratification and hospital variables for discharges were not included in the NHDS file, so the SURVEYMEANS procedure could not be used with this sample. A description of the method used for calculating standard errors for the NHDS is given in Appendix A.

For each NIS-NHDS comparison, a test was performed to determine whether the NIS and NHDS estimates differed significantly. Because the NIS and NHDS estimates were both based on samples, two-sample t-tests were used where valid estimates of the NHDS standard error could be made. Due to the limited sample size, valid estimates were not available for all breakdowns of the NHDS data. Please see Appendix A for a description of comparison tests and an explanation of restrictions on calculating NHDS sample errors. Differences were reported at the .01 and .05 significance levels.

Because the MedPAR data are the population, and not a sample, a z-statistic was computed for these comparisons. The standard error used in these calculations was generated by the PROC SURVEYMEANS procedure for the subset of NIS discharges with Medicare identified as the principal payer or secondary payer.

RESULTS

Whenever two different samples are taken, population estimates will not be identical, i.e., random variation occurs. Statistically significant differences between the NIS and NHDS can also be expected, for a variety of reasons. First, some differences exist in the sampling strategies used. Second, the NHDS use of a non-standard method of coding diagnoses for pregnancy and delivery can be expected to lead to significant differences on these comparisons. Finally, the sheer number of tests conducted (330) generally produce, purely by chance 16-17 results statistically significant at the .05 level and three or four differences significant at the .01 level.

While some type of correction for the number of tests could be applied, given the number of tests, this would greatly increase the risk of a Type II error. For example, if a Bonferroni correction was used for the total number of tests, the applied alpha level would be .05/330 or .00015.

Comparisons by Region

NIS and NHDS estimates of discharges, average lengths of stay (ALOS) and in-hospital mortality, are shown in Table 5. Overall and by region, no statistically significant differences were found between the NIS and NHDS data on any of the three variables measured (discharge counts, average length-of-stay and in-hospital mortality rate). ALOS comparisons could not be made for the Northeast and Midwest, because a reliable standard error for the NHDS estimate could not be determined. However, the magnitude of the differences between NIS and NHDS estimates in these regions is small and appear consistent with the non-significant differences shown in other regions.

Table 5. NIS and NHDS Estimates by Region, 1999

	Number of Discharges in Thousands (Standard Error)		Average Length of Stay in Days (Standard Error)		In-hospital Mortality Rate Percent (Standard Error)	
	NIS	NHDS	NIS	NHDS	NIS	NHDS
U.S.	35,467 (589)	35,858 (1,421)	4.71 (.04)	4.78 (.31)	2.46 (.04)	2.41 (.05)
Census Region						
Northeast	7,249 (249)	7,649 (549)	5.48[a] (.11)	5.51 (b)	2.72 (.13)	2.62 (.08)
Midwest	8,221 (283)	8,169 (803)	4.64[a] (.06)	4.42 (b)	2.38 (.05)	2.26 (.08)
South	13,331 (398)	13,347 (770)	4.60 (.05)	4.78 (.45)	2.56 (.06)	2.50 (.08)
West	6,666 (214)	6,693 (440)	4.20 (.08)	4.37 (.49)	2.11 (.06)	2.17 (.11)

[a] A significance test was not performed because a valid standard error was not available.
[b] A reliable standard error could not be calculated.

Comparisons of the MedPAR data set and the Medicare discharges from the NIS are shown by region and for the nation in Table 6. The NIS estimate of total discharges is 112% that of the MedPAR total. Given that approximately 16% of Medicare patients were excluded from the MEDPAR data, this discrepancy is not unexpected. The NIS estimates 13% more records in the Northeast region, 7% more in the Midwest, 7% more in the South, and 20% more in the West. The magnitude of differences in the regional discharge estimates appears greatest in the regions with the largest Medicare managed care penetration, such as the Northeast, South, and West.

NIS average length of stay estimates were significantly lower than MedPAR statistics, nationwide as well as in the Northeast, South, and West. As with the regional differences in discharge estimates, these are the regions with the largest Medicare managed care penetration. All of the regional differences show lower ALOS estimates in the NIS than in MedPAR, suggesting that the missing managed care discharges have significantly shorter stays than are present in fee-for-service Medicare admissions. It is not possible to compare ALOS for FFS and Managed Care Medicare enrollees within the NIS because not all states make this distinction.

There are no significant national and regional differences between MedPAR and NIS estimates of in-hospital mortality or in total charges. Although the NIS and MedPAR yield different estimates of ALOS, the similarity of their mortality and charges estimates suggest that the two databases do not have fundamental differences in their description of patient outcomes.

Table 6. NIS and MedPAR Comparisons by Region, 1999

	Number of Discharges in Thousands (Standard Error)		Average Length of Stay In Days (Standard Error)		In-hospital Mortality Rate Percent (Standard Error)		Total Hospital Charges (Standard Error)	
	NIS	MedPAR	NIS	MedPAR	NIS	MedPAR	NIS	MedPAR
U.S.	13,045** (250)	11,676	6.05** (.04)	6.51	4.74 (.05)	4.65	15,716 (278)	15,776
Census Region								
Northeast	2,773** (121)	2,402	7.01** (.14)	7.69	5.19 (.20)	5.06	16,776 (964)	17,200
Midwest	3,200 (129)	2,989	5.90 (.06)	6.00	4.47 (.07)	4.36	14,566 (384)	13,710
South	5,091* (158)	4,716	5.82** (.06)	6.46	4.77 (.07)	4.70	14,253 (283)	14,661
West	1,981** (80)	1,569	5.52** (.10)	5.82	4.47 (08)	4.40	20,068 (754)	19,607

* $p < .05$ ** $p < .01$

Table 7 compares the discharges reported in the AHA Annual Survey with weighted and unweighted NIS discharge estimates. The definition of hospital location used as a NIS sampling stratum is based on AHA annual survey results. Therefore, it is not surprising that NIS discharge estimates by Census Region align with the discharge counts from the AHA survey, as shown in Table 7.

Table 7. Number of Hospitals in NIS Frame and AHA Universe by Census Region, 1999

	1999 AHA Universe	1999 NIS Frame[2] (Weighted)	1999 NIS Frame[2] (Unweighted)
U.S.	4,859	4,859	984
Census Region			
Midwest	1,407	1,407	286
Northeast	679	679	138
South	1,861	1,861	370
West	912	912	190

Note: Significance tests were not performed because AHA numbers are not sample statistics.

In summary, national and regional NIS estimates matched the NHDS and the AHA survey on all measures tested. The NIS overestimated MedPAR counts of Medicare discharges and underestimated MedPAR ALOS statistics. These differences were greatest in the Northeast, South, and West, and the differences were consistent with the hypothesis that MedPAR data underreports care delivered to beneficiaries in Medicare + Choice and other Medicare demonstration plans.

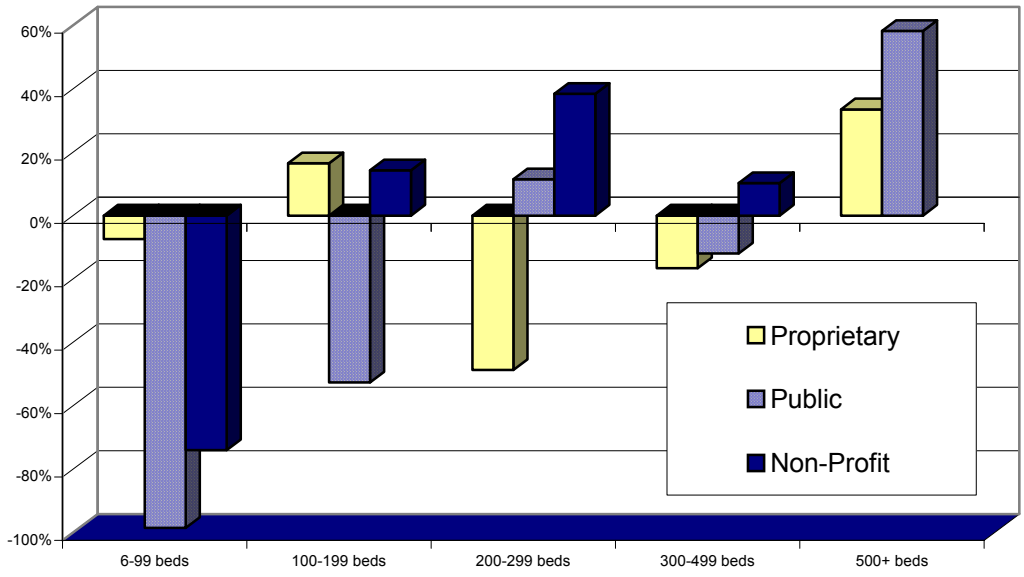
Comparisons by Hospital Characteristics

NIS and NHDS estimates of 1999 discharges, average length of stay and in-hospital mortality are shown in Table 8. The table reports each database's estimates by hospital ownership categories (proprietary, public and private non-profit), then by bedsize categories (6-99, 100-199, 200-299, 300-499 and 500+) within each ownership category. Each estimate is accompanied by its standard error, when the database permitted a reliable estimation of that standard error.

NIS and NHDS estimates were similar for all three measures for each hospital ownership category. Significant differences did appear, however, when comparisons were made for some bedsize categories within each level of hospital ownership. Most of these differences emerged when comparing estimates of total discharges within category. It can be seen in Figure 1 that the NIS tends to underestimate discharges relative to the NHDS for smaller hospitals and overestimates discharges represented by the largest hospitals.

[2] The 1999 frame contains 24 states.

Figure 1. Differences in NIS and NHDS Discharges by Ownership and Bedsize Categories



For proprietary hospitals, the NIS and NHDS discharge estimates were significantly different for three bedsize categories.

- The NIS estimate was 49% lower for hospitals with 200-299 beds.
- The NIS estimate was 17% lower for hospitals with 300-499 beds.
- The NIS estimate was 34% higher for hospitals with 500 or more beds.

Public hospitals represent the vast majority of discharges. The trend of fewer discharges from small hospitals and more from larger hospitals is seen here once again. Total discharge estimates from the NIS and NHDS are significantly different for all five bedsize categories.

- The NIS estimate was 99% lower for hospitals with 6-99 beds.
- The NIS estimate was 53% lower for hospitals with 100-199 beds.
- The NIS estimate was 11% higher for hospitals with 200-299 beds.
- The NIS estimate was 12% lower than the NHDS estimate for hospitals with 300-499 beds.
- The NIS estimate was 58% higher than NHDS for hospitals with 500 or more beds.

For private, non-profit hospitals, there were also significant differences in discharge estimates.

- The NIS estimate was 74% lower than NHDS for hospitals with 6-99 beds.
- The NIS estimate was 14% higher for hospitals with 100-199 beds.
- The NIS estimate was 38% higher for hospitals with 200-299 beds.

Although several categories of bed size within ownership yielded differences in NIS and NHDS discharge estimates, far fewer differences emerged in estimates of ALOS or mortality. NIS mortality estimates for the largest proprietary hospitals exceeded the NHDS estimate. In addition, the NIS estimate of ALOS in the smallest private non-profit hospitals was significantly lower than the comparable NHDS estimate. It should be noted that statistical comparisons could not be performed for private non-profit hospitals with 500 or more beds, as the NHDS included no hospitals of this type.

Table 9 compares NIS and MedPAR estimates of discharges, ALOS, and mortality by hospital ownership and bedsize. NIS discharge estimates higher than MedPAR counts continue to reflect the exclusion of Medicare managed care discharges in MedPAR. However, these results should be interpreted cautiously, as substantial percentages of MedPAR records did not clearly identify hospital ownership (8%) or bed size (17%).

The NIS overestimated mortality rates relative to MedPAR in the private investor-owned category (overall) and also in the largest public hospitals. However, these differences do not appear to be pervasive or systematic. No significant differences emerged in estimates of total charges. Significant differences in mean length of stay are found for private, but not public hospitals.

We also compared NIS and MedPAR estimates for teaching and non-teaching hospitals in urban areas, and for all hospitals in rural areas. These comparisons are shown in Table 10, with additional bed size comparisons reported within each category. The NIS discharges are significantly higher than MedPAR for all categories except for urban non-teaching hospitals with 100-199 beds and for rural hospitals with over 100 beds. Again, these discrepancies reflect the omission of managed care patients from the MedPAR data. Results should be interpreted cautiously, as 8% of MedPAR records did not permit the identification of the hospital's population density or teaching status.

The NIS estimates again trended lower than MedPAR estimates for ALOS, reaching statistical significance for some bed size categories of rural hospitals and urban teaching hospitals. As with previous comparisons, there were no significant differences in NIS and MedPAR estimates of mortality or of total charges.

Table 8. NIS and NHDS Comparisons by Hospital Ownership and Size, 1999

Control/Bedsize	Number of Discharges in Thousands (Standard Error)		Average Length of Stay in Days (Standard Error)		In-hospital Mortality Rate Percent (Standard Error)	
	NIS	NHDS	NIS	NHDS	NIS	NHDS
Total Proprietary	4,445 (142)	4,349 (176)	4.81 (.09)	4.68 0.31	2.47 (.06)	2.32 (.14)
6-99 beds	1,219 (53)	1,309 (56)	3.83 (.06)	3.66 (.25)	2.56 (.07)	2.80 (.27)
100-199	1,044 (81)	872 (39)	4.14 (.13)	4.19 (.29)	2.40 (.12)	1.99 (.28)
200-299	279 ** (30)	414 (20)	4.98 (.19)	5.75 (.42)	2.50 (.02)	2.95 (.49)
300-499	973** (40)	1,135 (49)	5.36 (.15)	5.43 (.37)	2.37 (.02)	2.10 (.25)
500+ beds	930** (26)	618 (29)	6.25 (.35)	5.46 (.39)	2.52 (.02)	1.74 * (.31)
Total Public	26,739 (522)	27,755 (1,100)	4.74 (.04)	4.79 (.31)	2.47 (.05)	2.42 (.05)
6-99 beds	2,586 ** (94)	5,134 (207)	3.83 (.06)	4.38 (.29)	2.42 (.07)	2.39 (.13)
100-199 beds	4,782** (127)	7,302 (293)	4.33 (.13)	4.56 (.30)	2.37 (.12)	2.41 (.11)
200-299 beds	6,179* (183)	5,473 (221)	4.64 (.19)	4.90 (.32)	2.49 (.02)	2.43 (.12)
300-499 beds	6,180* (206)	6,918 (278)	4.85 (.15)	4.98 (.32)	2.51 (.02)	2.45 (.11)
500+ beds	7,013** (312)	2,927 (120)	5.34 (.35)	5.42 (.36)	2.52 (.02)	2.40 (.17)
Total Private non-profit	4,283 (163)	3,753 (153)	4.44 (.09)	4.77 (.31)	2.41 (.08)	2.44 (.15)
6-99 beds	631 ** (40)	1,099 (48)	3.89** (.14)	4.96 (.34)	2.16 (.11)	2.60 (.29)
100-199	1,513 * (84)	1,297 (56)	4.25 (.11)	4.44 (.30)	2.38 (.12)	1.93 (.23)
200-299	1,088** (76)	670 (31)	4.71 (.22)	5.23 (.37)	2.43 (.19)	2.38 (.35)
300-499	767 (55)	689 (31)	4.72 (.20)	4.65 (.33)	2.62 (.15)	3.20 (.40)
500+ beds	284 (b)	0 (b)	4.87 (b)	0 (b)	2.38 (b)	0 (b)

[*] $p < .05$ [**] $p < .01$

[a] A significance test was not performed because a valid standard error was not available.

[b] A reliable standard error could not be calculated.

Table 9. NIS and MedPAR Comparisons by Hospital Ownership and Size, 1999

	Number of Discharges in Thousands (Standard Error)		Average Length of Stay in Days (Standard Error)		In-hospital Mortality Rate Percent (Standard Error)		Total Hospital Charges (Standard Error)	
	NIS	MedPAR	NIS	MedPAR	NIS	MedPAR	NIS	MedPAR
Total Public	1,552 (63)	1,431[b]	5.83 (.09)	5.86	4.81 (.10)	4.66	13,103 (300)	12,893
1-99 beds	567** (22)	442[c]	4.79 (.08)	4.80	4.60* (.11)	4.36	7,232 (171)	7,269
100-199 beds	377** (32)	278[c]	5.64 (.17)	5.74	5.03 (.21)	4.82	13,144 (746)	12,013
200-299 beds	95** (8)	184[c]	6.63 (.52)	6.46	5.02 (.31)	4.96	17,046 (2,876)	14,310
300-499 beds	277* (20)	225[c]	6.50 (.18)	6.68	4.60 (.19)	4.72	18,732 (627)	18,948
500+ beds	236 (27)	199[c]	7.53 (.28)	7.06	5.15* (.26)	4.64	18,726 (1,022)	19,338
Total Private, Non-profit	9,886 (216)	8,055[b]	6.10* (.05)	6.21	4.77 (.07)	4.71	15,616 (338)	15,408
1-99 beds	1,155** (42)	927[c]	4.85** (.07)	5.09	4.46 (.09)	4.28	8,842 (205)	8,983
100-199 beds	1,855** (66)	1,613[c]	5.71** (.09)	5.97	4.71 (.09)	4.68	12,660 (366)	12,373
200-299 beds	2,297** (85)	1,471[c]	6.14 (.11)	6.21	4.87 (.22)	4.83	15,266 (568)	15,506
300-499 beds	2,208** (87)	1,817[c]	6.57 (.11)	6.43	4.86 (.12	4.78	16,282 (480)	17,083
500+ beds	2,370** (123)	1,447[c]	6.75 (.12)	6.87	4.79 (.12)	4.85	20,886 (1,036)	20,205
Total Private, Investor-owned	1,607** (63)	1,374[b]	5.91** (.11)	6.61	4.49* (.09)	4.30	18,911 (810)	19,372
1-99 beds	242* (15)	200[c]	5.33** (.23)	8.03	4.39** (.17)	3.54	13,742 (907)	14,983
100-199 beds	579** (37)	376[c]	5.81* (.18)	6.22	4.45 (.15)	4.24	17,784 (797)	17,507
200-299 beds	451** (33)	247[c]	6.08 (.22)	6.12	4.24* (.12)	4.50	22,471 (2,313)	21,183
300-499 beds	242** (14)	174[c]	6.08** (.13)	6.53	5.03 (.25)	4.96	20,437 (1,863)	23,800
500+ beds	94 (a)	50[c]	6.79 (a)	6.50	4.80 (a)	5.05	17,164 (a)	24,299

[*] p < .05 [**] p < .01

[a] A significance test was not performed because a valid standard error was not available.

[b] Caution should be taken in interpretation of the total discharge estimates for MedPAR by ownership type as 8% of the records (N=951,485) had missing data for type of hospital ownership

[c] Caution should be taken in interpretation of the total discharge estimates for MedPAR by bedsize as 17% of the records (N=2,027,349) had missing data for bed size.

Table 10. NIS and MedPAR Comparisons by Hospital Type, 1999

	Number of Discharges in Thousands (Standard Error)		Average Length of Stay in Days (Standard Error)		In-hospital Mortality Rate Percent (Standard Error)		Total Hospital Charges (Standard Error)	
	NIS	**MedPAR**	**NIS**	**MedPAR**	**NIS**	**MedPAR**	**NIS**	**MedPAR**
Total Rural	2,540* (83)	2,341	5.12* (.06)	5.24	4.45 (.06)	4.38	9,297 (207)	9,383
1-49 beds	618** (23)	548	4.31 (.06)	4.38	4.17 (.09)	4.06	6,839 (219)	6,680
50-99 beds	699* (26)	642	4.88* (.07)	5.07	4.45 (.11)	4.29	8,321* (196)	8,770
100+ beds	1,223 (60)	1,151	5.67 (.09)	5.74	4.60 (.10)	4.58	11,121 (327)	11,013
Total Urban, Teaching	6,279** (151)	5,409	6.02** (.06)	6.35	4.84 (.09)	4.70	15,899 (301)	16,137
1-299 beds	661** (37)	558	5.44** (.13)	6.96	4.78 (.12)	4.13	11,823 (442)	12,924
300-499 beds	1,863** (69)	1,618	5.84** (.10)	6.13	4.81 (.10)	4.63	14,680 (455)	14,703
500+ beds	3,755** (123)	3,232	6.21 (.08)	6.35	4.87 (.14)	4.84	17,271 (438)	17,410
Total Urban, Nonteaching	4,226** (179)	3,111	6.64 (.10)	6.72	4.76 (.09)	4.77	19,288 (685)	19,269
1-99 beds	967** (73)	619	6.08 (.16)	6.32	4.53 (.18)	4.63	16,136 (970)	16,669
100-199 beds	1,165 (68)	1,114	6.61 (.18)	6.58	4.88 (.16)	4.75	17,633 (726)	18,649
200+ beds	2,095** (138)	1,377	6.92 (.14)	7.02	4.80 (.13)	4.84	21,589 (1,153)	20,929

[*] p < .05 [**] p < .01

Table 11 reports weighted and unweighted NIS discharge estimates to results from the AHA hospital survey. The table includes discharge estimates for each hospital ownership category, and additional estimates for various permutations of population density, teaching status, and bed size. As with the regional comparisons reported previously, the AHA-derived sampling weights in the NIS yield hospital counts consistent with AHA universe counts for various categories of hospital types.

Several statistics reported in the AHA survey were also replicated using NIS data; the results appear in Table 12. NIS estimates closely match the AHA survey results, with eleven of the eighteen estimates differing by 1% or less. For only one of these measures, hospital length of stay, is the difference greater than 5%.

Table 11. Hospitals in NIS Frame and AHA Universe by Hospital Characteristics, 1999

	1999 AHA Universe	1999 Frame[1] Weighted	1999 Frame[1] Unweighted
Control / Ownership			
Private/investor-owned	689	679.5	140
Private/non-profit	2969	3018.3	614
Government/non-federal	1201	1161.2	230
Location / Teaching Status / Bedsize			
Rural			
Total	2,191	2,191	437
1 – 49 Beds (small)	1,267	1,260.4	247
50 – 99 Beds (medium)	545	562.6	115
100+ Beds (large)	379	368.0	75
Urban			
Total	2,668	2,668.0	547
Teaching			
Total	606	659.0	135
1 – 299 Beds (small)	248	285.2	58
300 – 499 Beds (medium)	202	184.1	38
500+ Beds (large)	156	189.7	39
Nonteaching			
Total	2,062	2,009.0	412
1 – 99 Beds (small)	656	664.2	135
100 – 199 Beds (medium)	727	707.7	146
200+ Beds (large)	679	637.1	131

Note: Significance tests were not performed because these are not sample statistics.

[1] The 1999 frame contains 24 states.

Table 12. NIS 24-State Sampling Frame and AHA Universe Comparisons, 1999

	Universe Mean	Frame Weighted Mean	Universe Median	Frame Weighted Median
Hospital Admissions	6,524.13	6,623.76	3,583.00	3,693.00
Hospital Discharges	6,524.13	6,623.76	3,583.00	3,693.00
Hospital Discharges[1]	7,410.02	7,486.86	4,088.00	4,205.00
Hospital Beds	151.73	152.76	95.00	93.00
Hospital Average Length of Stay	5.61	5.20	4.55	4.51
Hospital Occupancy	0.49	0.49	0.50	0.50
Total Hospital Expenses (in dollars)	68,555,563	68,711,160	30,944,506	31,656,303
Hosp Expenses per Bed (in dollars)	384,489	379,037	351,370	350,062
Total Hospital Payroll (in dollars)	28,644,342	28,867,032	13,033,152	13,133,037
Hospital Payroll per Bed (in dollars)	160,630	159,922	1,45700	147,103
% Medicare Days	52.38	52.99	53.16	54.07
% Medicare Discharges	45.49	46.00	45.49	45.35
% Medicare Discharges[1]	40.93	41.51	40.00	40.07
% Medicaid Days	12.93	13.39	10.63	10.87
% Medicaid Discharges	13.73	14.31	12.86	12.86
% Medicaid Discharges[1]	12.13	12.69	11.24	11.26
FTE[2]	800.09	795.71	406.00	406.50
FTE[2] / Bed	4.32	4.20	4.01	3.94

Note: Significance tests were not performed because these are not sample statistics.

[1] Adjusted for well newborns.
[2] Full-time equivalents.

In summary, NIS discharge estimates differ from NHDS estimates by underreporting discharges from smaller hospitals and over-reporting discharges from larger hospitals. NIS discharge estimates consistently exceed MedPAR estimates, as expected, consistent with the absence of managed care patients in MedPAR data, but are similar to AHA estimates.

Mean length of stay estimates from the NIS were lower than NHDS and MedPAR estimates for some hospital categories, but the differences were not systematically confined to a particular category of hospitals. NIS estimates of inpatient mortality showed only minor, inconsistent differences with other database estimates, and no discrepancies were reported in estimates of total charges.

Comparisons by Patient Characteristics

Age Group and Gender

Estimates by Age Group and Gender generated by the NIS and NHDS, of discharges, average lengths of stay and in-hospital mortality, are shown in Table 13. No significant differences were found for either age group or gender on any of the three variables measured.

Table 13. NIS and NHDS Comparisons by Age and Gender, 1999

	Number of Discharges in Thousands (Standard Error)		Average Length of Stay in Days (Standard Error)		In-hospital Mortality Rate Percent (Standard Error)	
	NIS	NHDS	NIS	NHDS	NIS	NHDS
Age Group						
0-15 years	5,952 (181)	6,185 (795)	3.49 (.06)	3.69 (.75)	.43 (.02)	.44 (.04)
16-44 years	10,069 (205)	10,092 (428)	3.66 (.05)	3.66 (.26)	.50 (.02)	.46 (.04)
45-64 years	6,580 (122)	6,899 (316)	4.99 (.05)	4.99 (.36)	2.10 (.04)	1.91 (.10)
65+ years	12,867 (244)	12,683 (597)	5.96 (.04)	6.08 (.43)	5.13 (.06)	5.20 (.11)
Gender						
Male	14,627 (240)	14,641 (596)	5.03 (.04)	5.09 (.35)	2.93 (.04)	2.88 (.08)
Female	20,841 (364)	21,217 (847)	4.49 (.03)	4.56 (.30)	2.13 (.04)	2.09 (.06)

NIS – MedPAR comparisons are shown in Table 14. NIS In-hospital Mortality Rate estimates for two age groups (0-64 and 75-84) were higher than MedPAR rates, but there were no significant differences in total charges for any age group or either gender. As expected, NIS discharge estimates were higher than MedPAR counts for all age group and gender categories, while NIS average length-of-stay estimates were lower than MedPAR averages for all categories. This is not surprising given the differences for the total NIS and MedPAR estimates and the attribution of this difference to managed care enrollees. Managed care enrollees could be expected among both genders and all races and age groups.

Table 14. NIS and MedPAR Comparisons by Age and Gender, 1999

	Number of Discharges in Thousands		Average Length of Stay in Days		In-hospital Mortality Rate Percent		TOTAL CHARGES	
	NIS	MedPAR	NIS	MedPAR	NIS	MedPAR	NIS	MedPAR
Age Group								
0 to 64 years	1,901** (44)	1,734	6.33** (.07)	7.27	2.40** (.04)	2.20	15,766 (428)	15,478
65 to 74 years	4,192** (89)	3,620	5.73** (.04)	6.13	3.70 (.04)	3.74	16,880 (312)	16,946
75 to 84 years	4,642** (96)	4,201	6.13** (.04)	6.49	5.20** (.06)	4.94	15,812 (266)	16,053
85 years and over	2,309 (46)	2,258	6.29** (.06)	6.58	7.64 (.08)	7.54	13,382 (221)	13,616
Gender								
Male	5,670** (114)	5,098	6.05** (.04)	6.55	5.12 (.06)	5.05	16,848 (332)	16,857
Female	7,375** (138)	6,714	6.07** (.04)	6.48	4.44 (.05)	4.37	14,847 (241)	14,956

* $p < .05$ ** $p < .01$

Race Comparisons

As can be seen in Table 15, there were significant differences between NIS and NHDS estimates by race, with the NIS having a lower estimate of discharges that were white, and significantly more discharges in the “other” category. The NHDS also found significantly lower mortality for white patients and significantly higher mortality for patients of “other” race. There were no significant racial differences on average length of stay.

Table 15. NIS and NHDS Comparisons by Race, 1999

	Number of Discharges in Thousands (Standard Error)		Average Length of Stay in Days (Standard Error)		In-hospital Mortality Rate Percent (Standard Error)	
	NIS	NHDS	NIS	NHDS	NIS	NHDS
Race						
White	19,494* (1,303)	22,903 (456)	4.77 (0.43)	4.80 (0.04)	2.75* (0.06)	2.54 (0.04)
Black	3,793 (301)	4,225 (225)	5.22 (0.61)	5.28 (0.06)	2.24 (0.11)	2.21 (0.07)
Other	3,716** (304)	2,096 (201)	4.35 (1.14)	4.77 (0.07)	1.71** (0.14)	2.03 (0.08)
Missing	8,465 (910)	6,634 (566)	4.50 (0.88)	4.37 (0.07)	2.24 (0.08)	2.2 (0.06)

* $p < .05$ ** $p < .01$

Across all racial groups, the NIS estimates of length of stay are lower. NIS shows dramatically more records missing a racial designation than do the MedPAR files. There is no difference in inpatient mortality figures or total charges for black patients versus white ones. However, the “other” category differs significantly from the MedPAR figures on every variable, with lower average length of stay, higher inpatient mortality and higher total charges. Even with forty times

the missing records of the MedPAR files, the NIS still has a higher estimate of discharges of patients from “other” racial groups.

Table 16. NIS and MedPAR Comparisons by Race, 1999

	Number of Discharges in Thousands (Standard Error)		Average Length of Stay in Days (Standard Error)		In-hospital Mortality Rate Percent (Standard Error)		Total Hospital Charges (Standard Error)	
	NIS	MedPAR	NIS	MedPAR	NIS	MedPAR	NIS	MedPAR
Race								
White	8,539** (217)	9,880	5.98** (.05)	6.34	4.76 (.06)	4.69	15,363 (338)	15,485
Black	1,067** (66)	1,340	6.95** (.10)	7.59	4.70 (.13)	4.64	16,307 (406)	17,094
Other	695** (57)	536	6.57** (.12)	6.89	4.78** (.16)	4.19	20,878** (989)	17,894
Missing	2,745** (186)	57	5.85** (.08)	6.67	4.70** (.07)	5.29	15,301 (434)	15,420

* $p < .05$ ** $p < .01$

Primary Payer Comparisons

Table 17 shows NIS-NHDS comparisons across the different categories of expected primary payer. Discharge estimates show no significant differences between the NIS and NHDS for any of the primary payer groups except the missing category where the NIS estimates fewer discharges. There were no statistically significant differences by payer on length of stay estimates. For two payer categories, self-pay and no-charge, the NHDS mortality estimates were significantly lower than the NIS.

Table 17. NIS and NHDS Comparisons by Primary Payer, 1999

	Number of Discharges in Thousands (Standard Error)		Average Length of Stay in Days (Standard Error)		In-hospital Mortality Rate Percent (Standard Error)	
	NIS	NHDS	NIS	NHDS	NIS	NHDS
Primary Payer						
Medicare	12,736 (244)	12,540 (618)	6.04 (.04)	6.16 (.45)	4.75 (.05)	4.79 (.11)
Medicaid	5,909 (183)	5,475 (415)	4.49 (.07)	4.55 (.55)	1.04 (.03)	1.10 (.08)
Private Insurance	13,852 (393)	14,187 (1,149)	3.73 (.03)	3.79 (.49)	1.15 (.03)	1.06 (.12)
Self-pay	1,687 (81)	1,782 (122)	3.84 (.07)	3.83 (.44)	1.52** (.07)	1.12 (.13)
No Charge	80 (13)	133 (51)	5.17 (.34)	4.16 (2.18)	1.47* (.34)	0.74 (.32)
Other	1,000 (66)	1,305 (250)	4.24 (.07)	4.46 (1.27)	1.79 (.07)	1.82 (.52)
Missing	203** (32)	436 (79)	4.06 (.12)	4.79 (1.31)	1.83 (.12)	1.80 (.40)

* $p < .05$ ** $p < .01$

Patient Characteristics Summary

NIS and NHDS estimates were virtually identical across all age groups and both genders on all variables measured. NIS estimates are somewhat lower for mean length of stay within the Medicare population, and this difference was statistically significant in comparison to the MedPAR figures, for both genders and all age groups. NIS estimates of number of discharges by racial group differ significantly from both MedPAR and NHDS, with significantly fewer discharges shown for white patients and significantly more in the “other” category. The NIS had a dramatically higher number of records that are missing a racial classification, 21.0% compared to the 0.5% of MedPAR records with a missing race value. Yet, the NIS still shows more records in the ‘other’ category. This is likely yet another effect of the geographic selection bias. The NIS includes all the most racially diverse states in the nation (New York and California) and excludes many of the least racially and ethnically diverse states (e.g., North Dakota).

Comparisons by Diagnosis Category

The Clinical Classification Software (CCS), formerly known as the Clinical Classifications for Health Policy Research (CCHPR), was developed as a means to categorize diagnoses and procedures into a limited number of clinically relevant categories. Developed for health policy analysis, the CCS can be used for aggregating the thousands of ICD-9-CM diagnoses and procedures into a manageable number of meaningful categories.

NIS-NHDS Comparisons

Table 18 compares the NIS and NHDS by the most frequent principal diagnosis categories, ranked according to the NIS estimates of number of discharges by category. CCS code categories are assigned based on the principal diagnosis. The NIS discharge estimates are significantly different for eleven of the 25 diagnosis categories. The NHDS estimates are significantly larger for six categories and smaller for five diagnosis categories.

Of the eleven significant differences, six can be attributed to code reordering in the NHDS (nonspecific chest pain, myocardial infraction, and 4 pregnancy/delivery categories). In contrast to the NHDS, there was no reordering of diagnoses with NIS data: the first diagnosis listed for each discharge was assigned as the principal diagnosis.

Under certain conditions diagnoses were reordered in the NHDS. For example, when a symptom appeared as the first-listed code, it was reassigned as a secondary diagnosis. This explains the dramatically lower figure for non-specific chest pain in the NHDS sample compared to the NIS. As another example, the NHDS shows significantly more patients with acute myocardial infarction as the principal diagnosis. This is not surprising since this condition was reordered in the NHDS to the first position wherever it was found as a secondary diagnosis along with other circulatory disorders.

There are four diagnoses in the top 25 relating to pregnancy and delivery, including the category "normal pregnancy". Significant differences were found with all four of them. Again, this can be attributed to reordering of diagnosis codes in the NHDS data – regardless of the original principal diagnosis, the NHDS gives a code of V27 from the supplemental classification as the principal diagnosis for all women discharged after delivery. As a result, the NHDS estimates 3.8 million "normal pregnancies" – significantly higher than the NIS estimate. However, the NHDS estimates for the other three pregnancy/delivery categories were significantly lower than the NIS estimates.

In five areas, the difference in number of discharges could not be attributed to coding differences. For four categories, the NIS estimates were lower than NHDS (fluid and electrolyte disorders, osteoarthrities.cardiac dysrhythmias, chronic obstructive pulmonary disease and bronchiectasis). For the fifth category, “complications of surgical procedures or medical care”, the NIS estimate was significantly higher.

There are only two significant differences on average length of stay, and two diagnoses that differ significantly on in-hospital mortality. All of these differences occur for categories subject to code reordering in the NHDS. In the NIS, the normal delivery category is listed as the principal diagnosis only when this is the code given by the hospital. The normal delivery population in the NIS represents deliveries where no complications were present. In contrast, deliveries in the NHDS normal delivery category include women who have had episiotomies as well as a variety of minor birth complications. It is not surprising then, that both the average length of stay and mortality would be higher for the NHDS normal category, as it represents a somewhat higher risk population.

Table 18. NIS and NHDS Comparisons by Top 25 Principal Diagnoses, 1999

	Number of Discharges in Thousands (Standard Error)		Average Length of Stay in Days (Standard Error)		In-hospital Mortality Rate Percent (Standard Error)	
	NIS	NHDS	NIS	NHDS	NIS	NHDS
218: Live birth	3,843 (109)	3,738 (152)	3.05 (.04)	3.18 (.21)	.35 (.02)	.37 (.06)
122: Pneumonia (except that caused by tuberculosis and sexually transmitted diseases)	1,372 (21)	1,362 (58)	5.9 (.04)	5.98 (.40)	5.74 (.08)	5.59 (.37)
101: Coronary atherosclerosis	1,248 (48)	1,382 (59)	3.85 (.05)	3.63 (.25)	.87 (.02)	1.18 (.17)
108: Congestive heart failure, nonhypertensive	991 (19)	996 (44)	5.60 (.05)	5.48 (.38)	4.80 (.07)	5.32 (.42)
100: Acute myocardial infarction	730** (20)	829 (37)	5.50 (.06)	5.25 (.36)	8.67** (.11)	9.47 (.60)
193: Trauma to perineum and vulva	726 (25)	3** (1)	1.96 (.01)	1.81[a] (b)	.00 (.00)	0 (b)
102: Non-specific chest pain	675** (19)	71 (6)	1.88 (.02)	1.43[a] (b)	.08 (.07)	0 (b)
127: Chronic obstructive pulmonary disease and bronchiectasis	644** (12)	713 (32)	5.33 (.04)	5.06 (.36)	2.79 (.05)	2.62 (.36)
69: Affective disorders	635 (31)	723 (33)	8.07 (.21)	7.70 (.54)	.07 (.01)	.12 (.08)
195: Other complications of birth, puerperium affecting management of the mother	616** (23)	47 (4)	2.50* (.02)	3.52 (.47)	.03[a] (0)	.50 (b)
106: Cardiac dysrhythmias	602** (15)	687 (31)	3.62 (.04)	3.53 (.25)	1.33 (.03)	1.11 (.24)
109: Acute cerebrovascular disease	588 (11)	570 (27)	6.66 (.07)	6.76 (.48)	11.37 (.14)	11.31 (.79)
205: Spondylosis, invertebral disc disorders, other back problems	542 (19)	578 (27)	3.12 (.04)	3.31 (.24)	.19 (.01)	.20 (.11)
55: Fluid and electrolyte disorders	508** (9)	621 (29)	4.20 (.04)	4.02 (.29)	2.96 (.01)	2.40 (.36)
196: Normal pregnancy and/or delivery	500** (14)	3,822 (155)	1.90** (.01)	2.47 (.16)	.00** (0)	.03 (.02)
237: Complication of device, implant or graft	500 (16)	480 (23)	5.82 (.06)	6.11 (.44)	1.90 (.06)	1.84 (.36)
128: Asthma	444 (15)	478 (23)	3.27 (.04)	3.19 (.24)	.27 (.02)	.12 (.09)
254: Rehabilitation care, fitting of prostheses, and adjustment of devices	436 (24)	428 (21)	13.65 (.22)	13.73 (1.0)	.89 (.10)	.67 (.23)
149: Biliary tract disease	435 (8)	446 (22)	4.09 (.04)	4.00 (.30)	.80 (.03)	.56 (.21)
50: Diabetes mellitus with complications	433 (8)	455 (22)	5.63 (.06)	5.73 (.42)	1.42 (.04)	1.20 (.30)
159: Urinary tract infections	429 (7)	485 (23)	4.70 (.05)	4.79 (.35)	1.77 (.06)	1.38 (.31)

	Number of Discharges in Thousands (Standard Error)		Average Length of Stay in Days (Standard Error)		In-hospital Mortality Rate Percent (Standard Error)	
	NIS	NHDS	NIS	NHDS	NIS	NHDS
203: Osteoarthritis	416** (14)	434 (21)	4.31 (.03)	4.52 (.33)	.17 (.01)	.32 (.16)
181: Other complications of pregnancy	386** (13)	171 (10)	2.44 (.02)	2.63 (.24)	.04[a] (.01)	0 (b)
238: Complications of surgical procedures or medical care	384* (10)	340 (17)	6.08 (.05)	6.11 (.46)	1.76[a] (.05)	1.27 (b)
2: Septicemia (except in labor)	365 (8)	342 (17)	8.13 (.09)	8.42 (.63)	15.84 (.20)	17.92 (1.23)

* $p < .05$ **$p < .01$

[a] A significance test was not performed because a valid standard error was not available.
[b] A reliable standard error could not be calculated

NIS-MedPAR Comparisons

Comparisons between NIS and MedPAR for the 25 most common diagnoses are shown in Table 19 below. Diagnoses are grouped by CCS category and ranked by frequency of NIS discharges with Medicare as the expected payer. Significant differences were found with discharges for all 25 categories, with most NIS estimates 10 to 15 percent higher than the MedPAR count. The NIS estimate was smaller than the MedPAR count for one category: "affective disorders."

For 18 of the 25 diagnoses, the MedPAR data showed a significantly higher mean length of stay than the NIS estimates. Although the estimates were consistently higher, this does not represent a substantial difference. The average discrepancy was .29 days, or less than 5% of the overall mean length of stay of 6.51 days found for the MedPAR data file as a whole. Even this relatively small figure is likely an overestimate of the difference between the NIS estimate and the Medicare population, as the MedPAR file excludes managed care discharges which tend to have a shorter length of stay.

With regard to in-hospital mortality, NIS and MedPAR estimates were extremely close. For 18 of the 25 diagnoses, there was no significant difference in mortality estimates. Unlike discharge and length of stay comparisons, there was no clear pattern of differences in mortality. For four of the diagnoses the MedPAR values were higher and for three diagnoses the NIS estimates were higher. Again, these discrepancies were quite small, the mean difference between the NIS and MedPAR figures for in-patient mortality was -.03, a difference of less than 1% of the overall mortality rate of 4.65 computed from the MedPAR file.

Table 19. NIS and MedPAR Comparisons by Top 25 Principal Diagnoses, 1999

	Number of Discharges in Thousands (Standard Error)		Average Length of Stay in Days (Standard Error)		In-hospital Mortality Rate Percent (Standard Error)		Total Hospital Charges (Standard Error)	
	NIS	MedPAR	NIS	MedPAR	NIS	MedPAR	NIS	MedPAR
122: Pneumonia (except that caused by tuberculosis and sexually transmitted diseases)	796** (14)	696	6.71 (.05)	6.73	8.03** (.10)	7.78	14,352* (234)	13,755*
108: Congestive heart failure, nonhypertensive	762** (16)	681	5.71** (.05)	5.85	5.23** (.07)	5.5	13,112 (244)	13,092
101: Coronary atherosclerosis and other heart diseases	703* (28)	641	4.26 (.06)	4.35	1.22 (.03)	1.24	21,783 (552)	21,778
127: Chronic obstructive pulmonary disease and bronchiectasis	451** (9)	417	5.54** (.04)	5.86	3.24** (.07)	3.31	11,590 (187)	11,661
100: Acute myocardial infarction	435** (12)	375	6.15** (.07)	6.36	11.69** (.15)	12.23	24,626 (592)	24,926
109: Acute cerebrovascular disease	412** (8)	375	6.51** (.07)	7.47	11.79** (.16)	11.05	15,676 (362)	16,195
106: Cardiac dysrhythmias	402** (10)	355	4.00 (.04)	4.05	1.63 (.04)	1.64	13,226 (278)	13,061
254: Rehabilitation care, fitting of prostheses, and adjustment of devices	317** (17)	286	13.06** (.17)	13.99	1.07** (.11)	0.55	16,965 (493)	19,018
237: Complication of device, implant or graft	291** (9)	258	5.91 (.06)	5.95	2.28 (.07)	2.32	22,518 (662)	21,790
55: Fluid and electrolyte disorders	287** (5)	261	5.08 (.05)	5.12	4.16 (1.00)	4.36	9,121 (155)	9,050
203: Osteoarthritis	268* (9)	246	4.45** (.04)	4.97	.22 (.02)	0.2	20,770* (318)	20,127
226: Fracture of neck of femur (hip)	266** (6)	243	6.55** (.06)	7.14	3.12 (.08)	3.14	18,575 (265)	18,522

	Number of Discharges in Thousands (Standard Error)		Average Length of Stay in Days (Standard Error)		In-hospital Mortality Rate Percent (Standard Error)		Total Hospital Charges (Standard Error)	
	NIS	MedPAR	NIS	MedPAR	NIS	MedPAR	NIS	MedPAR
102: Nonspecific chest pain	260** (7)	218	2.23* (.02)	2.28	.15 (.02)	0.14	6,752 (103)	6,583
159: Urinary tract infections	249** (5)	225	5.40 (.06)	5.50	2.70 (.09)	2.74	9,874 (179)	9,593
2: Septicemia (except in labor)	247** (6)	214	8.34* (.11)	8.60	18.36* (.25)	18.94	20,192 (414)	20,409
153: Gastrointestinal hemorrhage	205** (4)	182	5.09** (.04)	5.24	5.04 (.10)	5.09	12,605 (220)	12,429
50: Diabetes mellitus with complications	196** (4)	177	6.67 (.07)	6.92	2.32 (.08)	2.4	15,166 (353)	14,912
69: Affective disorders	180** (8)	218	10.86 (.28)	11.72**	.17 (.02)	0.16	12,130 (470)	12,514
205: Spondylosis, intervertebral disc disorders, other back problems	177* (6)	165	4.16 (.05)	4.55**	4.39 (.03)	0.4	14,249 (507)	13,749
238: Complications of surgical procedures or medical care	169* (5)	138	6.98 (.07)	7.15*	2.84 (.09)	2.79	17,964 (559)	17,822
149: Biliary tract disease	167* (4)	150	5.34 (.05)	5.43**	1.68 (.06)	1.7	17,066 (276)	16,365*
145: Intestinal obstruction without hernia	158* (3)	142	6.90 (.05)	7.03**	4.94 (.13)	4.95	16,105 (264)	15,933
129: Aspiration pneumonitis, food/vomitus	147** (4)	129	8.92 (.09)	9.21**	20.26 (2.67)	20.62	21,657 (498)	21,807
99: Hypertension with complications and secondary hypertension	146* (4)	138	6.01 (.06)	6.15*	3.83 (.12)	3.88	16,501 (457)	16,134
146: Diverticulosis and diverticulitis	146** (4)	128	5.77 (.08)	6.00*	2.03 (.08)	2.17	14,242 (290)	14,416

* $p < .05$ ** $p < .01$

Summary of Diagnosis Comparisons

There are very few differences between the NIS and NHDS data that cannot be attributable directly to coding differences. The NHDS recodes certain categories while NIS does not. Six of

the eleven diagnoses that differ in discharge estimates were in these recoded categories. The two significant differences in mean length of stay and the two for inpatient mortality all occurred on diagnoses that were coded differently by NIS and NHDS. The rank order of the most common diagnoses was nearly identical for the NIS and NHDS. Similarly, the NIS and MedPAR had almost identical rankings for the most common diagnoses within the Medicare population. Due to the omission of managed care patients in MedPAR data, the NIS discharge estimates were somewhat higher for nearly every diagnosis. The sole exception was “affective disorders,” for which MedPAR estimates were higher. There were few differences between the NIS and MedPAR in either total charges for diagnoses or inpatient mortality. The NIS had lower mean length of stay estimates for most diagnoses, but, due to smaller cell sizes and the associated increase in sampling error, not all of these differences approached statistical significance.

Comparison by DRG Category

The top 25 diagnosis related group (DRG) categories, ranked according to the NIS estimates of discharges are shown in Table 20. The NIS consistently estimates shorter mean length of stays than MedPAR averages. Of the top 20 DRG categories, 17 had significantly shorter length of stay estimates when compared to MedPAR. The NIS also had higher estimates of total discharges for eighteen of twenty DRG categories. In contrast, no consistent differences were observed by inpatient mortality, three NIS estimates were significantly lower than MedPAR and two were significantly higher. Similarly, only three DRG categories significantly differed in total charges; NIS estimates for specific cerebrovascular disorders and rehabilitation were significantly lower, and significantly higher for chest pain.

Table 20. NIS and MedPAR Comparisons by Top 20 DRGs, 1999

	Number of Discharges in Thousands (Standard Error)		Average Length of Stay in Days (Standard Error)		In-hospital Mortality Rate Percent (Standard Error)		Total Hospital Charges (Standard Error)	
	NIS	MedPAR	NIS	MedPAR	NIS	MedPAR	NIS	MedPAR
127: Heart failure & shock	752** (14)	679	5.27 (0.14)	5.41	4.77** (0.07)	5.03	10,774 (180)	10,756
89: Simple pneumonia & pleurisy age >17 w cc	607** (11)	546	5.92** (0.04)	6.07	6.02 (0.10)	6.2	11,034 (165)	11,023
88: Chronic obstructive pulmonary disease	453** (9)	418	5.13* (0.14)	5.45	2.09 (0.06)	2.16	9,727 (147)	9,878
14: Specific cerebrovascular disorders except tia	379** (8)	344	5.93** (0.06)	6.96	11.46** (0.15)	10.73	12,755** (208)	13,578
209: Major joint & limb reattachment procedures of lower extremity	375** (11)	338	5.03** (0.04)	5.14	0.88* (0.03)	0.94	22,001 (331)	21,440
116: Other perm card pacemak impl or ptca w coronary artery stent implnt	328 (18)	309	3.75 (0.06)	3.71	1.04 (0.05)	1.03	26,243 (531)	25,474
430: Psychoses	323** (15)	396	11.46** (0.3)	13.36	0.15 (0.02)	0.14	12,565 (503)	12,958
462: Rehabilitation	312 (17)	281	12.89** (0.16)	13.87	1.07** (0.11)	0.54	16,585** (476)	18,716
174: G.I. hemorrhage w cc	269** (5)	235	4.73** (0.03)	4.86	3.71 (0.08)	3.77	10,658 (167)	10,529
296: Nutritional & misc metabolic disorders age >17 w cc	260** (5)	236	5.25 (0.05)	5.3	4.71 (0.11)	4.9	9,264 (156)	9,202
182: Esophagitis, gastroent & misc digest disorders age >17 w cc	253** (5)	233	4.28** (0.04)	4.41	1.27 (0.05)	1.34	8,389 (133)	8,253
416: Septicemia age >17	224** (6)	194	7.26** (0.08)	7.54	18.72** (0.26)	19.43	16,336 (292)	16,619

	Number of Discharges in Thousands (Standard Error)		Average Length of Stay in Days (Standard Error)		In-hospital Mortality Rate Percent (Standard Error)		Total Hospital Charges (Standard Error)	
	NIS	MedPAR	NIS	MedPAR	NIS	MedPAR	NIS	MedPAR
143: Chest pain	220** (6)	184	2.08** (0.02)	2.17	0.14 (0.02)	0.13	5,916** (94)	5,713
138: Cardiac arrhythmia & conduction disorders w cc	218** (5)	190	3.96* (0.04)	4.06	3.08 (0.09)	3.15	8,880 (162)	8,762
79: Respiratory infections & inflammations age >17 w cc	205** (5)	184	8.34** (0.07)	8.7	15.43 (0.22)	15.36	17,441 (338)	17,726
320: Kidney & urinary tract infections age >17 w cc	205** (4)	184	5.34* (0.05)	5.44	2.96 (0.1)	3.02	9,450 (168)	9,224
121: Circulatory disorders w ami & major comp, dischargedalive	192** (5)	160	6.26** (0.05)	6.56	0 (0)	0	16,457 (273)	16,614
132: Atherosclerosis w cc	169** (5)	149	3.00** (0.03)	3.27	0.83 (0.05)	0.92	7,062 (141)	7,134
124: Circulatory disorders except ami, w card cath & complexdiag	155** (6)	131	4.22** (0.07)	4.4	0.97 (0.07)	1.06	14,926 (317)	15,100
15: Transient ischemic attack & precerebral occlusions	155** (4)	141	3.5** (0.04)	3.78	0.49 (0.04)	0.52	7,935 (130)	7,939

* $p < .05$ ** $p < .01$

Comparisons by Procedure Category

Summary of Procedure Comparisons

Very few differences by procedure were found between the NIS and NHDS. Compared to MedPAR, NIS estimates of total discharges tended to be 8-15% higher for each procedure, and length of stay was generally found to be higher, again, reflecting the absence of managed care clients in the MedPAR file.

NIS-NHDS Comparisons

The top 25 procedure categories, ranked according to the NIS estimates of discharges, are shown in Table 21. CCS codes are assigned based on the principal, or first-listed, procedure for each discharge. The NIS discharge estimates differ significantly from the NHDS estimates for five of the twenty-five categories. NIS estimates are significantly higher for two categories and significantly lower for three categories.

Procedures for which the NIS discharge estimates were significantly higher than the NHDS estimates were "other procedures to assist delivery" and "alcohol and drug detoxification/rehabilitation." Procedure categories with NIS estimates significantly lower than the NHDS estimates included "repair of current obstetric laceration, episiotomy, and other therapeutic procedures."

As can be seen in Table 21, the estimates of average length of stay from the two sources tended to be extremely close. In 15 of the 25 categories NIS and NHDS estimates differed by less than 0.10 days. Comparisons of average length of stay estimated by procedure category showed no significant differences between the NIS and NHDS. Valid standard errors for in-hospital mortality rates could only be calculated for eight of the procedure categories due to a combination of low mortality and the smaller sample size of the NHDS yielding insufficient sample sizes to produce valid estimates. (See Appendix for validity criteria.) For the eight categories that could be compared only one was significantly different, with the NHDS estimate of mortality significantly higher for patients with a procedure code of "diagnostic cardiac catheterization, coronary arteriography".

Table 21. NIS and NHDS Comparisons by Top 25 Principal Procedures, 1999

	Number of Discharges in Thousands (Standard Error)		Average Length of Stay in Days (Standard Error)		In-hospital Mortality Rate Percent (Standard Error)	
	NIS	NHDS	NIS	NHDS	NIS	NHDS
137: Other procedures to assist delivery	1271** (51)	805 (36)	2.07 (0.02)	2.09 (0.15)	0[a] (0.00)	0 (b)
115: Circumcision	1194 (43)	1128 (49)	2.50 (0.02)	2.51 (0.17)	0 (0.00)	0.02 (0.03)
134: Cesarean section	841 (25)	834 (37)	3.78 (0.26)	3.78 (0.03)	0.03 (0.00)	0.02 (0.03)
47: Diagnostic cardiac catheterization, coronary arteriography	655 (24)	615 (28)	3.70 (0.27)	3.74 (0.05)	1.05** (0.04)	2.00 (0.34)
70: Upper gastrointestinal endoscopy, biopsy	649 (18)	633 (29)	5.46 (0.41)	5.75 (0.11)	2.09 (0.06)	2.15 (0.34)
140: Repair of current obstetric laceration	636* (29)	745 (34)	2.05 (0.15)	2.05 (0.01)	0.01[a] (0.01)	0 (b)
124: Hysterectomy, abdominal and vaginal	573 (17)	592 (27)	2.94 (0.21)	2.85 (0.02)	0.09 (0.01)	0.2 (0.11)
216: Respiratory intubation and mechanical ventilation	548 (12)	506 (24)	10.90 (0.84)	11.90 (0.20)	29.92 (0.37)	27.9 (1.18)
133: Episiotomy	532** (22)	664 (30)	2.08 (0.15)	2.06 (0.01)	0[a] (0.00)	0 (b)
45: Percutaneous coronary angioplasty (PTCA)	502 (27)	537 (25)	3.03 (0.22)	2.95 (0.05)	0.98[a] (.04)	0.07 (b)
84: Cholecystectomy and common duct exploration	373 (8)	372 (19)	4.48 (0.33)	4.40 (0.04)	0.85 (0.03)	1.08 (0.32)
219: Alcohol and drug rehabilitation/detoxification	373** (29)	281 (15)	5.17 (0.46)	5.98 (0.19)	0.02[a] (.02)	0 (b)
231: Other therapeutic procedures	349** (31)	475 (23)	5.33 (0.39)	5.29 (0.12)	2.43 (0.17)	1.85 (0.37)
44: Coronary artery bypass graft (CABG)	324 (17)	316 (16)	8.83 (0.66)	8.81 (0.12)	2.85[a] (.10)	3.63 (b)
152: Arthroplasty knee	311 (12)	314 (16)	4.18 (0.33)	4.25 (0.04)	0.17[a] (.01)	0.38 (b)
135: Forceps, vacuum, and breech delivery	307 (11)	328 (17)	2.24 (0.18)	2.26 (0.02)	0.01[a] (.01)	0.29 (b)
222: Blood transfusion	303 (12)	288 (15)	5.81 (0.43)	5.50 (0.08)	6.45[a] (.14)	5.47 (b)
3: Laminectomy, excision intervertebral disc	293 (13)	277 (15)	2.82 (0.25)	3.01 (0.05)	0.19[a] (.02)	0.10 (b)
153: Hip replacement, total and partial	292 (8)	299 (16)	5.46 (0.43)	5.59 (0.05)	1.24[a] (.05)	1.62 (b)
54: Other vascular catheterization, not heart	283 (9)	269 (14)	10.13 (0.80)	10.54 (0.14)	11.39[a] (.24)	10.18 (b)
76: Colonoscopy and biopsy	273 (14)	271 (14)	5.30 (0.47)	5.99 (0.24)	1.17[a] (.07)	1.59 (b)
146: Treatment, fracture or dislocation of hip and femur	270 (5)	259 (14)	6.18 (0.48)	6.11 (0.05)	2.05[a] (.06)	1.19 (b)
78: Colorectal resection	260 (6)	250 (14)	10.18 (0.74)	9.62 (0.06)	4.57[a] (.10)	4.54 (b)

	Number of Discharges in Thousands (Standard Error)		Average Length of Stay in Days (Standard Error)		In-hospital Mortality Rate Percent (Standard Error)	
	NIS	NHDS	NIS	NHDS	NIS	NHDS
80: Appendectomy	254 (6)	267 (14)	3.24 (0.28)	3.42 (0.03)	0.11[a] (.01)	0.14 (b)
4: Diagnostic spinal tap	249 (9)	252 (14)	5.36 (0.42)	5.32 (0.10)	0.09[a] (.09)	1.18 (b)

[*] $p < .05$ [**] $p < .01$

[a] A significance test was not performed because a valid standard error was not available.
[b] A reliable standard error could not be calculated

NIS-MedPAR Comparisons

Comparisons between NIS and MedPAR for the 25 most common procedures are shown in Table 22 below. All NIS discharge estimates were higher than the MedPAR numbers, those differences were usually statistically significant. Most NIS estimates were 8 to 15 percent higher than the MedPAR count.

Comparisons of average length-of-stay and in-hospital mortality produced results similar to the comparisons by diagnosis discussed above, as would be expected since this represents simply another way of categorizing the data from the same sources and using the same variables. For 11 of the 25 procedures, the MedPAR data showed a significantly higher mean length of stay than the NIS estimates. Although the estimate was consistently higher, again, few large differences were observed either in absolute or relative terms. The largest difference observed was for the procedure, “respiratory intubation and mechanical ventilation” where the NIS estimate was nine and one half days, compared to the MedPAR mean length of stay of approximately ten days. For 18 of the 25 procedures, there was no significant difference in mortality estimates. Again, the differences in mortality were mixed. For five of the diagnoses the MedPAR values were higher, and for two diagnoses the NIS estimates were higher.

NIS estimates of total hospital charges were very close to the MedPAR statistics. For 22 of the 25 procedures, there were no significant differences between NIS and MedPAR. For three procedures ("arthroplasty knee," "cholecystectomy and common duct exploration," and "other vascular catheterization, not heart"), the MedPAR estimates were significantly lower although the differences were 3-6 percent.

Table 22. NIS and MedPAR Comparisons by Top 25 Principal Procedures, 1999

	Number of Discharges in Thousands (Standard Error)		Average Length Of Stay In Days (Standard Error)		In-hospital Mortality Rate Percent (Standard Error)		Total Hospital Charges (Standard Error)	
	NIS	MedPAR	NIS	MedPAR	NIS	MedPAR	NIS	MedPAR
70: Upper gastrointestinal endoscopy, biopsy	373** (9)	337	6.14** (.08)	6.44	2.69 (.07)	2.79	13,738 (258)	13,820
47: Diagnostic cardiac catheterization, coronary arteriography	338** (14)	287	4.20* (.06)	4.34	1.57 (.07)	1.60	15,765 (382)	15,656
216: Respiratory intubation and mechanical ventilation	252* (5)	241	9.40** (.16)	9.98	41.74* (.35)	42.61	34,100 (613)	34,753
45: Percutaneous coronary angioplasty (PTCA)	251 (15)	222	3.40 (.06)	3.39	1.50 (.07)	1.43	26,452 (625)	25,725
153: Hip replacement, total and partial	206** (6)	185	5.74 (.05)	5.83	1.55* (.06)	1.67	22,935 (359)	22,392
222: Blood transfusion	189* (7)	175	6.05** (.09)	6.33	7.54 (.16)	7.80	12,761 (287)	13,061
146: Treatment, fracture or dislocation of hip and femur	189** (4)	169	6.32* (.06)	6.44	2.53 (.08)	2.54	18,077 (280)	17,550
152: Arthroplasty knee	189** (7)	167	4.43* (.04)	4.53	.24 (.02)	0.21	22,152* (363)	21,424*
44: Coronary artery bypass graft (CABG)	176 (10)	157	9.76 (.14)	9.66	3.98 (.15)	3.86	54,921 (1,416)	54,494
48: Insertion, revision, replacement, removal of cardiac pacemaker or cath	168** (7)	149	5.53 (.07)	5.51	2.19 (.09)	2.30	30,605 (586)	30,089
76: Colonoscopy and biopsy	162** (5)	142	6.01** (.14)	6.41	1.59** (.07)	1.81	12,454 (316)	12,886
58: Hemodialysis	150** (4)	140	5.62 (.07)	5.74	4.44** (.14)	4.43	13,502 (278)	13,230

	Number of Discharges in Thousands (Standard Error)		Average Length Of Stay In Days (Standard Error)		In-hospital Mortality Rate Percent (Standard Error)		Total Hospital Charges (Standard Error)	
	NIS	MedPAR	NIS	MedPAR	NIS	MedPAR	NIS	MedPAR
78: Colorectal resection	143* (3)	125	11.07** (.08)	11.32	6.77 (.15)	6.8	34,067 (564)	33,661
193: Diagnostic ultrasound of heart (echocardiogram)	142* (12)	116	5.74 (.16)	5.81	2.56** (.12)	2.96	12,234 (444)	12,700
84: Cholecystectomy and common duct exploration	136** (3)	124	6.05 (.06)	6.15	1.85 (.08)	1.95	20,429** (326)	19,508
54: Other vascular catheterization, not heart	133** (4)	117	9.81** (.11)	10.42	17.22* (.35)	17.97	23,361** (444)	24,963
61: Other O.R. procedures on vessels other than head and neck	124* (4)	115	7.23 (.12)	7.32	5.06 (.17)	5.14	28,737 (800)	27,891
213: Physical therapy exercises, manipulation, and other procedures	119 (11)	101	11.57 (.35)	11.82	1.21** (.17)	0.74	16,472 (947)	16,936
177: Computerized axial tomography (CT) scan head	117 (8)	107	5.53 (.15)	5.80	4.88 (.23)	5.19	11,896 (726)	11,430
231: Other therapeutic procedures	114 (13)	101	5.56** (.25)	6.21	5.60 (.27)	5.79	13,561 (917)	11,783
169: Debridement of wound, infection or burn	101** (2)	90	11.66 (.17)	11.99	5.27 (.19)	5.16	25,421 (553)	25,442
51: Endarterectomy, vessel of head and neck	99 (4)	92	3.22 (.55)	3.32	.62 (.06)	0.65	15,162 (321)	14,990
39: Incision of pleura, thoracentesis, chest drainage	95** (2)	83	8.41* (.08)	8.60	9.62 (.21)	9.83	18,140 (329)	18,332
113: Transurethral prostatectomy (TURP)	91** (3)	83	3.47** (.06)	3.65	.47 (.05)	0.41	9,581 (188)	9,329
37: Diagnostic bronchoscopy and biopsy of bronchus	87** (3)	78	9.57** (.10)	10.02	7.80 (.23)	7.96	23,774 (526)	24,211

* $p < .05$ ** $p < .01$

NIS-MedPAR Comparisons using Percentages: An Illustrative Example

Throughout this report, the NIS and MedPAR have been compared on the number of discharges by gender, bed size and other patient and hospital characteristics. Higher NIS discharge estimates have been attributed to the inclusion of managed care clients in the NIS. A second method of comparison is to test for significance of difference between proportions of patients receiving procedures. The number and percentage of discharges for each of the top twenty-five principal procedures are shown in Table 23. When the dependent variable is the percentage of patients rather than the number of patients, significant differences between the NIS and MedPAR drop from nineteen to one. MedPAR shows a significantly higher percentage of records with respiratory intubation and mechanical ventilation as a principal diagnosis.

Table 23: NIS and MedPAR Comparison of Number and Percentage of Discharges by Top 25 Principal Procedures, 1999

	Number of Discharges in Thousands (Standard Error)		Percentage of Discharges (Standard Error)	
	NIS	MedPAR	NIS	MedPAR
70: Upper gastrointestinal endoscopy, biopsy	373** (9)	337	8.99 (0.18)	9.09
47: Diagnostic cardiac catheterization, coronary arteriography	338** (14)	287	8.17 (0.25)	7.76
216: Respiratory intubation and mechanical ventilation	252* (5)	241	6.09** (0.13)	6.52
45: Percutaneous coronary angioplasty (PTCA)	251 (15)	222	6.06 (0.37)	5.99
153: Hip replacement, total and partial	206** (6)	185	4.96 (0.11)	4.99
222: Blood transfusion	189* (7)	175	4.56 (0.2)	4.73
146: Treatment, fracture or dislocation of hip and femur	189** (4)	169	4.55 (0.09)	4.56
152: Arthroplasty knee	189** (7)	167	4.55 (0.14)	4.52
44: Coronary artery bypass graft (CABG)	176 (10)	157	4.24 (0.26)	4.25
48: Insertion, revision, replacement, removal of cardiac pacemaker or cath	168** (7)	149	4.05 (0.12)	4.03
76: Colonoscopy and biopsy	162** (5)	142	3.92 (0.11)	3.84
58: Hemodialysis	150** (4)	140	3.62 (0.12)	3.79
78: Colorectal resection	143* (3)	125	3.46 (0.06)	3.39
193: Diagnostic ultrasound of heart (echocardiogram)	142* (12)	116	3.42 (0.3)	3.34
84: Cholecystectomy and common duct exploration	136** (3)	124	3.28 (0.06)	3.16
54: Other vascular catheterization, not heart	133** (4)	117	3.21 (0.10)	3.12
61: Other O.R. procedures on vessels other than head and neck	124* (4)	115	3 (0.08)	3.10
213: Physical therapy exercises, manipulation, and other procedures	119 (11)	101	2.87 (0.32)	2.89

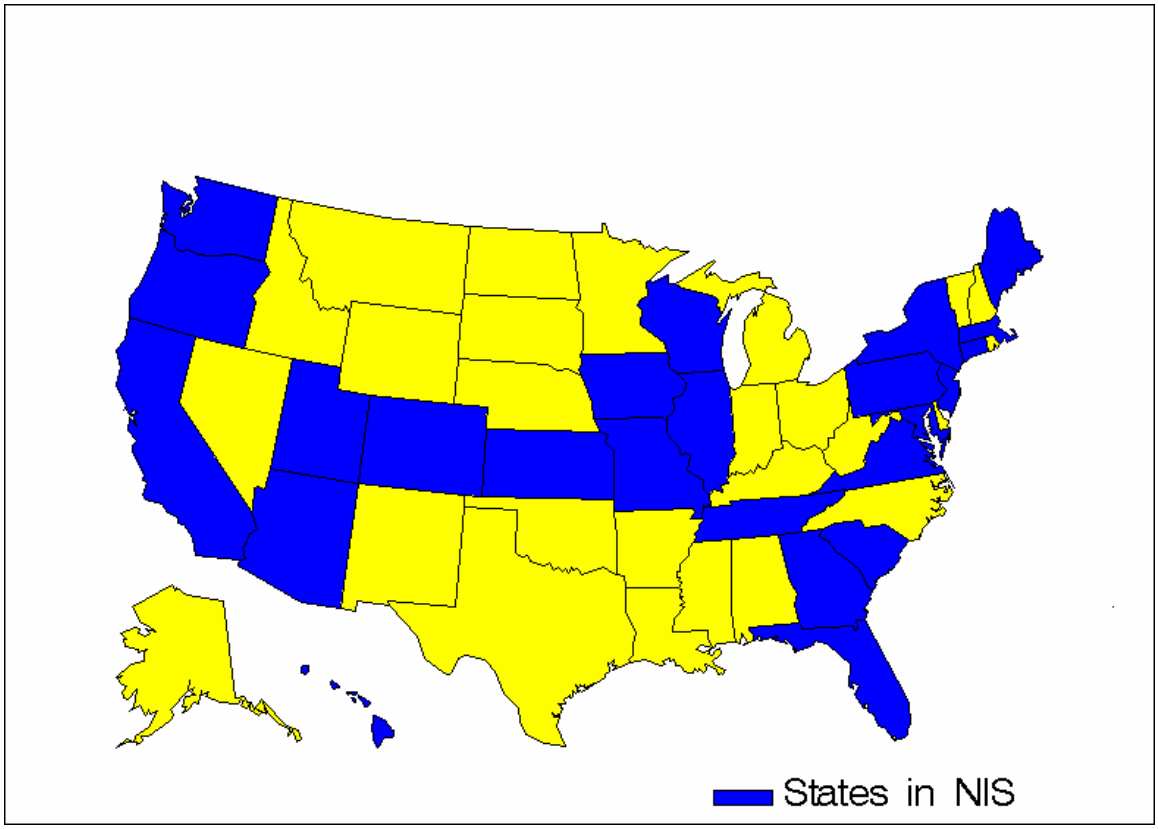
	Number of Discharges in Thousands (Standard Error)		Percentage of Discharges (Standard Error)	
	NIS	MedPAR	NIS	MedPAR
177: Computerized axial tomography (CT) scan head	117 (8)	107	2.83 (0.27)	2.74
231: Other therapeutic procedures	114 (13)	101	2.75 (0.33)	2.72
169: Debridement of wound, infection or burn	101** (2)	90	2.44 (0.06)	2.48
51: Endarterectomy, vessel of head and neck	99 (4)	92	2.4 (0.08)	2.42
39: Incision of pleura, thoracentesis, chest drainage	95** (2)	83	2.3 (0.04)	2.25
113: Transurethral prostatectomy (TURP)	91** (3)	83	2.19 (0.06)	2.23
37: Diagnostic bronchoscopy and biopsy of bronchus	87** (3)	78	2.1 (0.06)	2.10

DISCUSSION

Comparisons with NHDS and MedPAR Data

The key difference between the NIS and the databases to which it was compared is geographic. While both the National Hospital Discharge Survey and the Medicare Provider Analysis and Review data are gathered from a sampling frame of all 50 states, the 1999 NIS is limited to the 24 states shown in Figure 2. These states contain approximately 70 percent of all U.S. community hospital discharges. There are some significant differences between the states excluded and included in the NIS that offer likely explanations for some of the differences observed.

Figure 2. States in the NIS, 1999



The NIS states are disproportionately the more populated ones. Of the ten states with the highest population density, all but two are included in the NIS. These states, and their rank in terms of population density order, are: New Jersey (1), Massachusetts (3), Connecticut (4), Maryland (5), New York (6), Florida (7) and Pennsylvania (10). At the other end of the spectrum, only one of the ten least populous states are included in the NIS; Utah (41).[3] Given this difference in geographic sampling, it is not surprising that the NIS underestimates discharges from the smallest hospitals. While discharges are weighted by rural versus urban, the most rural state included in the sample, Utah, has a population density of 27.2 persons per square mile, compared with 1.1 for Alaska, 4.9 for Wyoming and 6.0 for Montana[4]. Even weighting the discharges from rural states does not adequately account for the remote areas of the country, which account for a disproportionate

[3] Source of state rankings: State and Metropolitan Area Data Book - 5th Edition
[4] None of these three states have all-payor hospital discharge data, so are not eligible for HCUP inclusion.

number of the smallest hospitals. Similarly, it would be expected that the NIS would overestimate the number of discharges from the larger hospitals.

The NIS is preferable to the MedPAR file for estimating the total Medicare discharges, as it includes the total population and not just the fee-for-service discharges. The underestimate by MedPAR is inconsequential in those areas where managed care providers have minimal market penetration and greater in the regions, particularly the West, where managed care participation by Medicare patients is greater.

One impact of the specific subset of states selected for the NIS is an overrepresentation of Medicare patients in managed care. In the twenty-four states included in the 1999 NIS, the market penetration of managed care providers for Medicare enrollees averages 16.9%, for the twenty-six states not included in the NIS, the mean market penetration of managed care providers is 8.5%. Table 24 breaks down managed care penetration by region of NIS and non-NIS states. For those regions that have a high proportion of managed care enrollees, such as the West, the MedPAR seems to substantially under-represent total discharges. In contrast, the Midwest and South have a low proportion of managed care enrollees. In these areas the NIS estimates more closely align with MedPAR numbers. This is consistent with the hypothesis that the MedPAR under-represent total discharges by omitting most managed care discharges.

Table 24. Mean Market Penetration by Region for Sampled and Non-Sampled States

	States not in the NIS		NIS States		All States in Region	
	Mean	N	Mean	N	Mean	N
Northeast	11.70%	3	17.54%	6	15.60%	9
Midwest	6.34%	7	8.38%	5	7.19%	12
South	7.73%	10	9.00%	6	8.21%	16
West	10.55%	6	29.34%	7	20.67%	13

NIS Strengths

While the above discussion focused on the differences between the NIS and other data sources, it should be noted that these differences only are of concern when there is a reason to expect geographic region might relate to the variable of interest. There is no rationale for proposing that the same diagnoses or procedures would differ in mortality, frequency or average length of stay in urban versus rural areas. In fact, very few differences are found on these dimensions. In areas where there are no biases due to sampling, the NIS provides a large enough sample size to yield estimates with much smaller standard errors than a smaller sample such as the NHDS. Without a sample of several million, such as in the NIS, estimates for the less common procedures and diagnoses are unreliable. Similarly, while the NIS does over-sample highly urbanized areas, this very over-sampling allows data to be available on less common hospital combinations, e.g., large non-profit hospitals, which are unusual enough not to be picked up at all in a smaller sample such as the NHDS.

In estimating mortality for the nation or within any major category of age, gender, region, procedure or diagnosis, the NIS rates are equivalent to the data sets to which it was compared. Because NIS estimates have greater precision due to a large sample size, it might be the preferred database for certain analyses based on relatively uncommon conditions. Furthermore, the NIS contains total hospital charges while the NHDS does not. For analysis involving charges on all payers, the NIS is the only choice.

Because the NIS data set includes the stratum and cluster variables, unlike the NHDS, it is possible to use the NIS to analyze thousands of possible combinations of age, gender, procedure, diagnosis, payer, and hospital ownership. In contrast, NHDS standard errors must be calculated using a table of parameters provided with the documentation, and these values are provided only for a limited range of categories.

The NIS provides a large sample of Medicare discharges both in managed care and fee-for-service plans, thus it would be the choice of researchers who desired to include all discharges regardless of type of payment. For researchers who are interested in discharges for which Medicare is a secondary payer, the NIS is the only one of the data sources discussed that provides a large sample of this population.

NIS Weaknesses

NIS estimates of mortality and length of stay are not significantly different from NHDS estimates. However, the latter would be preferable to researchers in those cases where total discharge estimates are of interest and it is important to the research hypothesis that representation of hospitals by size in the sample is proportional to the national distribution.

Due to the states available for the sample, the NIS overestimates the discrepancy between total Medicare discharges and the MedPAR's primarily fee-for-service population. Thus, the MedPAR database gives no estimate of managed care participants and the NIS database gives an overestimate.

Comparing the 1999 and 1997 NIS

In comparisons to the NHDS data, the 1999 NIS found fewer significant differences than in 1997. In 1997, significant differences were found for 16 diagnosis categories, compared to 11 in the current year. The 1997 NIS differed significantly from the NHDS in discharge estimates for eight procedure categories compared to five in the current year. This change was expected because of a slight increase in the number of states represented, and changes in the sampling design. Those differences that remained were primarily due to differences in coding between the two data sources and would therefore be expected to remain despite any sampling changes.

As in 1997, the NIS estimate of total discharges was greater than MedPAR because, as in 1997, MedPAR excluded most managed care records while the NIS estimates were based on a population that included both fee-for-service and managed care discharges.

Compared to the 1997 NIS, the sample taken in 1999 was much closer to the AHA population means on a wide range of variables. In 1997 there were many substantial differences from the mean, e.g., total hospital expenses and payroll were 45-49 percent higher, hospital admissions and discharges were 22 percent higher. In contrast, the 1999 NIS estimates on all of these variables were within 1-2% of the population mean.

Conclusion

Each of the data sources discussed has its strengths and weaknesses. Each may be the preferred choice for different research questions. The NIS offers a large sample that enables study of low incidence disorders and less common procedures. In addition, NIS estimates may be calculated for literally thousands of special sub-populations that may be of interest to researchers. The NHDS and MedPAR both offer samples that are drawn from all 50 states, rather than the 24 included in the NIS.

Where a comprehensive geographic representation is more important than a large sample size, and the question under study requires all age groups, the NHDS would be preferable. In the same situation, if only Medicare clients are of interest, the MedPAR data set would be preferable.

Is the NIS totally without bias? No. Does it provide a promising data source for answering many research questions? Yes. The source of the few differences that do exist between the NIS and NHDS is one area that warrants further investigation. It is possible, for example, that the lower prevalence of Chronic Obstructive Pulmonary Disease, dysrythmias, fluid and electrolyte disorders, and Osteoarthritis, in the face of higher numbers of surgical complications could reflect a relationship between hospital size and intense treatment patterns. Plans for the next comparison report using the NIS 2000 data include more detailed analyses of the interaction of hospital characteristics, e.g. bed size, in explaining differences in variables of interest, such as length of stay and procedures performed.

As for which of the data sources discussed is preferable or better, the answer, as with so much of research, is “It depends”. It depends on the use for which the data are intended. In general, the NIS estimates of such essential variables to healthcare policy as in-hospital mortality, population size, length of stay and costs are accurate, precise and can be calculated for both large groups ranging from the population of the United States, and small subsets with specific conditions. The characteristics documented herein ensure that the NIS will be an invaluable tool for researchers and policymakers alike.

APPENDIX

Estimates of Standard Error for NHDS Statistics

A variety of statistics were estimated based on these data:

1) total number of discharges,

2) in-hospital mortality, and

3) average length of stay (calculated as the difference between discharge and admission dates).

The standard errors were calculated as follows:

Total Numbers of Discharges

From the NHDS Documentation (National Center for Health Statistics, 2001), constants *a* and *b* were obtained for 1999. The relative standard error for the estimate of total discharges is approximated by:

$$RSE(W_{TD}) = \sqrt{a + b/W_{TD}}$$

where W_{TD} is the weighted sum of total discharges (i.e., the estimate of total discharges).

The standard error is then calculated as:

$$SE = RSE \times W_{TD}$$

Percent Mortality

Let p be the estimated proportion of in-hospital deaths (with the number of deaths estimated as the numerator and the discharge estimate is the denominator). The relative standard error of this proportion expressed as a percent is approximated by:

$$RSE(p) = \sqrt{b(1-p) \big/ (p \times W_{TD})}$$

The standard error is then calculated as:

$$SE = RSE \times p$$

Where *b* is the parameter in the formula for approximated $RSE(W_{TD})$ given by the NHDS documentation, i.e., the same used in the formula for calculating the standard error for number of discharges.

Average Length of Stay

Let average length of stay be the estimated average length of stay based on a weighted number of discharges equal to TD. If the weighted sum of patient length of stay is TLOS, and

$$ALOS = \frac{W_{TLOS}}{W_{TD}}$$

then the relative standard error is:

$$RSE(ALOS) = RSE(W_{TLOS} / W_{TD}) = \sqrt{[RSE(W_{TLOS})^2] + [RSE(W_{TD})^2]}$$

The estimate of the relative standard error is valid only if:

1) the relative standard error of the denominator (estimated discharges) is less than five percent, or

2) both the relative standard error of the numerator (estimated total stay days) and the denominator (estimated discharges) are less than ten percent.

For all parameter estimates, when values of *a* and *b* were available in the NHDS documentation, i.e., for procedures, gender, region, race and diagnoses, the appropriate values for *a* and *b* were used. When a variable represented the sum of more than one NHDS category, as recommended by Korn and Graubard (1999, p.224) the standard error for each category was calculated, and the largest of these standard errors was reported and used in significance testing. For example, the NIS category of "private insurance" includes three NHDS categories; Blue Cross/Blue Shield, HMO/PPO and other private insurance. The standard error was calculated for all three categories, using the values of *a* and *b* provided in the NHDS documentation, and the largest value was used in computing the t-value to test for significant difference.

When no parameter estimates were available, the values of *a* and *b* for the total sample were used in calculating the standard errors. For example, in the hospital control X ownership comparisons, the values for the total sample were used in calculating standard errors, because the NHDS documentation provides parameter estimates by neither ownership nor bed size.

Tests of Statistical Significance

To test for a statistically significant difference between an NIS estimate, *X*, and an NHDS estimate, *Y*, the following procedure was used. The difference is significant if

$$\left| \frac{(X - Y)}{\sqrt{SE_X^2 + SE_Y^2}} \right| \geq S$$

where SE_X is the estimated standard error for the NIS estimate and SE_Y is the estimated standard error of the NHDS estimate.

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