Comparison Analysis for the HCUP Nationwide Inpatient Sample, Release 1 (1988-1992)

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ASSESSING POTENTIAL BIASES IN THE HCUP-3 NATIONWIDE INPATIENT SAMPLE, RELEASE 1

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ASSESSING POTENTIAL BIASES IN THE HCUP-3 NATIONWIDE INPATIENT SAMPLE, RELEASE 1

EXECUTIVE SUMMARY

This report assesses potential biases of statistics calculated from the Nationwide Inpatient Sample (NIS), Release 1 of the Healthcare Cost and Utilization Project (HCUP-3). The NIS, Release 1 includes hospital discharge data from a sample of community hospitals for the calendar years 1988 through 1992. Statistics for discharge- and hospital-level characteristics of the NIS data are compared with the Medicare Provider Analysis and Review (MedPAR) data and the National Hospital Discharge Survey (NHDS).

Most statistics calculated from the NIS are consistent with those from the NHDS. The NIS estimates of average lengths of stay and in-hospital mortality appear to be consistent with the NHDS in most contexts except for mortality in the South, where the NIS estimate is higher than the NHDS estimate by 17 percent for 1988, and by 19 percent for 1991. Florida (the only NIS, Release 1 state in the South) seems to have a higher than average in-hospital mortality rate than other Southern states. This finding should be seriously considered when conducting mortality analyses with NIS data.

The NIS estimates for the number of Medicare discharges appears to be slightly higher than the MedPAR data, particularly in the South. The NIS estimates for average hospital charges also appear to be higher in the South in comparison to MedPAR. The next version of the NIS (Release 2) will include hospitals from additional Southern states. This should produce NIS estimates in the South more consistent with the NHDS and MedPAR.

Sometimes, these inconsistencies are caused by differences in coding schemes. In some cases, differences are due to certain shortcomings in the NIS, such as Florida being the only southern state 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.

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INTRODUCTION

This report assesses potential biases of statistics calculated from the Nationwide Inpatient Sample (NIS), Release 1 of the Healthcare Cost and Utilization Project (HCUP-3). The NIS, Release 1 includes hospital discharge data from a sample of community hospitals for the calendar years 1988 through 1992. Statistics for discharge- and hospital-level characteristics of the NIS data are compared with the Medicare Provider Analysis and Review (MedPAR) data and the National Hospital Discharge Survey (NHDS).

The NIS, Release 1 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 11 of these states (8 for 1988, as shown in Table A below) could be included for this first release. The NIS, Release 1 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

Calendar Years	States in the Frame
1988	California, Colorado, Florida, Illinois, Iowa, Massachusetts, New Jersey, and Washington
1989-1992	Add Arizona, Pennsylvania, and Wisconsin

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 40 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. *Bedsize* — small, medium, and large, specific to the hospital's location and teaching status as shown in Table B.

Table B: Bedsize Categories

Location and Teaching Status	Bedsize		
	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 1,* 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 11 states contributed data to this first 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 1.

DATA SOURCES

Benchmark statistics for 1991 from several data sources were compared. A limited number of comparisons was also performed for 1988, since the NIS was drawn from a frame of only eight states that year. 1991 was selected as a representative middle year, using the 11-state frame for 1989 through 1992. NIS statistics were mainly compared with those calculated from the following three data sources:

1. *National Hospital Discharge Survey (NHDS), 1988 and 1991*. 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 of less than 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*, *1991*. 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 1991 and 1992 were used to create a calendar-year 1991 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 1991 fee-for-service Medicare discharges. However, only about 1.4 percent of the discharges were for HMO enrollees, while approximately 6.5 percent of the Medicare population was enrolled in an HMO during 1991 (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 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, 1988 and 1991*. This hospital-level file contains one record for every hospital in the NIS universe. The file contains hospital-level statistics, making it a convenient source for calculating various statistics based on both the population of hospitals and the NIS sample of hospitals. The calendar-year conforming hospital files (CYCHFs) developed for HCUP-3 were used. In addition, hospitals in the HCUP-3 AHA file were linked to those in the Area Resource File (ARF) to identify frontier rural counties (defined as counties with a population density of six or less per square mile — see Gesler et al., 1992). The ARF, maintained by the Health Resources Administration's Bureau of Health Professions, contains health professions and related data for all U.S. counties, including physician distribution by specialty, population characteristics, and hospital utilization and expenditure data.

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 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, rural areas, and frontier rural areas (defined as counties with a population density of less than six persons per square mile). These are areas in which the NIS, Release 1 coverage is limited. The South region is represented only by Florida. By design, the NIS contains about 20% of the total number of rural hospitals in each region. However, this resulted in a low number of rural hospitals in the NIS because of the relatively small number of rural hospitals nationwide.

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

Tables 2 and 3 compare estimates of discharges, average lengths of stay, and in-hospital mortality between the NIS and NHDS in total and by region for 1988 and 1991, respectively. The NIS and NHDS estimates were not significantly different for discharges and average lengths of stay. However, NIS estimates of in-hospital mortality rates for 1988 were significantly higher than NHDS estimates in the South by 17 percent (3.14/2.69), and in the West by 19 percent (2.71/2.27). Overall, the 1988 NIS mortality estimate is about 7 percent higher than the NHDS estimate. The 1991 NIS estimate of the in-hospital mortality rate did not significantly differ from the NHDS estimate in the West, as it did for 1988. This is probably the result of an additional state (Arizona) in the 1991 NIS sampling frame as compared to 1988. However, the NIS estimate of the in-hospital mortality rate remained significantly higher than the NHDS estimate by 19 percent in the South. The NIS contains hospitals from only one southern state (Florida).

Comparisons by Hospital Characteristics

Table 4 compares estimates of discharges, average lengths of stay, and in-hospital mortality between the NIS and NHDS for 1991, 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+).

Few estimates were significantly different between the two sources. For investor-owned hospitals, the NIS discharge estimates are about 36 percent lower than the NHDS estimates for hospitals with 6-99 beds and 200-299 beds. For nonprofit nongovernment hospitals, the NIS

discharge estimates are significantly lower than the NHDS estimates for hospitals with 6-99 beds and 100-199 beds, and significantly higher than NHDS estimates for hospitals with 500 or more beds.

It should be noted that the total number of universe discharges in hospitals with over 500 beds is 6.8 million according to the AHA file. Consequently, the NIS (with 7.7 million) may provide a better estimate of discharge counts for large hospitals than the NHDS (with 4.0 million). These differences in estimated discharge counts may contribute to differences in outcome statistics between the two sources because these discharge counts are essentially sums of discharge weights, which are used to calculate outcome statistics.

For nonprofit nongovernment hospitals with 100-199 beds, the NIS estimated in-hospital mortality rate is also significantly higher than that for the NHDS, by about 16 percent. For government hospitals, the NIS estimated average length of stay is significantly higher by about 19 percent than the NHDS estimate for hospitals with 6-99 beds. Also, for government hospitals with 300-499 beds, the estimated in-hospital mortality rate is significantly higher, by 44 percent.

Nevertheless, these differences do not appear to follow any pattern, and the overall agreement is good between the two sources. Out of 46 comparisons, 39 show no significant differences.

Comparisons by Patient Characteristics

Table 5 compares estimates of discharges, average lengths of stay, and in-hospital mortality between the NIS and NHDS for 1991 — by primary payer, age group, gender, and race. Few estimates were significantly different between the two data sources for these strata.

The NIS estimate for the number of self-pay discharges was significantly lower than the NHDS estimate, by about 47 percent. This probably resulted from the lack of a "self-pay" category for NIS Florida hospitals, and therefore all of the South. (In 1993, Florida introduced a "self-pay" category). However, this may not be a major concern because the overall percentage of self-pay discharges is only about 5 percent (in the NHDS).

For private-insurance discharges, the NIS estimate of in-hospital mortality rate is significantly higher than the NHDS estimate, by 31 percent. The NIS estimates of in-hospital mortality significantly differed from the NHDS estimates by age group. The overall estimated mortality rate for the 15-44 age group is low — on the order of 0.5 percent — but the NIS estimate is about 21

percent higher than the NHDS estimate. For the 45-64 age group the NIS estimate is about 7 percent higher, and for the 65+ age group the NIS estimate is about 3 percent lower than the NHDS estimate.

The NIS estimate of discharges by race differs significantly from the NHDS estimate, mainly because race is missing in the NIS data for an estimated 65 percent of discharges (beginning with 1992, Florida data includes race, which lowers the percentage of missing race in the NIS). Nevertheless, the estimates of average length of stay and in-hospital mortality do not differ significantly by race.

There does not appear to be a consistent, overall trend in these differences across patient categories. Out of 38 patient-level comparisons, 31 show no significant differences.

Comparisons for the South Region

Table 6 gives a detailed comparison for the South by hospital and patient characteristics. We note that the payer category "self-pay" is not a separate category in the NIS data for Florida, representing the South region. Consequently, that category is omitted from Table 6 ("other" for NHDS includes self-pay/no charge). The 1991 NIS in-hospital mortality estimates are higher than the 1991 NHDS estimates for nearly every hospital and patient category, including by age group. Although the differences are not statistically significant for every category, this trend indicates that in-hospital mortality rates from Florida hospitals tend to be higher than those in other southern hospitals, even within hospital sampling strata. A reason for this may be that Florida has a large immigrant population with serious health problems.

Comparisons by Diagnosis Category

Table 7 compares the NIS and NHDS by 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 18 of the 50 categories; NIS estimates are significantly higher for 12 diagnosis categories and significantly lower for six 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, with a code designating normal or abnormal delivery in the first-listed position. This could explain differences in the number of discharges counted in the diagnosis group for normal pregnancy and/or delivery (ranked as 5). Furthermore, the NIS may estimate fewer normal delivery discharges because the NIS has a higher number of estimated discharges from hospitals with more than 500 beds, which usually have a more complicated case-mix.

Comparisons of ALOS and in-hospital mortality rates by diagnosis category (also shown in Table 7) do not show any significant difference between NIS and NHDS estimates. Estimated ALOS show no significant differences for the top 50 diagnosis categories. The in-hospital mortality rates yielded valid significance tests for only four categories, since valid NHDS standard errors for in-hospital mortality could be calculated for only four categories (see Appendix for validity criteria).

Also, in the NHDS, acute myocardial infarction (AMI) was moved to the first-listed diagnosis whenever it occurred with other circulatory diagnoses. This may partially explain differences for diagnosis groups ranked 2, 4, and 6 (coronary atherosclerosis, congestive heart failure [CHF], and AMI). The estimated number of AMI discharges is lower from the NIS than from the NHDS, although the difference is not significant. The estimated number of atherosclerosis and CHF discharges is higher from the NIS than from the NHDS, by 16 percent and 10 percent, respectively. Part of this difference could also be explained by a 17 percent higher estimate for the number of elderly (age 65+) discharges from the NIS.

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 diagnosis categories ranked 12, 40, and 46 (nonspecific chest pain, epilepsy and convulsions, and syncope).

Finally, some discrepancies may be explained by the low frequency of specialty hospitals in the NHDS compared to the NIS. In particular, it might explain the higher NIS estimate for the number of discharges for the diagnosis category ranked 48 (rehabilitation care).

Comparisons by Procedure Category

Table 8 lists the top 50 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 21 of the 50 categories; NIS estimates are significantly higher for 11 procedure categories, and significantly lower for 10 categories.

Procedures for which the NIS discharges were significantly higher than the NHDS estimates include the following: episiotomy, upper gastrointestinal endoscopy, transurethral prostatectomy (TURP), alcohol and drug rehabilitation, and coronary artery bypass graft (CABG). These differences may be explained by the estimated high number of discharges from large hospitals in the NIS compared to the NHDS (see Table 4). For example, the higher number of discharges with CABG as the first-listed procedure in the NIS may be explained by the fact that CABGs are more frequent at larger hospitals.

Similar factors could also explain differences in which the NIS estimates were lower than the NHDS. Of the 10 procedures that had significantly lower numbers of discharges in the NIS, most were broad CCHPR categories, such as other therapeutic procedures, other respiratory therapy, and physical therapy.

Significance tests were not performed for the in-hospital mortality rate estimates for the majority of categories due to the unavailability of valid standard errors for NHDS estimates (see Appendix).

Comparisons Between the NIS and MedPAR, 1991

Comparisons by Region

Table 9 compares the NIS and MedPAR for 1991 (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 15 percent. The NIS estimate for the South region exceeds the MedPAR count by 20 percent. This discrepancy could be explained, in part, by the undercount of managed care enrollees from the MedPAR database. This resulted in a total undercount of approximately 5 percent.

The NIS overall estimate of average length of stay is about 4 percent lower than the MedPAR average. The NIS estimate falls considerably short of the MedPAR average — by 12 percent in the Northeast, and 4 percent in the South — and exceeds the MedPAR average by 5 percent in the West. 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 overall estimate of in-hospital mortality is about 6 percent lower than the MedPAR rate. It is about 8 percent lower in the Midwest, 10 percent lower in the Northeast, and 3 percent lower in the South. Again, if the mortality rate is lower among HMO enrollees, their partial exclusion from the MedPAR database could provide an explanation for these differences.

Finally, the NIS overall estimate of average total charges is 6 percent higher than the MedPAR average. This discrepancy is driven largely by hospitals in the South and West (although the difference is not significant in the West). The NIS estimate is significantly higher — 15 percent — for the South. This could be explained by higher than average charges in Florida hospitals compared to other hospitals in the South.

Comparisons by Hospital Characteristics

Table 10 compares the NIS and MedPAR for 1991, by hospital characteristics. Except for average lengths of stay, few estimates were significantly different between the two sources.

For private/nonprofit hospitals, the NIS discharge estimate is considerably higher than the MedPAR count, by about 19 percent. For urban nonteaching hospitals, the NIS discharge estimate exceeds the MedPAR count by 13 percent. Although the difference is statistically significant only for these two hospital characteristics, the NIS discharge estimates are higher than the MedPAR count for nearly every hospital category.

The NIS estimated average length of stay is lower than the MedPAR average for every hospital category except government hospitals and small rural hospitals. In many cases the difference is statistically significant.

Although none of the NIS estimates of in-hospital mortality rates for hospital characteristics are notably different from the MedPAR rates, the NIS estimate for nearly every hospital category is lower than the MedPAR rate.

Similarly, although none of the NIS estimates of average charges for hospital characteristics are significantly different from the MedPAR averages, the NIS estimate for every hospital category is higher than the MedPAR average, except for investor-owned and small urban nonteaching hospitals.

The patterns in Table 10 indicate that inconsistencies between NIS estimates and MedPAR statistics are not limited to certain types of hospitals. Rather, the NIS estimates of average lengths of stay and in-hospital mortality tend to be lower than the MedPAR averages for most types of hospitals, and the NIS estimates of average total charges tend to be higher than the MedPAR averages for most types of hospitals.

Comparisons by Patient Characteristics

Table 11 compares the NIS and MedPAR for 1991, 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 about 15 percent higher than the MedPAR count for each patient group;

- the NIS average length of stay estimates are usually about 4 percent lower than MedPAR for each patient group;

- the NIS estimates of in-hospital mortality rates tend to be about 6 percent lower than the MedPAR rate for each patient group; and

- the NIS estimates of average total charges tend to be about 6 percent higher than the MedPAR average for each patient group.

Comparisons for the South, Rural, and Frontier Rural Locations

Table 12 compares estimates for the South, which is represented in the NIS only by Florida hospitals. The South was the only region for which estimated total Medicare discharges were significantly different from a statistical standpoint.

Table 13 compares estimates for rural locations. The same general patterns emerge for the South and rural locations as were evident for the U.S. as a whole. In particular, compared to the MedPAR, the NIS tends to overestimate discharges, underestimate average length of stay, underestimate in-hospital mortality rates, and overestimate average hospital charges across most hospital and patient groups.

Table 14 compares NIS estimates to MedPAR figures for frontier rural locations. Frontier rural hospitals are those located in counties with a population density of at most six persons per square mile. The NIS contains frontier rural hospitals only in the West. Overall, the NIS underestimates the number of frontier rural discharges by about 54,000 (71 percent). The MedPAR count of such Medicare discharges is very low for the South and Northeast. However, the count is about 25,000 discharges for the Midwest, none of which are represented in the NIS. The NIS severely underestimates the number of frontier rural Medicare discharges for all hospital and patient groups.

Comparisons by Diagnosis Category

Table 15 lists the top 50 diagnosis categories, ranked according to the NIS estimated number of Medicare discharges for each category. The NIS discharge estimates are significantly higher than the MedPAR counts for 27 of the 50 categories. The NIS estimated average length of stay is lower than the MedPAR average in all 50 categories, and is significantly lower for 38 of the 50 categories. The NIS estimates of in-hospital mortality rates are lower than the MedPAR rate for 40 of the 50 categories, and the NIS mortality rates differ significantly for 20 of the 50 categories. The NIS estimates of average total charges are higher than the MedPAR averages for 44 of the 50 categories, and are significantly different for 39 of the 50 categories.

These trends suggest that the differences between statistics calculated from the NIS and the MedPAR files tend to hold generally across patients in most diagnostic categories.

Comparisons by Procedure Category

Table 16 lists the top 50 procedure categories ranked according to the NIS estimated number of Medicare discharges for each category. For 29 of the 50 categories, the NIS discharge estimates are significantly higher than the MedPAR counts. In 38 categories, the NIS estimated average length of stay is lower than the MedPAR average, while the NIS estimate is significantly different for 22 of the 50 categories. For 41 of the 50 categories, the NIS estimates of in-hospital mortality rates are lower than the MedPAR rate, while the NIS mortality rates differ significantly for 19 of the 50 categories. The NIS estimates of average total charges are higher than the MedPAR averages for 49 of the 50 categories, and significantly different for 37 of the 50 categories.

These findings indicate that the discrepancies between statistics calculated from the two data sources hold across patients belonging to most procedure groups.

Comparisons Using Other Data Sources

The 11 NIS frame states were compared to all 50 states on four statistics reported in Table 17. On average, the NIS states tend to enroll a relatively larger share of their population in Medicaid as a percentage of their population below the poverty level. The NIS states' Medicaid payment rate for hysterectomy averages about two-thirds of the Medicare payment rate, which is consistent with the overall ratio across the 50 states. Hospital expenses per person average about 7 percent higher for NIS states than the average across all states. This may explain why the NIS estimates of average charges are about 6 percent higher than the MedPAR average for Medicare patients. The poverty rate average is slightly lower for the NIS states than for all 50 states.

Comparison with AHA Data

Table 18 demonstrates that hospital weights associated with the NIS yield hospital 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 19 demonstrates that, while the NIS hospital weights accurately weight sample hospitals back to the universe of rural hospitals, they do not accurately weight back to the universe of frontier rural hospitals. In particular, the NIS contains frontier rural hospitals only in the West region.

Tables 20 and 21 compare the mean and median of selected hospital-level measures taken from the 1988 AHA Annual Survey and the 1991 AHA Annual Survey, respectively, between the hospital-weighted sample frame and the hospital universe. The frame hospital weighted averages and medians appear to closely match the universe averages. The only notable discrepancy is in the percent of hospital days that are Medicaid days. In 1988, the frame average is 36 percent higher than the universe average, indicating that hospitals in the frame tend to have more Medicaid days of care than the number found in the universe of hospitals. However, this gap closed in 1991 with the addition of three frame states.

Table 22 repeats the statistics in Table 21 for rural and frontier rural hospitals. The agreement is good for rural hospitals. However, the discrepancies are substantial for frontier rural hospitals because they are under-represented in the NIS.

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, such as Florida being the only state in the NIS that represents the South. 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 HMO enrollees over 64 years of age, 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. While, in general, the overall estimates compare favorably with other data sets, breaking down the estimates by diagnosis and procedure groups yields some significant differences that could be attributable to:

- the fact that the NIS tends to have higher estimates of discharges for "large" hospital category (see Table 4), and that these patients may represent a somewhat different case-mix than those in large NHDS hospitals;

- disproportionate weight given to elderly patients in the NIS, probably due to Florida as the only representative of the South; and

- 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.

An important difference is the calculated in-hospital mortality rate for the South. The NIS estimate is higher than the NHDS estimate by 17 percent for 1988, and by 19 percent for 1991. This difference persists across various hospital groups and patient groups in the South. Consequently, Florida, the only NIS state in the South, seems to have a higher than average in-hospital mortality rate than other Southern states. This finding should be seriously considered when conducting mortality analyses with NIS data. To help remedy this shortcoming, more Southern states will be added to future versions of the NIS.

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, compared to the MedPAR the NIS seems to have:

- higher Medicare discharge counts by about 15 percent,
- lower Medicare average lengths of stay by about 4 percent,
- lower Medicare in-hospital mortality rates by about 6 percent, and
- higher Medicare charges by about 6 percent.

However, it is not clear how much of these discrepancies can be attributed to the limited sampling frame for the NIS, and how much can 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 our estimates for the number of Medicare discharges for each region from each of the four sources:

Table C: 1991 Medicare Discharges (Thousands)

Region	Data Source			
	NIS	NHDS	AHA	MedPAR
Total U.S.	11,814	11,091	10,895	10,256
Midwest	2,926	2,746	2,824	2,570
Northeast	2,617	2,520	2,469	2,321
South	4,580	4,209	3,929	3,811
West	1,691	1,616	1,673	1,554

The AHA estimates are based on the total number of Medicare discharges for the NIS universe of hospitals in the 1991 HCUP-3 calendar-year conforming AHA file.

An estimated 5 percent of Medicare stays were excluded from the 1991 MedPAR file because of the underreporting of HMO stays. This is somewhat consistent with the total AHA count exceeding the MedPAR count by 6.2 percent, as shown. Further, the NHDS estimates are in

substantial agreement with the AHA estimates, which indicates that the AHA provides a better, less biased estimate of the number of Medicare discharges than the MedPAR.

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

- in the Midwest by 3.6 percent,
- in the Northeast by 6.0 percent,
- in the South by 16.6 percent, and
- in the West by 1.1 percent.

The large discrepancy in the South is most likely because the NIS contains only Florida hospitals from the South.

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: 1991 Mortality Rates and Average Length of Stay

Region	Statistic	Data Source		
		NIS	NHDS	MedPAR
Total	ALOS (days)	8.40	8.56	8.77
	Mortality (%)	5.89	6.05	6.24
Midwest	ALOS (days)	8.05	8.35	8.00
	Mortality (%)	5.42	5.55	5.91
Northeast	ALOS (days)	10.02	10.13	11.38
	Mortality (%)	6.35	6.95	7.04
South	ALOS (days)	8.08	8.21	8.43
	Mortality (%)	6.04	5.97	6.24
West	ALOS (days)	7.38	7.36	6.99
	Mortality (%)	5.59	5.68	5.61

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, especially in the South, NIS estimates of other Medicare statistics may be relatively unbiased. One potential remedy for the bias in the number of discharges would be to develop Medicare-specific discharge weights from the AHA file. This would result in NIS estimates identical to the AHA estimates for the number of Medicare discharges. It would also result in different estimates of other NIS statistics. For example, the estimate of ALOS would put less weight on the South than the current set of weights does (3,929 thousand vs. 4,580 thousand discharges).

Conclusion

In summary, the NIS estimates of ALOS and in-hospital mortality appear to be unbiased in most contexts except for mortality in the South, which is biased upward. The NIS estimates for the number of Medicare discharges appear to be biased upward, particularly in the South. The NIS estimates for average hospital charges also appear to be biased upward in the South. The next version of the NIS will include hospitals from more Southern states than Florida, which should help decrease these biases for the South.

REFERENCES

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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 separately for 1988 and 1991. The standard error for the estimate of total discharges is:

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

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

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

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.