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ASSESSING POTENTIAL BIASES IN THE HCUP-3 NATIONWIDE INPATIENT SAMPLE, RELEASE 2

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ASSESSING POTENTIAL BIASES IN THE HCUP-3 NATIONWIDE INPATIENT SAMPLE, RELEASE 2

EXECUTIVE SUMMARY

This report assesses potential biases of statistics calculated from the Nationwide Inpatient Sample (NIS), Release 2 of the Healthcare Cost and Utilization Project (HCUP-3). The NIS, Release 2 includes hospital discharge data from a sample of community hospitals for calendar year 1993. Statistics for discharge- and hospital-level characteristics of the NIS data are compared with the National Hospital Discharge Survey (NHDS) and the Medicare Provider Analysis and Review (MedPAR) data.

Most statistics calculated from the NIS are consistent with those from the NHDS, particularly those for region and patient characteristics. Several differences exist between the NIS and NHDS discharge estimates when discharges are stratified by hospital size. The sample of hospitals in the NIS was stratified on hospital size and weighted to the AHA universe to better represent the universe of hospitals. The NIS estimates of average length of stay appear consistent with the NHDS. NIS estimates of in-hospital mortality rates are higher than the NHDS estimates in all the regions except the Midwest.

In comparison with the MedPAR data, the NIS estimates of Medicare discharges and average total charges appear to be high, while the estimates of average length of stay and in-hospital mortality rates appear low.

Inconsistencies between the NIS estimates and estimates from the NHDS and MedPAR data may be caused by a number of factors. Sample design may cause some differences. Some may be due to differences in coding schemes. In other cases, differences may be attributed to slightly dissimilar populations. For example, the MedPAR data exclude nearly all HMO enrollees.

ASSESSING POTENTIAL BIASES IN THE HCUP-3 NATIONWIDE INPATIENT SAMPLE, RELEASE 2

INTRODUCTION

This report assesses potential biases of statistics calculated from the Nationwide Inpatient Sample (NIS), Release 2 of the Healthcare Cost and Utilization Project (HCUP-3). The NIS, Release 2 includes hospital discharge data from a sample of community hospitals for the calendar year 1993. Statistics for discharge- and hospital-level characteristics of the NIS data are compared with the Medicare Provider Analysis and Review (MedPAR) data, the National Hospital Discharge Survey (NHDS), and the American Hospital Association Annual Survey data.

The NIS, Release 2 was established to provide analyses of hospital utilization across the United States. For each calendar year, the NIS *universe* of hospitals was established as all community hospitals located in the U.S. 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 Health Care Policy and Research (AHCPR) has agreements with 22 data sources that maintain statewide, all-payer discharge data files to include their data in the HCUP-3 database. However, only 17 of these states could be included for this second release. This represents the addition of six states, two from the South, more than the first release. The NIS, Release 2 is composed of all discharges from a sample of hospitals from these frame states.

Table A: States in the Frame for the NIS, Release 1 and 2

Calendar Years	States in the Frame
1988 (Release 1)	California, Colorado, Florida, Illinois, Iowa, Massachusetts, New Jersey, and Washington
1989-1992 (Release 1)	Add Arizona, Pennsylvania, and Wisconsin
1993 (Release 2)	Add Connecticut, Kansas, Maryland, New York, Oregon, and South Carolina

As a further restriction, the Illinois Health Care Cost Containment Council stipulated that no more than 40 percent of Illinois data could be included in the database for any calendar quarter. Consequently, approximately 50 percent of the Illinois community hospital universe was

randomly selected for the frame each year.

To improve the generalizability of the NIS estimates, five hospital sampling strata were used:

1. *Geographic Region* — Midwest, Northeast, West, and South.
2. *Ownership* — government, investor-owned, and nonprofit nongovernment.
3. *Location* — urban and rural.
4. *Teaching Status* — teaching and nonteaching.
5. *Bedsizes* — small, medium, and large, specific to the hospital's location and teaching status as shown in Table B.

Table B: Bedsizes Categories

Location and Teaching Status	Bedsizes		
	Small	Medium	Large
Rural	1-49	50-99	100+
Urban, nonteaching	1-99	100-199	200+
Urban, teaching	1-299	300-499	500+

To further ensure geographic representativeness, hospitals were sorted by state and the first three digits of their zip code prior to systematic sampling.

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 overall objective was to select a sample of hospitals "generalizable" to the target universe, including hospitals outside the frame (which had a zero probability of selection). See *Design of the HCUP-3 Nationwide Inpatient Sample, Release 2*, for more details on the design of the sample.

Sample weights were developed for the NIS to obtain national estimates of hospital and inpatient parameters. For example, with these weights it should be possible to estimate DRG-specific average lengths of stay over all U.S. hospitals, using weighted average lengths of stay based on averages or regression estimates from the NIS. Ideally, relationships among outcomes and their correlates estimated from the NIS should generally hold across all U.S. hospitals. However, since only 17 states contributed data to this second release, some estimates may be biased. In this report, we compare estimates based solely on the NIS against estimated quantities from

other sources of data.

This report compares 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.

This report is organized as follows. First, the data sources used in the analysis are discussed. Second, the methodology is explained. This is followed by a presentation of the results tabulated at the end of the document. The final section offers some conclusions and recommendations for analyses of the NIS, Release 2.

DATA SOURCES

Benchmark statistics for 1993 from several data sources were compared. The NIS Release 2, 1993 data were drawn from a frame of 17 states. NIS statistics were mainly compared with those calculated from the following three data sources:

1. *National Hospital Discharge Survey (NHDS), 1993.* Conducted by the National Center for Health Statistics, the NHDS includes about 250,000 discharges sampled from 400 hospitals. To be part of the NHDS, hospitals must have six or more beds staffed for patient use. The NHDS covers discharges from short-stay U.S. hospitals (hospitals with an average length of stay under 30 days), general-specialty (medical or surgical) hospitals, and children's hospitals. Federal, military, and Veterans Administration hospitals are excluded from the survey. The NHDS sampling frame includes very few specialty hospitals such as psychiatric, maternity, alcohol/chemical dependency, orthopedic, and head-injury hospitals.

Statistics calculated from the NHDS do have sampling error. However, the statistics are assumed to be unbiased because the sampling frame is relatively unrestricted, encompassing all nonfederal, acute-care, general U.S. hospitals with six or more beds.

2. *MedPAR, 1993.* The MedPAR data obtained from the Health Care Financing Administration (HCFA) include all records for each fee-for-service Medicare discharge from a Medicare-certified, short-stay U.S. hospital. Federal fiscal-year files for 1993 and 1994 were used to create a calendar-year 1993 MedPAR file with over 10 million discharge records. Medicare discharge statistics calculated from this source have no sampling error associated with them, because this file represents a census of 1993 fee-for-service Medicare discharges. However, only about 1.4 percent of the discharges were for HMO enrollees (based on 1991 and 1992 statistics), while approximately 6.5 percent of the Medicare population was enrolled in an HMO during 1993 (source: personal communication with Mr. Malcolm Sneen, Health Care Financing Administration, and based on tables produced by the Bureau of Data Management and Strategy, Office of Health Care Information Systems, on September 21, 1995). This suggests that the MedPAR records underreport total Medicare discharges by approximately 5 percent.

MedPAR stays that were not covered by Medicare or that represent some adjustment/correction records (where the number of Covered Days is zero) were eliminated, as were stays from special units (psychiatric, rehabilitation, swing bed, alcohol/drug) within short-stay hospitals. 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 file, same-day stays (admitted and discharged on the same day) were assigned a length of stay of one day. Consequently, in comparisons of average lengths of stay between the NIS and MedPAR files, same-day stays in the NIS were recoded from zero to one day for this analysis.

3. *AHA Annual Survey of Hospitals, 1993.* This hospital-level file 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. The file contains hospital-level statistics for hospital reporting periods, which do not necessarily correspond to the calendar year.

Table 1 summarizes some of the key differences in hospitals and discharges represented by the NIS, NHDS, and MedPAR data files.

METHODS

Comparisons with NHDS and MedPAR

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

- Total number of discharges
- Average length of stay (ALOS)
- In-hospital mortality rate
- Average total hospital charges (NIS and MedPAR only).

These measures of utilization, outcomes, and cost were selected because they are typically used in health services research.

For each statistic, a test was performed to determine whether a difference was statistically significant between: (1) the NIS and NHDS estimates, and (2) the NIS and MedPAR estimates. Because the MedPAR estimate was based on the entire population, one-sample t-tests were used. Since the NHDS estimate was based on a sample, two-sample t-tests were used, as described in the Appendix. Differences were reported at the one and five percent significance levels.

To assess their reliability, the statistics listed above were compared within the following types of strata:

- Geographic regions (Midwest, Northeast, West, and South)
- Hospital characteristics (ownership, rural location, teaching status, and bedsize)
- Patient characteristics (age, race, gender, and payer)
- Diagnosis groups (The principal diagnosis code for each discharge was assigned to a diagnosis group defined by the Clinical Classifications for Health Policy Research (CCHPR) Version 2 algorithm — see Elixhauser and McCarthy, 1996).
- Procedure groups (The principal procedure code for each discharge was assigned to a procedure group defined by the CCHPR Version 2 algorithm — see Elixhauser and McCarthy, 1996).

Further, special analyses were conducted for hospitals in the South region, an area in which the NIS coverage is limited. In the NIS, Release 1, the South region was represented by only Florida. For Release 2 of the NIS, the South is represented by Florida, Maryland, and South Carolina.

All NIS statistics used sample weights and accounted for the sample design using the SUDAAN microcomputer statistical software to calculate finite sample statistics and their variances. All NHDS and MedPAR statistics were calculated with Statistical Analysis System (SAS) microcomputer software. For NHDS statistics, standard errors were calculated as described in the Appendix.

RESULTS

Comparisons Between the NIS and the NHDS

Since the NIS and the NHDS represent different samples of the same universe of hospitals, some differences are expected, and can be attributed to statistical "noise." Moreover, because of the large number of comparisons, some of the statistically significant differences will not be real differences using 0.05 level of significance. While bias could be present in either sample, the NHDS estimates are less likely to be biased because the hospital sampling frame is far less restricted than that for the NIS. The following sections describe results of statistical comparisons by region, hospital characteristics, patient characteristics, diagnosis, and procedure.

Comparisons by Region

Table 2 compares estimates of discharges, average lengths of stay, and in-hospital mortality between the NIS and NHDS in total and by region for 1993. The NIS and NHDS estimates are not significantly different for discharges and average length of stay. NIS estimates of in-hospital mortality rates however, are significantly higher in total (by 9 percent) and for the Northeast, South, and West (by 13-14 percent).

Comparisons by Hospital Characteristics

Table 3 compares estimates of discharges, average lengths of stay, and in-hospital mortality between the NIS and NHDS for 1993, by hospital ownership categories (private/investor-owned, private/nonprofit, and government/nonfederal) and bedsize categories (6-99, 100-199, 200-299, 300-499, and 500+).

Most discharge estimates are significantly different between the two sources. The NIS discharge estimate for investor-owned hospitals is nearly 21 percent lower than the NHDS estimate, while the estimate for government hospitals is 39 percent higher than the NHDS estimate. For private/nonprofit hospitals, which represent the majority of the discharges, there is no significant difference. Within the ownership groups, significant differences are found for all bedsize categories except for 100-199 bed, government hospitals. The NIS estimate is larger than the NHDS estimate for seven of the 14 differences, and lower for the remaining seven. The NIS discharge estimates tend to be higher for large hospitals, and lower for small government and nonprofit hospitals. The NIS discharge estimates for large hospitals (300-499 and 500+ beds) are higher than the NHDS estimates for government and nonprofit hospitals. NIS discharge estimates for small hospitals (6-99 beds) are smaller for private hospitals, and larger for government hospitals, when compared to the NHDS estimates.

It should be noted that the total number of 1993 universe discharges in hospitals with over 500

beds is 7.0 million according to the AHA file. Consequently, the NIS (with 7.6 million) may provide a better estimate of discharge counts for large hospitals than the NHDS (with 3.9 million). These differences in estimated discharge counts may contribute to differences in outcome statistics, reported in Table 3, between the two sources because the discharge counts are essentially sums of discharge weights, which are used to calculate outcome statistics.

Few average length of stay (ALOS) or in-hospital mortality estimates were significantly different between the two sources: we note here four significant ALOS differences out of 14 comparisons. For investor-owned hospitals, the NIS ALOS estimates are about 29 percent higher than the NHDS estimates for hospitals with 6-99 beds, and 20 percent higher for hospitals with 100-199 beds. Overall, for government hospitals, the NIS ALOS estimates are significantly higher than the NHDS estimates (13 percent). By bedsize however, significant differences between the NIS and NHDS for government hospitals estimates are found only for 200-299 bed hospitals (16 percent lower) and 6-99 bed hospitals (21 percent higher).

Estimates for in-hospital mortality tend to be higher for the NIS than for NHDS. Although there are only four significant differences between the NIS and NHDS estimates, the NIS estimate is higher than the NHDS estimate for 12 of the 14 strata. The NIS estimate is significantly higher than the NHDS estimate for investor-owned and private nonprofit hospitals by 29 and 7 percent, respectively.

Comparisons by Patient Characteristics

Table 4 compares estimates of discharges, average lengths of stay, and in-hospital mortality between the NIS and NHDS for 1993 — by primary payer, age group, gender, and race. The majority of estimates are not significantly different between the two data sources for these strata.

Discharge estimates for Medicare, Medicaid, all age groups, males, females, and two categories of race (Black and missing), show no significant differences between the NIS and NHDS. Significant differences however, are found for the payer categories of private insurance, self-pay, no charge, other, and missing. The NIS discharge estimates for private insurance and self-pay patients are 19 and 81 percent higher, respectively, than the NHDS estimates. NIS estimates for White and other race also differ from the NHDS estimates.

Average length of stay estimates from the two sources are not statistically different. Estimates of in-hospital mortality rates from the NIS are generally higher than the NHDS estimates, however. Of the 17 strata in Table 4, the NIS estimates are larger than the NHDS estimates for 12 strata, although not all differences are statistically significant. The NIS estimates are significantly larger than NHDS estimates for the payer categories of self-pay and other (40 and 31 percent); age groups 15-44 years, 45-64 years, and 65+ years (15, 6, and 4 percent); males and females (10 and 8 percent); plus the white, and missing race categories (13 and 20 percent). The NIS estimate is significantly smaller, by 49 percent, than the NHDS estimate for the no charge payer category.

Comparisons for the South Region

Table 5 gives a detailed comparison for the South Region by hospital and patient characteristics. Many of the NIS estimates in Table 5 are significantly different from their corresponding NHDS estimates for the number of discharges (10 out of 21). However, few (2 out of 21) of the comparisons for average lengths of stay are statistically different.

No significant differences in discharge estimates are found for any ownership or age group categories. All bedsize categories, however, show significant differences between the NIS and NHDS estimates of discharges. The NIS estimates are lower than the NHDS estimates for small and medium hospitals (6-99, 100-199, and 200-299 beds) by 11 to 47 percent. The NIS estimates for large hospitals (300-499 and 500+ beds) are larger than the NHDS estimates by 42 to 54 percent. No significant differences are found for the primary payer categories of Medicare, Medicaid, and private insurance, while the categories of self-pay, no charge, other and missing do show significant differences. In addition, the discharge estimate for females are 8 percent lower than the NHDS estimate.

The average length of stay estimates from the NIS generally agree with the NHDS estimates for

the South, although significantly longer NIS estimates are generated for investor-owned, government, and 6-99 bed hospitals. The NIS in-hospital mortality estimates are higher than the NHDS estimates for nearly every hospital and patient category, including by age group. The differences are statistically significant for about half of the categories. The higher NIS estimates may stem from the higher weight given Florida hospitals. Florida has a large immigrant population with serious health problems.

Comparisons by Diagnosis Category

Table 6 compares the NIS and NHDS by the 25 most frequent principal diagnosis categories, ranked according to the NIS estimated number of discharges for each category. The first-listed diagnosis code for each discharge is classified according to CCHPR Version 2 diagnosis code categories. The NIS discharge estimates differ significantly from the NHDS estimates for 14 of the 25 categories; NIS estimates are significantly higher for 12 diagnosis categories and significantly lower for only two categories.

Some of the discrepancies found in the number of discharges may be explained when considering characteristics of the NIS and NHDS databases. For example, differences in the number of delivery-related discharges could be explained by the reordering of diagnosis codes in the NHDS. For women discharged after a delivery, a code of V27 (Outcome of Delivery) from the supplemental classification is entered as the second-listed code. A code designating normal or abnormal delivery is then listed in the first position. This could explain differences in the number of discharges counted in the diagnosis group for normal pregnancy and/or delivery (rank 5), trauma to the perineum and vulva (rank 7), fetal distress and abnormal forces of labor (rank 18), other complications of birth affecting mother (rank 22), and the complications of pregnancy (rank 23).

Further, in the NHDS, if the first-listed diagnosis was a symptom, it was moved farther down the list of diagnoses. This may have affected estimates for the 12th ranked diagnosis category, nonspecific chest pain. Taking the differences in ordering of diagnoses into account reduces the discrepancies to 8 of the 25 categories.

Comparisons of ALOS and in-hospital mortality rates by diagnosis category (also shown in Table 6) indicate few significant differences between NIS and NHDS estimates. Significant differences are found for only two ALOS estimates and for no in-hospital mortality estimates. The in-hospital mortality rates yielded valid significance tests for only 20 categories. This is due to the fact that valid NHDS standard errors for in-hospital mortality could not be calculated for five categories (see Appendix for validity criteria).

Comparisons by Procedure Category

Table 7 lists the top 25 procedure categories, ranked according to the NIS estimated number of discharges for each category. Similar to the diagnosis groups, the first-listed procedure code is classified according to the CCHPR, Version 2 procedure code categories. The NIS discharge estimates differ significantly from the NHDS estimates for 12 of the 25 categories; NIS estimates are significantly higher for 10 procedure categories, and significantly lower for only two categories.

Procedures for which the NIS discharges were significantly higher than the NHDS estimates include the following: episiotomy, upper GI, diagnostic cardiac catheterization, respiratory intubation, CT scan, cancer chemotherapy, alcohol/drug rehabilitation, diagnostic spinal tap, arthroplasty knee, and hip replacement. These differences may be explained by the estimated high number of discharges from large hospitals in the NIS compared to the NHDS, which are more likely to do high technology procedures (see Table 3).

Comparisons of average length of stay and in-hospital mortality rate estimates by procedure category show few significant differences between NIS and NHDS estimates. Three significant differences are found for ALOS, and two such differences are found for in-hospital mortality. Significance tests were not performed for two in-hospital mortality rate estimates due to the unavailability of valid standard errors for NHDS estimates (see Appendix).

Comparisons Between the NIS and MedPAR

Comparisons by Region

Table 8 compares the NIS and MedPAR for 1993 (in total and by region) according to four measures:

- number of discharges,
- ALOS,
- in-hospital mortality, and
- average total charges.

The NIS and MedPAR estimates for the U.S. as a whole were significantly different for all four statistics. The NIS overall estimate of discharges exceeds the MedPAR figure by 24 percent. The NIS estimates exceed the MedPAR count in the Midwest, Northeast, South, and West, by 15, 21, 30 and 26 percent respectively. These discrepancies could be explained, in part, by the

undercount of managed care enrollees from the MedPAR database, although this undercount is estimated to be only approximately 5 percent.

The NIS overall estimates of average length of stay are about 1.4 percent lower than the MedPAR average. It is possible that the HMO enrollees who are in the NIS, and are not in MedPAR, have lower lengths of stay, on average. The NIS estimate falls short of the MedPAR average by 5 percent in the Northeast and by 2 percent in the South — and it exceeds the MedPAR average by 2 percent in the Midwest.

The NIS overall estimates of in-hospital mortality are about 4 percent lower than the MedPAR rates. Again, if the mortality rate is lower among HMO enrollees, their partial exclusion from the MedPAR database could provide an explanation for these differences. They are about 6 percent lower in the Midwest and over 5 percent lower in the South.

Finally, the NIS overall estimates of average total charges are 4 percent higher than the MedPAR averages. The NIS estimates are higher than the MedPAR averages for all regions except the Midwest (although the difference is not significant in the Northeast or West). The NIS estimates are significantly higher — 7 percent — for the South.

Comparisons by Hospital Characteristics

Table 9 compares the NIS and MedPAR, by hospital characteristics.

NIS discharge estimates are larger than MedPAR counts for all categories of ownership and location. Most estimates are 10 to 30 percent larger than the MedPAR counts, although the NIS estimates of discharges from investor-owned hospitals exceed the MedPAR count by 52 percent. The NIS estimated average length of stay is lower than the MedPAR average for private and urban hospitals except for large urban hospitals, and higher for government and rural hospitals. The NIS estimates are over 9 percent higher for urban teaching hospitals with at least 500 beds. The NIS estimates fall short of the MedPAR counts in eight strata and exceed the MedPAR counts in six strata.

Most (9 out of 15) NIS estimates of in-hospital mortality are significantly lower than MedPAR rates. Private/nonprofit, government, rural, urban teaching, and urban nonteaching hospitals all have NIS estimates lower than MedPAR. Of the 15 strata in the table, 13 show NIS estimates smaller than MedPAR, although not all differences are statistically significant.

While the majority of the average total charge estimates are not significantly different from the MedPAR averages, significant differences are found for government, rural, and urban nonteaching hospitals. Overall, the NIS estimates are higher, although not necessarily statistically different than the MedPAR average in 12 of the 15 strata.

The patterns in Table 9 indicate that inconsistencies between NIS estimates and MedPAR statistics are not limited to certain types of hospitals. Rather, the NIS estimates of in-hospital mortality tend to be lower than the MedPAR averages for most types of hospitals, and the NIS estimates of discharges and average total charges tend to be higher than the MedPAR averages for most types of hospitals.

Comparisons by Patient Characteristics

Table 10 compares the NIS and MedPAR, by age group and gender. Nearly all NIS estimates are significantly different from the MedPAR figures for each patient category. Moreover, the direction of the difference is consistently the same for each statistic:

- the NIS discharge estimates tend to be over 20 percent higher than the MedPAR count for each patient group;
- the NIS average length of stay estimates are usually about 1 to 5 percent lower than MedPAR for each patient group;
- the NIS estimates of in-hospital mortality rates tend to be about 4 to 5 percent lower than the MedPAR rate for each patient group (2 percent lower for under 65 years); and
- the NIS estimates of average total charges tend to be about 4 percent higher than the MedPAR average for each patient group.

More will be said about these differences in the discussion section, below.

Comparison with AHA Data

Table 11 demonstrates that hospital weights associated with the NIS yield hospital counts consistent with AHA universe counts for various categories of hospital types. This is expected because the sample of hospitals was stratified on most of these variables, and sample hospital weights were calculated within strata based on AHA data.

Table 12 compares the mean and median of selected hospital-level measures taken from the 1993 AHA Annual Survey, between the hospital-weighted sample frame and the hospital universe. The frame hospital weighted averages and medians appear to closely match the universe averages.

DISCUSSION

In general, for many types of estimates, the NIS performs very well. Some differences emerge when the NIS is compared to specific data sets. Sometimes, these variations are caused by differences in definitions (e.g., NIS and NHDS coding schemes). In some cases, differences are due to certain shortcomings in the NIS. In other cases, differences may be attributed to slightly dissimilar populations. For example, the MedPAR data do not include all HMO enrollees. Consequently, if a study's target population is all Medicare patients (HMO and non-HMO), the NIS may be the better file.

Comparisons of Total Population Estimates

Based on comparisons between statistics calculated from the NIS and the NHDS, it appears that most statistics calculated from the two data sources are similar. Overall, when compared with the NHDS, the NIS seems to estimate discharge estimates for certain types of hospitals (government hospitals and large hospitals) and higher in-hospital mortality rates. The higher mortality estimates may be in part because the NIS tends to have higher estimates of discharges for "large" hospitals, and these patients may represent a somewhat different severity of illness than those in other hospitals.

Estimates of LOS and mortality by diagnosis and procedure groups show few significant differences. However, several estimates of discharges by diagnosis and procedure groups are significantly different. These differences of LOS and mortality could be attributable to differences in data handling — the NIS takes all diagnosis and procedure codes as they are recorded, while the NHDS has specific rules for what is considered a valid first-listed diagnosis.

Comparisons of Medicare Estimates

Based on comparisons between statistics calculated from the NIS and the MedPAR, most statistics calculated from the NIS *appear* different for the Medicare population. Across most hospital and patient classifications, as compared to the MedPAR, the NIS seems to have:

- higher Medicare discharge counts by about 24 percent;
- lower Medicare average lengths of stay by about 1.4 percent;
- lower Medicare in-hospital mortality rates by about 4 percent; and
- higher Medicare charges by about 4 percent.

However, it is not clear how many of these discrepancies can be attributed to the limited sampling frame for the NIS, and how many should be attributed to bias in the MedPAR caused by the near exclusion of HMO enrollees.

Focusing our attention solely on the estimates of discharge counts, Table C shows the estimates for the number of Medicare discharges for each region from each of four sources:

Table C: 1993 Medicare Discharges (Thousands)

Region	Data Source			
	NIS	NHDS	AHA	MedPAR
Total U.S.	11,999	11,688	10,271	9,706
Midwest	2,953	2,981	2,647	2,560
Northeast	2,628	2,694	2,431	2,177
South	4,582	4,402	3,797	3,513
West	1,836	1,611	1,397	1,456

The AHA estimates are based on the total number of Medicare discharges for the NIS universe of community hospitals in the 1993 AHA Annual Survey of Hospitals.

An estimated 5 percent of Medicare stays were excluded from the 1993 MedPAR file because of the underreporting of HMO stays. This is somewhat consistent with the total AHA count exceeding the MedPAR count by 5.8 percent, as shown. The NHDS estimates exceed the AHA estimates by 14 percent overall, and are closer to the NIS estimates of the number of Medicare discharges.

A comparison between the NIS and the AHA estimates of total Medicare discharges suggests that NIS estimates of total Medicare discharges are:

- overestimated by 12 percent in the Midwest;
- overestimated by 8 percent in the Northeast;
- overestimated by 21 percent in the South; and
- overestimated by 31 percent in the West.

Table D compares the estimated mortality rates and average lengths of stay (ALOS) for Medicare patients for each of the three data sources:

Table D: 1993 Mortality Rates and Average Length of Stay

Region	Statistic	Data Source		
		NIS	NHDS	MedPAR
Total	ALOS (days)	8.00	7.84	8.11
	Mortality (%)	5.57	5.16	5.82
Midwest	ALOS (days)	7.41	7.64	7.28
	Mortality (%)	5.16	5.02	5.48
Northeast	ALOS (days)	10.18	9.09	10.67
	Mortality (%)	6.38	5.27	6.49
South	ALOS (days)	7.68	7.55	7.84
	Mortality (%)	5.58	5.39	5.90
West	ALOS (days)	6.61	6.91	6.38
	Mortality (%)	5.06	4.60	5.25

The ALOS and mortality rate estimates are usually higher for the MedPAR than for the NHDS. This is consistent with lower mortality and lower lengths of stays by HMO enrollees compared to other Medicare enrollees, due in part to a possibly healthier HMO enrollee population.

These comparisons suggest that, while the NIS estimates of Medicare discharge counts may be biased upward, NIS estimates of other Medicare statistics may be relatively unbiased. Currently, there is no definitive source for Medicare discharge data: MedPAR excludes most HMO stays so underrepresents discharges, while the reporting periods of AHA hospitals vary and do not necessarily correspond to calendar year reporting.

Conclusion

In summary, the NIS estimates of ALOS appear to be unbiased in most contexts. The NIS estimates for in-hospital mortality and the number of Medicare discharges are higher than estimates from other sources. Overall, the NIS estimates of in-hospital mortality are higher than the NHDS for all regions except the Midwest. However, the NIS estimates of Medicare mortality are higher than the NHDS estimates but lower than the MedPAR statistics. Based on comparisons with MedPAR data, the NIS estimates for average hospital charges may be biased upward. This probably results from the larger percentage of weighted NIS discharges coming from "large" hospitals — and the more complex case mix of those hospitals — when compared

to the universe and other data sources.

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2. Elixhauser, A. and McCarthy, E. *Clinical Classifications for Health Policy Research, Version 2: Hospital Inpatient Statistics*. (AHCPR Publication No. 96-0017) Agency for Health Care Policy and Research, Healthcare Cost and Utilization Project (HCUP-3) Research Note 1. February, 1996.

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, constants a and b were obtained for 1993. The standard error for the estimate of total discharges is:

$$SE_{TD} = (aW_{TD}^2 + bW_{TD})^{1/2}$$

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

This estimate of standard error is valid only if:

- (1) estimated total discharges exceeds 366,657 or
- (2) estimated total discharges exceeds 60,769 and estimated total days exceeds 283,338.

Percent Mortality

Let P be the estimated proportion of in-hospital deaths. The standard error of this proportion expressed as a percent is:

$$SE_p = 100 \left(\frac{c P (1 - P)}{W} \right)^{1/2}$$

Where the constant c is given by NHDS documentation. This estimate of the standard error is valid only if:

- (1) estimated total discharges exceeds 366,657 and the estimated number of deaths exceeds zero, or
- (2) both estimated total discharges and estimated total deaths exceed 60,769.

Average Length of Stay

Let ALOS 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

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

then the estimated standard error is:

$$SE_{ALOS} = ALOS \left[\left(a_1 + \frac{b_1}{TD} \right) + \left(a_2 + \frac{b_2}{TLOS} \right) \right]^{1/2}.$$

Constants a_1 , a_2 , b_1 , and b_2 were obtained from the NHDS documentation concerning standard error calculations for average length of stay.

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

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

where SE_X is the estimated standard error for the NIS estimate and SE_Y is the estimated standard error of the NHDS estimate. S is equal to 1.96 for significance at the .05 level and S is equal to 2.576 for significance at the .01 level.

The same significance test was applied to comparisons between the NIS and MedPAR estimates. However, for MedPAR statistics, $SE_Y = 0$ was substituted.

If a valid estimate of either standard error, SE_X or SE_Y , could not be obtained, then a significance test was not performed.

Table 1: Differences Among NIS – Release 2, NHDS, and MedPAR Files Used in This Analysis

CHARACTERISTIC	DATABASE		
	NIS – Release 2	NHDS	MedPAR
Intended Universe	Discharges from community hospitals as defined by the AHA — nonfederal, short-term general, or other special hospitals that are not a hospital unit of an institution.	Discharges from noninstitutional U.S. hospitals (with the exception of federal, military, and Veterans Administration hospitals). Only short-stay hospitals (hospitals with an average length of stay of less than 30 days), general-specialty (medical or surgical) hospitals, or children's hospitals are included.	Discharges from Medicare-certified short-stay and community hospitals located in the U.S. that link to community hospitals in the AHA Annual Survey file.
- Specialty hospitals and units	AHA community hospitals may be specialty hospitals. Some AHA community hospitals include specialty units — obstetrics/ gynecology; short-term rehabilitation; and ear, nose, and throat.	Includes discharges from a few specialty hospitals (i.e., psychiatric, maternity, alcohol/chemical dependency, orthopedic, and head injury rehabilitation hospitals).	Excludes discharges from special units of community hospitals (psychiatric, rehabilitation, swing beds, and alcohol/chemical dependency).
- HMO enrollees	Included	Included	Generally excluded
- Bedsizes	No restriction on bedsize.	Must have at least six beds staffed for patient use.	No restriction on bedsize.
Sample or Universe	Sample	Sample	Universe
Sampling Frame	8 states (1988) 11 states (1991) 17 states (1993)	50 states and the District of Columbia	Not a sample

CHARACTERISTIC	DATABASE		
	NIS – Release 2	NHDS	MedPAR
Sample Design	By geographic region, control/ownership, location, teaching status, and bedsize (bedsize categories are specific to the hospital's location and teaching status). 913 hospitals.	Includes all hospitals with at least 1,000 beds or more than 40,000 discharges annually — plus an additional sample of hospitals based on a stratified three-stage design. The first stage consists of a selection of 112 primary sampling units (PSU's) used in the National Health Review Survey. The second stage consists of a selection of noncertainty PSU's. At the third stage, a systematic random sample of discharges within the hospitals is selected. 478 hospitals.	Not a sample
Discharges included in database	All discharges from sampled hospitals: 6,538,976 discharges.	A sample of discharges from sampled hospitals: 235,411 discharges.	100% of Medicare fee-for-service discharges from short-stay hospitals: 10,478,404 discharges.
Charges	Reported charges missing for some HMO enrollees.	Not reported	Reported

CHARACTERISTIC	DATABASE		
	NIS – Release 2	NHDS	MedPAR
Reassignment of diagnosis codes	None	Myocardial infarctions are reassigned to the principal diagnosis when other circulatory diagnoses are present. For women discharged after a delivery, a code of V27 (Outcome of Delivery) from the supplemental classification is entered as the second-listed code, with a code designating normal or abnormal delivery in the first-listed position.	None

Table 2: NIS and NHDS Comparisons by Region, 1993

	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.	34,715 (423)	34,404 (1,102)	5.79 (0.05)	5.65 (0.30)	2.72 ** (0.03)	2.49 (0.06)
Census Region						
Midwest	8,329 (159)	7,890 (615)	5.43 (0.05)	5.74 (0.74)	2.46 (0.04)	2.54 (0.10)
Northeast	7,646 (268)	7,654 (421)	7.17 (0.16)	6.65 (0.58)	3.03 ** (0.07)	2.67 (0.09)
South	12,380 (178)	12,870 (645)	5.76 (0.04)	5.46 (0.44)	2.91 ** (0.03)	2.55 (0.10)
West	6,360 (224)	5,989 (432)	4.65 (0.10)	4.69 (0.56)	2.32 * (0.07)	2.05 (0.12)

* Difference is significant at the 0.05 level.

** Difference is significant at the 0.01 level.

Table 3: NIS and NHDS Comparisons by Hospital Characteristics, 1993

	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
Control/Bedsize						
Private/ Investor-owned						
Total	3,263 ** (100)	4,170 (141)	5.65 (0.14)	5.31 (0.29)	3.24 ** (0.10)	2.52 (0.18)
6 - 99 beds	538 ** (33)	1,521 (56)	5.49 ** (0.25)	4.24 (0.25)	2.97 (0.12)	2.64 (0.30)
100 - 199 beds	1,414 ** (58)	418 (20)	5.46 ** (0.11)	4.56 (0.33)	3.33 * (0.15)	2.11 (0.52)
200 - 299 beds	709 * (158)	362 (18)	5.44 (0.42)	4.67 (0.35)	2.89 (0.33)	1.72 (0.51)
300 - 499 beds	402 ** (111)	1,110 (43)	6.35 (0.14)	6.42 (0.38)	3.76 (0.38)	2.77 (0.36)
500+ beds	201 ** (70)	759 (32)	6.74 (0.25)	6.51 (0.41)	3.41 (0.24)	2.52 (0.42)
Private/Nonprofit						
Total	26,147 (402)	26,421 (848)	5.76 (0.06)	5.76 (0.30)	2.67 * (0.03)	2.50 (0.07)
6 - 99 beds	2,156 ** (59)	4,238 (143)	4.64 (0.10)	4.98 (0.27)	2.72 (0.06)	2.58 (0.18)
100 - 199 beds	4,846 ** (157)	6,609 (218)	5.44 (0.09)	5.47 (0.29)	2.65 (0.06)	2.43 (0.14)
200 - 299 beds	4,490 ** (304)	5,658 (188)	5.76 (0.11)	5.74 (0.31)	2.75 (0.08)	2.54 (0.15)
300 - 499 beds	9,017 ** (404)	6,766 (223)	5.63 (0.07)	6.24 (0.33)	2.64 (0.05)	2.46 (0.14)
500+ beds	5,638 ** (349)	3,151 (108)	6.68 (0.20)	6.41 (0.35)	2.68 (0.08)	2.59 (0.21)

Table 3: NIS and NHDS Comparisons by Hospital Characteristics, 1993 (continued)

	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
Government/ Nonfederal						
Total	5,303 ** (105)	3,813 (129)	6.00 * (0.09)	5.31 (0.29)	2.63 (0.04)	2.33 (0.18)
6 - 99 beds	1,349 ** (34)	1,062 (41)	5.30 ** (0.10)	4.38 (0.27)	2.87 ** (0.05)	1.66 (0.29)
100 - 199 beds	1,064 (115)	1,136 (44)	4.77 (0.29)	5.29 (0.32)	2.29 (0.10)	2.70 (0.36)
200 - 299 beds	359 ** (93)	1,113 (43)	5.17 * (0.29)	6.13 (0.37)	2.52 (0.20)	2.45 (0.34)
300 - 499 beds	746 ** (85)	469 (22)	5.80 (0.27)	5.50 (0.38)	2.42 (0.13)	2.72 (0.56)
500+ beds	1,786 ** (99)	33 (4)	7.51 ^a (0.19)	5.45 (^b)	2.77 ^a (0.09)	1.76 (b)

^a A significance test was not performed because a valid standard error was not available.
^b The NHDS sample size was too small to calculate a valid estimate of standard error.

*** Difference is significant at the 0.05 level.
**** Difference is significant at the 0.01 level.

Table 3: NIS and NHDS Comparisons by Hospital Characteristics, 1993 (continued)

Table 4: NIS and NHDS Comparisons by Patient Characteristics, 1993

	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	11,999 (160)	11,688 (706)	7.98 (0.05)	7.82 (0.56)	5.57 (0.04)	5.16 (0.29)
Medicaid	6,310 (179)	5,661 (1,201)	5.16 (0.11)	4.90 (1.10)	1.13 (0.03)	1.05 (0.11)
Private Insurance	12,955 ** (281)	10,887 (544)	4.28 (0.04)	4.20 (0.34)	1.18 (0.02)	1.05 (0.08)
Self-pay	1,961 ** (68)	1,085 (164)	4.78 (0.09)	4.82 (1.03)	1.71 * (0.05)	1.22 (0.21)
No charge	27 ** (7)	819 (124)	5.37 (0.49)	5.71 (1.22)	1.15 * (0.28)	2.25 (0.33)
Other	1,210 ** (56)	3,629 (544)	5.34 (0.11)	4.57 (0.97)	1.40 * (0.07)	1.07 (0.11)
Missing	252 * (36)	635 (181)	4.75 (0.21)	5.13 (1.81)	1.18 (0.08)	1.34 (0.19)
Age Group						
Under 15 years	6,022 (137)	5,720 (765)	3.84 (0.06)	3.84 (1.18)	0.48 (0.02)	0.45 (0.02)
15 - 44 years	10,706 (175)	11,200 (1,096)	4.30 (0.07)	4.14 (0.76)	0.63 ** (0.02)	0.55 (0.02)
45 - 64 years	5,819 (87)	6,283 (714)	6.25 (0.05)	6.16 (1.27)	2.47 ** (0.03)	2.33 (0.04)
65 years and over	12,167 (163)	11,201 (1,201)	7.84 (0.05)	7.81 (1.35)	5.80 ** (0.04)	5.56 (0.03)
Gender						
Male	14,507 (173)	14,085 (943)	6.19 (0.05)	6.07 (0.60)	3.31 ** (0.03)	3.01 (0.07)
Female	20,203 (262)	20,318 (646)	5.50 (0.05)	5.37 (0.29)	2.30 * (0.03)	2.12 (0.07)
Race						
White	19,518 * (468)	22,158 (1,081)	5.87 (0.05)	5.73 (0.44)	3.02 ** (0.03)	2.67 (0.10)
Black	3,901 (135)	4,100 (311)	6.43 (0.10)	6.17 (0.76)	2.46 (0.04)	2.46 (0.13)
Other	3,109 ** (219)	1,571 (268)	5.31 (0.19)	4.90 (1.38)	1.95 (0.08)	1.89 (0.18)
Missing	8,187 (487)	6,575 (850)	5.48 (0.09)	5.26 (1.05)	2.42 ** (0.05)	2.02 (0.11)

Table 3: NIS and NHDS Comparisons by Hospital Characteristics, 1993 (continued)

***** Difference is significant at the 0.05 level.
***** Difference is significant at the 0.01 level.

Table 5: NIS and NHDS Comparisons by Hospital and Patient Characteristics for South Region, 1993

	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
Control/Ownership						
Private/ Investor-owned	2,226 (70)	2,410 (85)	5.75 * (0.09)	5.07 (0.29)	3.55 ** (0.09)	2.84 (0.25)
Private/Nonprofit	7,398 (156)	7,646 (251)	5.62 (0.06)	5.60 (0.30)	2.78 * (0.05)	2.50 (0.13)
Government/ Nonfederal	2,756 (54)	2,814 (98)	5.75 (0.09)	5.39 (0.30)	2.76 (0.02)	2.43 (0.21)
Bedsizes						
6 - 99 beds	1,605 ** (24)	3,011 (104)	5.50 ** (0.05)	4.42 (0.25)	3.12 ** (0.03)	2.28 (0.20)
100 - 199 beds	2,732 ** (51)	3,071 (106)	5.44 (0.05)	5.25 (0.29)	3.07 (0.05)	2.71 (0.22)
200 - 299 beds	1,643 ** (136)	2,443 (86)	5.47 (0.12)	5.70 (0.32)	2.89 (0.12)	2.53 (0.23)
300 - 499 beds	3,410 ** (188)	2,403 (85)	5.67 (0.07)	6.12 (0.34)	2.92 (0.07)	2.58 (0.24)
500+ beds	2,989 ** (222)	1,941 (70)	6.47 (0.11)	6.26 (0.35)	2.65 (0.07)	2.69 (0.27)
Primary Payer						
Medicare	4,582 (76)	4,402 (276)	7.67 (0.04)	7.54 (0.58)	5.58 (0.04)	5.39 (0.48)
Medicaid	2,258 (65)	2,021 (430)	4.94 (0.06)	4.34 (0.98)	1.17 (0.03)	1.06 (0.18)
Private Insurance	4,192 (103)	4,420 (225)	4.31 (0.05)	4.23 (0.35)	1.30 * (0.03)	1.00 (0.12)
Self-pay	925 ** (21)	184 (29)	4.70 (0.04)	4.41 (0.99)	1.78 (0.03)	1.44 (0.56)
No charge	1 ** (0)	375 (57)	5.52 (0.39)	5.18 (1.13)	1.99 (0.34)	2.03 (0.46)
Other	420 ** (13)	1,153 (174)	6.29 (0.05)	4.64 (0.99)	1.79 ** (0.10)	0.97 (0.18)
Missing	2 ** (0)	315 (90)	4.23 (0.22)	4.79 (1.69)	3.72 ** (0.47)	1.26 (0.26)
Age Group						
Under 15 years	2,054 (57)	2,087 (279)	4.24 (0.07)	4.19 (1.29)	0.51 ** (0.02)	0.36 (0.03)
15 - 44 years	3,610 (71)	4,254 (417)	4.28 (0.05)	3.86 (0.71)	0.74 ** (0.02)	0.60 (0.04)
45 - 64 years	2,127 (37)	2,383 (271)	6.11 (0.04)	5.82 (1.20)	2.54 (0.03)	2.48 (0.07)
65 years and over	4,588 (78)	4,146 (445)	7.44 (0.04)	7.53 (1.30)	5.87 ** (0.04)	5.69 (0.06)

	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
Gender						
Male	5,253 (77)	5,099 (342)	6.12 (0.04)	5.93 (0.59)	3.55 ** (0.03)	3.23 (0.11)
Female	7,124 * (106)	7,771 (251)	5.50 (0.04)	5.15 (0.28)	2.44 ** (0.03)	2.10 (0.11)

***** Difference is significant at the 0.05 level.

***** Difference is significant at the 0.01 level.

Table 6: NIS and NHDS Comparisons by Principal Diagnoses Ranked by NIS Data, 1993

Rank ^a	CCHPR Category ^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
1	218: Liveborn	3,836 (94)	3,598 (123)	3.01 (0.46)	3.09 (0.17)	0.38 (0.01)	0.32 (0.07)
2	101: Coronary atherosclerosis	1,408 (41)	1,336 (50)	5.13 (0.06)	5.05 (0.30)	1.01 (0.03)	1.08 (0.21)
3	122: Pneumonia (except that caused by tuberculosis and sexually transmitted diseases)	1,184 (13)	1,220 (47)	7.91 (0.06)	7.94 (0.46)	7.50 (0.09)	7.10 (0.54)
4	108: Congestive heart failure, nonhypertensive	946 (13)	898 (36)	7.41 (0.06)	7.46 (0.45)	6.59 (0.06)	6.22 (0.60)
5	196: Normal pregnancy and/or delivery	703 ** (22)	4,034 (137)	1.76 ** (0.02)	2.42 (0.14)	0.00 (0.00)	0.02 (0.02)
6	100: Acute myocardial infarction	683 (14)	745 (31)	7.43 (0.07)	7.32 (0.46)	10.53 (0.11)	10.07 (0.82)
7	193: Trauma to perineum and vulva	620 ** (19)	2 (1)	1.77 ^a (0.02)	1.62 (^b)	0.00 ^a (0.00)	0.00 (^b)
8	109: Acute cerebrovascular disease	555 (8)	530 (24)	9.80 (0.14)	10.15 (0.66)	12.81 (0.12)	11.10 (1.01)
9	205: Spondylosis, intervertebral disc disorders, other back problems	549 (9)	532 (24)	5.48 * (0.04)	4.77 (0.33)	1.57 (0.03)	1.33 (0.37)
10	106: Cardiac dysrhythmias	541 (8)	563 (25)	4.74 (0.04)	4.46 (0.30)	0.79 (0.02)	0.65 (0.25)
11	149: Biliary tract disease	536 ** (14)	622 (27)	4.63 (0.05)	4.44 (0.30)	0.17 (0.01)	0.10 (0.09)
12	102: Nonspecific chest pain	517 ** (10)	90 (8)	2.51 ^a (0.02)	1.85 (^b)	0.09 ^a (0.01)	0.00 (^b)
13	69: Affective disorders	485 * (17)	553 (25)	12.97 (0.36)	12.30 (0.79)	0.11 (0.01)	0.03 (0.05)
14	128: Asthma	484 (12)	468 (22)	4.29 (0.04)	4.43 (0.31)	0.54 (0.03)	0.41 (0.22)
15	127: Chronic obstructive pulmonary disease and bronchiectasis	461 (7)	505 (23)	7.24 (0.06)	6.87 (0.46)	3.90 (0.07)	4.02 (0.65)
16	45: Maintenance chemotherapy, radiotherapy	435 ** (6)	520 (24)	6.02 (0.06)	6.03 (0.41)	5.35 (0.11)	5.15 (0.72)
17	55: Fluid and electrolyte disorders	427 ** (28)	139 (10)	3.64 (0.08)	3.96 (0.41)	0.71 (0.04)	0.77 (0.55)

Table 6: NIS and NHDS Comparisons by Principal Diagnoses Ranked by NIS Data, 1993 (continued)

Rank ^a	CCHPR Category ^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
18	190: Fetal distress and abnormal forces of labor	417 ** (12)	1 (1)	2.70 ^a (0.03)	1.52 (b)	0.01 ^a (0.00)	0.00 (b)
19	237: Complication of device, implant or graft	398 * (11)	355 (18)	7.23 (0.07)	7.24 (0.52)	1.84 (0.04)	1.33 (0.45)
20	159: Urinary tract infections	387 * (5)	440 (21)	6.34 (0.06)	6.38 (0.44)	2.23 (0.06)	1.83 (0.47)
21	50: Diabetes mellitus with complications	374 (6)	379 (19)	7.39 (0.10)	8.11 (0.57)	1.89 (0.05)	2.15 (0.55)
22	195: Other complications of birth, puerperium affecting management of the mother	352 ** (11)	164 (11)	2.67 (0.06)	2.65 (0.28)	0.04 ^a (0.00)	0.00 (b)
23	181: Other complications of pregnancy	348 ** (12)	52 (6)	2.29 ^a (0.03)	2.70 (b)	0.04 ^a (0.01)	0.00 (b)
24	203: Osteoarthritis	341 (9)	336 (17)	7.19 (0.08)	7.91 (0.57)	0.24 (0.01)	0.22 (0.19)
25	2: Septicemia (except in labor)	333 ** (8)	273 (15)	10.05 (0.09)	10.51 (0.78)	14.97 (0.29)	13.04 (1.51)

^a NIS rank is based on number of discharges.

^b Diagnoses classified according to *Clinical Classifications for Health Policy Research, Version 2* (see Elixhauser and McCarthy, 1996).

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

^b The NHDS sample size was too small to calculate a valid estimate of standard error.

***** Difference is significant at the 0.05 level.

***** Difference is significant at the 0.01 level.

Table 7: NIS and NHDS Comparisons by Principal Procedures Ranked by NIS Data, 1993

Rank ^a	CCHPR Category ^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
1	115: Circumcision	1,062 (30)	1,044 (41)	2.47 (0.02)	2.50 (0.16)	0.00 (0.00)	0.00 (0.02)
2	137: Other procedures to assist delivery	975 (38)	1,024 (40)	1.89 (0.02)	1.92 (0.13)	0.00 (0.00)	0.01 (0.02)
3	134: Cesarean section	822 * (22)	914 (37)	4.00 (0.03)	3.93 (0.25)	0.03 (0.00)	0.01 (0.02)
4	133: Episiotomy	797 ** (29)	552 (25)	1.95 (0.02)	1.87 (0.14)	0.00 (0.00)	0.01 (0.03)
5	47: Diagnostic cardiac catheterization, coronary arteriography	627 * (25)	545 (24)	4.75 (0.08)	4.31 (0.30)	1.16 * (0.04)	0.60 (0.25)
6	70: Upper gastrointestinal endoscopy, biopsy	605 ** (8)	501 (23)	7.15 (0.05)	6.63 (0.45)	2.70 * (0.04)	1.64 (0.42)
7	231: Other therapeutic procedures	522 (11)	538 (24)	3.91 (0.03)	3.76 (0.26)	0.10 (0.01)	0.17 (0.13)
8	124: Hysterectomy, abdominal and vaginal	493 (41)	427 (20)	6.43 (0.16)	6.15 (0.43)	3.01 (0.32)	2.79 (0.59)
9	140: Repair of current obstetric laceration	488 (20)	513 (23)	1.82 (0.02)	1.99 (0.16)	0.00 ^a (0.00)	0.00 (^b)
10	84: Cholecystectomy and common duct exploration	452 (7)	462 (22)	5.10 (0.05)	4.66 (0.33)	0.85 (0.02)	0.91 (0.33)
11	216: Respiratory intubation and mechanical ventilation	424 ** (9)	251 (14)	12.37 ** (0.18)	9.56 (0.73)	32.91 (0.46)	29.30 (2.12)
12	224: Cancer chemotherapy	410 ** (27)	289 (16)	4.14 (0.11)	4.08 (0.33)	1.15 (0.05)	1.71 (0.56)
13	219: Alcohol and drug rehabilitation/detoxification	402 * (31)	314 (16)	7.85 (0.30)	8.43 (0.62)	0.12 ^a (0.02)	0.08 (^b)
14	45: Percutaneous coronary angioplasty (PTCA)	378 (21)	341 (17)	4.64 (0.05)	4.58 (0.35)	1.05 (0.04)	0.94 (0.39)
15	177: Computerized axial tomography (CT) scan head	373 * (17)	317 (17)	7.27 (0.16)	6.76 (0.50)	4.95 (0.13)	4.49 (0.86)

Table 7: NIS and NHDS Comparisons by Principal Procedures Ranked by NIS Data, 1993 (continued)

Rank ^a	CCHPR Category ^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
16	3: Laminectomy, excision intervertebral disc	368 (11)	410 (20)	2.09 (0.02)	2.07 (0.17)	0.01 (0.00)	0.01 (0.04)
17	135: Forceps, vacuum, and breech delivery	357 (11)	393 (19)	4.61 (0.07)	4.57 (0.34)	0.21 (0.01)	0.18 (0.16)
18	44: Coronary artery bypass graft (CABG)	312 (18)	287 (15)	11.80 (0.13)	12.00 (0.88)	3.34 (0.10)	4.04 (0.86)
19	4: Diagnostic spinal tap	296 * (9)	256 (14)	6.59 (0.10)	6.69 (0.53)	2.23 (0.07)	1.87 (0.63)
20	193: Diagnostic ultrasound of heart (echocardiogram)	286 (15)	264 (15)	7.84 ** (0.14)	6.18 (0.49)	2.35 (0.09)	2.40 (0.70)
21	152: Arthroplasty knee	282 * (8)	248 (14)	6.29 (0.07)	6.07 (0.49)	0.20 (0.01)	0.34 (0.27)
22	146: Treatment, fracture or dislocation of hip and femur	266 (4)	259 (14)	9.55 (0.10)	9.49 (0.72)	2.58 (0.06)	1.84 (0.62)
23	153: Hip replacement, total and partial	263 * (6)	229 (13)	8.94 (0.09)	8.90 (0.71)	1.67 (0.04)	1.60 (0.61)
24	76: Colonoscopy and biopsy	249 ** (20)	321 (17)	4.99 (0.10)	5.62 (0.43)	3.89 (0.25)	3.32 (0.74)
25	217: Other respiratory therapy	249 (4)	226 (13)	7.67 ** (0.06)	5.98 (0.50)	1.77 (0.05)	1.17 (0.53)

^a NIS rank is based on number of discharges.

^b Diagnoses classified according to *Clinical Classifications for Health Policy Research, Version 2* (see Elixhauser and McCarthy, 1996).

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

^b The NHDS sample size was too small to calculate a valid estimate of standard error.

***** Difference is significant at the 0.05 level.
 ***** Difference is significant at the 0.01 level.

Table 8: NIS and MedPAR Comparisons by Region, 1993

	Number of Discharges in Thousands (Standard Error)			Average Length of Stay in Days (Standard Error)		In-Hospital Mortality Rate: Percent (Standard Error)		Average Total Charges in Dollars (Standard Error)	
	NIS	MedPAR ^a	Ratio of MedPAR to NIS	NIS ^b	MedPAR ¹	NIS	MedPAR ¹	NIS	MedPAR ¹
U.S.	11,999 ** (160)	9,706	0.81	8.00 * (0.05)	8.11	5.57 ** (0.04)	5.82	13,130 ** (164)	12,637
Census Region									
Midwest	2,953 ** (67)	2,560	0.87	7.41 * (0.05)	7.28	5.16 ** (0.05)	5.48	11,253 (217)	11,435
Northeast	2,628 ** (100)	2,177	0.83	10.18 * (0.19)	10.67	6.38 (0.12)	6.49	14,285 (490)	13,856
South	4,582 ** (76)	3,513	0.77	7.68 ** (0.04)	7.84	5.58 ** (0.04)	5.90	12,765 ** (139)	11,928
West	1,836 ** (73)	1,456	0.79	6.61 (0.12)	6.38	5.06 (0.10)	5.25	15,464 (650)	14,635

^a The standard error (SE) is zero for MedPAR measures because the MedPAR file contains 100% of the Medicare beneficiaries' records. MedPAR data exclude most HMO enrollees.
^b NIS Length of Stay values of zero have been recoded to values of one for consistency with MedPAR data.

 Difference is significant at the 0.05 level.
 Difference is significant at the 0.01 level.

Table 9: NIS and MedPAR Comparisons by Hospital Characteristics, 1993

	Number of Discharges in Thousands (Standard Error)			Percentage of Total Discharges		Average Length of Stay in Days (Standard Error)		In-Hospital Mortality Rate: Percent (Standard Error)		Average Total Charges in Dollars (Standard Error)	
	NIS	MedPAR ^a	Ratio of MedPAR to NIS	NIS	MedPAR ¹	NIS ^b	MedPAR ¹	NIS	MedPAR ¹	NIS	MedPAR ¹
Control/Ownership											
Private/ investor-owned	1,528 ** (55)	1,007	0.66	14.27	10.37	7.16 ** (0.10)	7.85	5.33 (0.09)	5.47	14,426 (302)	14,870
Private/nonprofit	8,911 ** (143)	7,298	0.82	83.25	75.19	8.13 ** (0.07)	8.30	5.57 ** (0.04)	5.83	13,038 (191)	12,694
Government/ Nonfederal	1,561 ** (51)	1,402	0.90	14.58	14.44	8.07 ** (0.10)	7.32	5.77 ** (0.08)	6.04	12,374 ** (557)	10,734
Location/Teaching Status/Bedsize											
Rural											
Total	2,294 ** (34)	2,023	0.88	21.43	20.84	6.86 ** (0.05)	6.58	5.44 ** (0.04)	5.67	8,147 ** (71)	7,839
1 - 49 beds	505 ** (11)	472	0.93	4.72	4.86	5.64 (0.06)	5.64	5.29 (0.07)	5.33	6,009 (71)	5,932
50 - 99 beds	643 ** (19)	571	0.89	6.01	5.88	6.90 ** (0.05)	6.19	5.42 (0.08)	5.55	7,352 (127)	7,261
100+ beds	1,145 ** (25)	980	0.86	10.70	10.10	7.38 (0.09)	7.26	5.52 ** (0.06)	5.90	9,522 ** (106)	9,094

Table 9: NIS and MedPAR Comparisons by Hospital Characteristics, 1993 (continued)

	Number of Discharges in Thousands (Standard Error)			Percentage of Total Discharges		Average Length of Stay in Days (Standard Error)		In-Hospital Mortality Rate: Percent (Standard Error)		Average Total Charges in Dollars (Standard Error)	
	NIS	MedPAR ^a	Ratio of MedPAR to NIS	NIS	MedPAR ¹	NIS ^b	MedPAR ¹	NIS	MedPAR ¹	NIS	MedPAR ¹
Urban teaching											
Total	3,182 ** (99)	2,577	0.81	29.73	26.55	9.21 (0.15)	9.43	5.71 ** (0.10)	5.97	16,400 (494)	15,775
1 - 299 beds	480 (43)	422	0.88	4.49	4.34	8.60 * (0.41)	9.65	5.38 (0.29)	5.22	13,102 (800)	13,568
300 - 499 beds	1,252 ** (62)	987	0.79	11.70	10.17	8.55 ** (0.16)	9.70	5.75 ** (0.14)	6.13	15,791 (898)	15,284
500+ beds	1,449 ** (64)	1,168	0.81	13.54	12.03	9.98 ** (0.26)	9.11	5.79 ** (0.14)	6.10	17,944 (705)	16,986
Urban nonteaching											
Total	6,524 ** (121)	5,106	0.78	60.95	52.61	7.80 ** (0.06)	8.05	5.54 ** (0.05)	5.81	13,290 (179)	12,954
1 - 99 beds	588 ** (23)	521	0.89	5.50	5.37	6.63 ** (0.13)	8.43	5.41 ** (0.12)	4.86	9,332 ** (246)	10,951
100 - 199 beds	1,771 ** (57)	1,391	0.79	16.55	14.33	7.61 ** (0.10)	7.94	5.64 (0.08)	5.68	12,451 (242)	12,247
200+ beds	4,164 ** (104)	3,195	0.77	38.90	32.92	8.05 (0.08)	8.04	5.52 ** (0.06)	6.03	14,209 * (257)	13,589

- a The standard error (SE) is zero for MedPAR measures because the MedPAR file contains 100% of the Medicare beneficiaries' records. MedPAR data exclude most HMO enrollees.
- b NIS Length of Stay values of zero have been recoded to values of one for consistency with MedPAR data.

***** Difference is significant at the 0.05 level.
***** Difference is significant at the 0.01 level.

Table 10: NIS and MedPAR Comparisons by Patient Characteristics, 1993

	Number of Discharges in Thousands (Standard Error)			Percentage of Total Discharges		Average Length of Stay in Days (Standard Error)		In-Hospital Mortality Rate: Percent (Standard Error)		Average Total Charges in Dollars (Standard Error)	
	NIS	MedPAR ^a	Ratio of MedPAR to NIS	NIS	MedPAR ¹	NIS ^b	MedPAR ¹	NIS	MedPAR ¹	NIS	MedPAR ¹
U.S.	11,999 ** (160)	9,706	0.81	100.00	100.00	8.00 * (0.05)	8.11	5.57 ** (0.04)	5.82	13,130 ** (164)	12,637
Age Group											
Under 65 years	1,318 * (22)	1,098	0.83	10.98	11.31	8.74 ** (0.11)	9.20	2.95 ** (0.04)	3.02	13,405 (270)	13,033
65 - 74 years	4,563 ** (69)	3,711	0.81	38.03	38.23	7.40 * (0.04)	7.50	4.26 ** (0.03)	4.45	13,779 ** (186)	13,266
75 - 84 years	4,250 ** (61)	3,387	0.80	35.42	34.89	8.17 (0.06)	8.18	6.17 ** (0.04)	6.50	13,140 ** (154)	12,577
85+ years	1,868 ** (28)	1,511	0.81	15.57	15.57	8.55 ** (0.08)	8.67	9.24 ** (0.07)	9.71	11,333 ** (141)	10,938
Gender											
Male	5,356 ** (75)	4,295	0.80	44.64	44.25	7.82 ** (0.05)	8.07	6.01 ** (0.04)	6.29	13,924 ** (189)	13,384
Female	6,642 ** (88)	5,411	0.81	55.36	55.75	8.14 (0.06)	8.14	5.21 ** (0.04)	5.46	12,492 ** (147)	12,044

^a The standard error (SE) is zero for MedPAR measures because the MedPAR file contains 100% of the Medicare beneficiaries' records.

Difference is significant at the 0.05 level.
Difference is significant at the 0.01 level.

- ^b MedPAR data exclude most HMO enrollees.
NIS Length of Stay values of zero have been recoded to values of one for consistency with MedPAR data.

Table 11: Number of Hospitals in the NIS Frame and AHA Universe by Hospital Characteristics, 1993

	1993 AHA Universe	1993 Frame ^a Weighted	1993 Frame ¹ Unweighted
U.S.	5,313	5,313	913
Census Region			
Midwest	1,533	1,533	302
Northeast	789	789	174
South	2,013	2,013	258
West	978	978	179
Control/Ownership			
Private/ investor-owned	738	716	113
Private/nonprofit	3,170	3,228	600
Government/ nonfederal	1,405	1,369	200
Location/Teaching Status			
Rural			
Total	2,271	2,271	340
1 - 49 beds	1,233	1,233	191
50 - 99 beds	602	602	84
100+ beds	436	436	66
Urban			
Total	3,042	3,042	570
Teaching			
Total	604	604	116
1 - 49 beds	187	187	36
50 - 99 beds	232	232	47
100+ beds	185	185	34
Nonteaching			
Total	2,438	2,438	454
1 - 49 beds	779	779	125
50 - 99 beds	804	804	161
100+ beds	855	855	169

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

^a The 1993 frame contains 17 states.

Table 12: NIS 17-State Sampling Frame and AHA Universe Comparisons by Selected Measures, 1993

	Universe Mean	Frame Weighted Mean	Universe Median	Frame Weighted Median
Hospital Admissions	5765.07	5913.06	3219.00	3459.00
Hospital Discharges	5771.62	5920.55	3238.00	3442.00
Hospital Discharges ^{*****}	6555.54	6702.17	3665.00	3823.00
Hospital Beds	158.73	160.74	100.00	99.00
Hospital Average Length of Stay	6.51	6.19	5.48	5.59
Hospital Occupancy	0.52	0.54	0.53	0.55
Total Hospital Expenses (in dollars)	49,354,305	50,885,894	22,443,918	24,671,835
Hospital Expenses per Bed (in dollars)	248,843	261,971	232,648	244,011
Total Hospital Payroll (in dollars)	21,633,624	22,235,044	9,332,772	10,249,473
Hospital Payroll per Bed (in dollars)	107,999	112,583	99,487	102,063
% Medicare Days	51.58	52.02	52.83	52.82
% Medicare Discharges	42.92	42.99	43.03	42.92
% Medicare Discharges ¹	38.90	39.22	38.40	38.76
% Medicaid Days	14.32	13.73	12.01	11.43
% Medicaid Discharges	16.12	15.82	14.60	14.18
% Medicaid Discharges ¹	14.24	13.88	13.10	12.82
Intern/Bed Ratio	0.03	0.03	0.00	
FTE ^{*****}	694.13	703.09	347.00	356.50
FTE ² /Bed	3.85	3.92	3.64	3.71
% MDs Board-Certified	73.18	74.68	75.19	76.46

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

***** Adjusted for well newborns.
***** Full-time equivalents.