Department of Health and Human Services

OFFICE OF INSPECTOR GENERAL

NATIONAL DRG VALIDATION STUDY UPDATE: TECHNICAL REPORT

AUGUST 1992

OFFICE OF INSPECTOR GENERAL

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BOTEC Analysis Corporation prepared this report under the direction of Janet Wilson Knight. Contract information and project participants appear in appendices 1 and 2.

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EXECUTIVE SUMMARY

PURPOSE

This inspection reabstracted the International Classification of Diseases, 9th Edition, Clinical Modification (ICD-9-CM) codes from a sample of Medicare discharges on a blinded basis. It compared the resulting diagnosis-related group (DRG) to the hospital's DRG to determine over-reimbursement or under-reimbursement. The sample was nationally representative and covered all of calendar year 1988, the most recent data available.

This study updates a previous inspection from the Office of Inspector General (OIG). It found that 20.8 percent of 1985 Part A bills contained coding errors that changed the DRG and that 61.7 percent of these errors over-reimbursed the hospitals. This improper DRG "creep" increased total prospective-payment system (PPS) disbursements by 1.9 percent or $308 million.

FINDINGS

DRG coding error reduced: 14.7 percent of 1988 discharges had DRG coding errors. This proportion of coding errors was statistically significantly lower than the 20.8 percent reported for 1985.

DRG creep eliminated: 51 percent of DRG errors over-reimbursed the hospital and 49 percent under-reimbursed the hospital.

DRG coding errors, overall, no longer over-reimburse hospitals: Taken together, 1988 DRG errors had the net financial effect of under-reimbursing all hospitals a statistically non-significant $69.8 million, or 0.1 percent of the $52 billion in 1988 PPS disbursements. Projected nationally, over-reimbursements totaled $2,657.8 million and under-reimbursements totaled $2,588.0 billion.

Mis-specification errors under-reimbursed the hospitals: Of the 361 DRG errors in the sample, 63.2 percent occurred because the attending physician mis-specified the narrative diagnoses. Of these 227 mis-specification errors, only 43.2 percent over-reimbursed the hospitals. The statutorily-required attestation probably reminded physicians of their obligation to select accurate narrative diagnoses.

Resequencing errors over-reimbursed the hospitals: Of the 361 DRG errors in the sample, another 26.6 percent occurred because the hospital substituted a secondary diagnosis for the (correct, narrative) principal diagnosis. Of these 96 resequencing errors, 66.7 percent over-reimbursed the hospitals. The sentinel effect of the Peer Review Organizations surveillance apparently did not fully prevent over-reimbursement due to resequencing.

RECOMMENDATIONS

- **The Peer Review Organizations should continue their surveillance of hospital coding for DRG reimbursement accuracy.**

  The attestation requirement appears to have deterred over-reimbursement due to mis-specification by attending physicians, causing their hospitals to be under-reimbursed. However, the sentinel effect did not fully prevent over-reimbursement due to resequencing by hospitals. Although these two trends approximately offset each other, this equilibrium may not continue in the future.

  The Agency for Health Care Policy Research plans to reabstract the ICD-9-CM codes from a large sample of Medicare charts to determine their diagnostic accuracy for health services research purposes. Using 1991 data, grouping these ICD-9-CM codes to DRGs, and selecting reasons for any differences would provide a third time point with which to track trends in reimbursement accuracy. The OIG supports this effort.

AGENCY COMMENTS

In its May 29, 1992 comments to the draft of this inspection, the Health Care Financing Agency (HCFA) concurred with the OIG recommendation. The HCFA noted that the improvement in DRG coding accuracy may be attributable to increased hospital experience with PPS, PRO review, and HCFA educational efforts.

The HCFA also made a number of technical comments. Based on these comments, the OIG made several changes to this report. The full text of the HCFA comments appear as an appendix.

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INTRODUCTION

Since the inception of the Medicare program, health care expenditures have grown faster than the rest of the economy, and the Medicare program has grown even faster than general health care expenditures. The need for innovative reimbursement policies and their evaluation has become critical to medical communities, beneficiaries, and payers of the Medicare program.[1]

ORIGIN OF THE PRESENT STUDY

Since 1965, Medicare has provided hospital and medical insurance to the nation's elderly and disabled.[2] However, rapidly escalating health care costs coupled with a rise in the proportion of the population eligible for Medicare have burdened its hospital insurance trust fund (Part A). Health care costs accounted for 7.4 percent of the gross national product in 1970, 9.1 percent in 1980, and 10.9 percent in 1986. In 1970, Medicare paid 8 percent of all health care costs, but by 1986 Medicare's proportion increased to 17 percent.

In 1983 Congress changed Medicare inpatient reimbursement from a retrospective, reasonable-cost basis to a prospective-payment system (PPS).[3] Under the PPS, hospital payments depended upon the patient's diseases and procedures as defined by the International Classification of Diseases, 9th Edition, Clinical Modification (ICD-9-CM).[4] The PPS "grouped" various combinations of the approximately 10,000 ICD-9-CM codes into 470 (currently 476) diagnosis-related groups (DRGs).[5] By reimbursing the average cost of care for each DRG, the PPS provided incentives for efficient delivery of health care. The Veterans Administration Medical System Resource Allocation Method emulated this change.

A hospital files a claim for Medicare payment at the time of patient discharge. The attending physician writes the narrative diagnoses and procedures on the face sheet; and attests to the principal diagnosis, secondary diagnoses, and any procedures. The hospital's medical records department then assigns numeric, ICD-9-CM codes to the narrative diagnoses and procedures, using the rules of the Uniform Hospital Discharge Data Set (UHDDS), "a minimum data set used by HHS programs to collect data on individual hospital discharges on a continuing basis."[6] The hospital's billing department enters up to five diagnoses and three procedure codes on the Medicare claim form. A Fiscal Intermediary (FI) receives the hospital bills for each State. It runs GROUPER software to select the correct DRG by assessing diagnosis and procedure codes. It then runs PRICER software that adjusts for geographic location, teaching costs, and other factors to calculate the payment due to the hospital.

Since 1976 the Office of the Inspector General (OIG) has had responsibility for protecting the integrity of the programs and program beneficiaries of the U.S. Department of Health and Human Services (HHS).[7] Following this statutory mandate, the OIG commissioned the 1985 National DRG Validation Study (1985 Study), which examined how the processes that assigned diagnosis and procedure

codes affected the accuracy of PPS reimbursement for Medicare discharges.[8] The 1985 Study analyzed a representative, national sample of medical records to obtain information on the accuracy of the diagnosis and procedure coding, the impact of coding errors on DRG assignment, and the potential net financial impact of coding errors. It also assessed the appropriateness and quality of the services provided to Medicare patients.

The 1985 Study found an overall error proportion of 20.8 percent in assigning DRGs.[9] In 61.7 percent of the errors, the hospitals over-reimbursed themselves. Physicians' mis-specification of narrative diagnoses and hospital billing departments' resequencing of diagnoses caused most errors. These errors caused $308 million in overpayments to hospitals, 1.9 percent of 1985 PPS reimbursement.

The Health Care Financing Administration (HCFA), as the payer of the Medicare reimbursements, made the following points in commenting on the 1985 Study.

- The PPS started in 1983. The 1985 Study data covered FY 1985. Physicians, hospital coders, and Peer Review Organizations (PROs) needed a longer learning period to adjust to the new payment and quality monitoring system.

- The 1985 Study appeared in 1987, so that its conclusions derived in part from information and coding conventions that had undergone updating by that time.

- The HCFA and hospital associations recently had begun to conduct training seminars for hospital personnel. The HCFA therefore expected that coding errors would decrease over time.

To examine these trends, the OIG initiated this follow-up project, implemented through contracts with the Health Data Institute (HDI) of Lexington, Massachusetts; American Medical Records Association (AMRA) of Chicago, Illinois; and BOTEC Analysis Corporation (BOTEC) of Cambridge, Massachusetts using 1988 data. This DRG Validation Study Update (1988 Study) had the purpose of determining how the PPS's coding accuracy changed over time. The OIG designed this inspection to meet the following objectives.

- Replicate the 1985 work on coding accuracy, using 1988 data.

- Compare the findings from 1985 and 1988.

- Identify patterns of coding errors that PPS changes could modify.

As in the previous study, this inspection assessed how coding errors affected hospital reimbursement and identified the coding problems most subject to error. It evaluated hospital and beneficiary characteristics for their relative contribution to DRG errors.

1983-1988 GROUPER CHANGES

The HCFA annually updates the taxonomy by which the ICD-9-CM codes group to DRGs.[10 11 12 13 14 15 16 17] It seeks to improve the GROUPER's fairness without a negative effect on patient quality of care. The adjustments respond to comments and suggestions from providers and administrators who work with the PPS in the field. The HCFA adopted the following major changes to the GROUPER from 1985 to 1989.

DRG 471 (major joint procedures): In FY 1986, the HCFA created DRG 471 to include bilateral multiple major joint procedures.

DRG 433-438 (alcohol and drug abuse): In FY 1986, the HCFA completely reclassified these DRGs and dropped DRG 438. The exclusion of drug and alcohol treatment facilities from the PPS ended as of FY 1988 (October 1, 1987).

HIV codes: In FY 1986, the HCFA incorporated the newly created ICD-9-CM codes for HIV. This disease formerly fell into ICD-9-CM diagnosis code 279.19 (other deficiency of cell-mediated immunity) which grouped to DRGs 398 and 399 (immunity disorders). After 1986, AIDS grouped to infectious disease DRGs.

DRG 385 (newborn transfers): In FY 1987, the HCFA reclassified DRG 385 (neonates, died or transferred) so that it applied only to transfers to another acute care facility.

DRG 472 (burns): In FY 1987, the HCFA changed DRG 457 to "extensive burns without an operating room procedure" and created DRG 472 for "extensive burns with operating room procedures."

DRG 473 (leukemia): In FY 1987, the HCFA removed acute leukemia cases in patients over age 17 from DRGs 401-405 and placed them in the new DRG 473.

Age over 69: In FY 1988, the HCFA eliminated "age over 69" as a criterion in all of the DRG pairs in which "age over 69" and/or complication-comorbidity (CC) was a factor. The HCFA continues to use "age under 18" in certain pediatric DRGs and to use "age $\geq$ 35" in DRG 294 (diabetes) and "age 0-35" in DRG 295 (diabetes).

DRG 103 (heart transplant): This DRG did not have a relative weight assigned until FY 1988.

DRG 474 and DRG 475 (ventilators): In FY 1988, the HCFA created DRG 474 (respiratory system diagnosis with tracheostomy) and DRG 475 (respiratory system diagnosis with ventilator support) to separate the resource intensive ventilator cases from other respiratory DRGs.

Complication-comorbidity exclusions: In FY 1988, the HCFA implemented the exclusion list for complications and/or comorbidity, which is based on the principal diagnosis. The HCFA has made changes to this list each year.

DRG 468 (unrelated operating room procedures): Each year, the HCFA has further refined this DRG by assigning more of its procedure codes to other specific DRGs. In FY 1989, two new DRGs were created in order to split DRG 468 even further: DRG 476 (prostatic operating room procedure unrelated to principle diagnosis) and DRG 477 (non-extensive operating room procedure unrelated to principle diagnosis).

Surgical hierarchies: Every year, the HCFA examines the surgical hierarchies for the GROUPER computer software logic and makes numerous changes.

Each year, the relative weights change to reflect alterations in resource consumption, coding, surgical hierarchy, and further DRG refinements. The HCFA presently tends to expand the DRG list with more specificity in each DRG. This taxonomic splitting allows the providers and hospitals to account for resource utilization more accurately rather than averaging high and low utilization conditions in the same DRG, but at the cost of greater reimbursement complexity. The OIG has a more detailed description of GROUPER changes that it will supply upon request.

PAYMENT ISSUES

The 1985 Study alludes to two probable sources of DRG coding error: random human error and systematic bias inherent to the coding system. First, error occurs naturally in every human endeavor. Presumably, over the PPS's five years of operation, general knowledge of the coding process increases and the overall error rate decreases. Whether due to time pressure or want of education, any human coding errors should occur stochastically, not favoring either the hospitals or Medicare. However, the 1985 Study finds intentional "gaming" or manipulating the coding process, not random variability.[18] [19]

Second, the DRG coding system may have inherent contradictions that make errors and inaccuracies inevitable. Certain DRGs or their underlying ICD-9-CM codes have high frequencies of coding error. For example, DRG 99 (respiratory signs and symptoms) has a high error rate because of it lacks a definite diagnosis and represents a cluster of symptoms. The DRG system may "build in" this type of variation.

In addition, some commentators propose modifying the PPS to adjust for severity of illness.[20] This modification measurement would increase the precision with which relative weights model actual resource consumption. However, unpublished data submitted to the HCFA indicates that severity reduces DRG variance by only one-third. In addition, collecting sufficient clinical data to quantify severity imposes significant transaction costs.

The PPS could also systematically overpay or underpay certain classes of hospitals. The most complicated and resource-intensive procedures, such as organ transplants, are rarely scheduled in small, nonmetropolitan hospitals. They therefore have no opportunity for the substantial reimbursement (or under-reimbursement) that accompanies such services. Conversely, medium-sized hospitals may attempt such procedures but with relative inefficiency compared to the higher volume at large, metropolitan, teaching hospitals.

METHODOLOGY

The 1988 National DRG Validation Study Update used essentially the same methods as its predecessor study.

SAMPLE DESIGN

The initial study population consisted of the 10.8 million Medicare funded discharges for calendar year 1988 from the 6,715 acute care, short-stay hospitals in the United States.[21] The design then excluded discharges from specialty institutions such as children's hospitals, tuberculosis units, and psychiatric facilities. It also excluded discharges in Maryland and New Jersey, which were still exempt from the PPS in 1988. It covered final bills only, omitting interim bills. It excluded bills for pediatric, obstetric, and psychiatric DRGs (principally drug and alcohol rehabilitation performed by a general hospital). Unlike its fiscal year (FY) 1985 predecessor, it included hospitals established since the advent of PPS in 1983.

The HCFA required two quarters following the close of a year to accumulate bills paid by its fiscal intermediaries and combine the reimbursement data into computer files. This administrative data consolidation imposed a continuous lag on the availability of information defining the study population. Accordingly, billing data for CY 1988 became available in the middle of 1989.

The 1988 National DRG Validation Study Update used a two-step, non-clustered sampling procedure. The first step selected all bills whose Health Insurance Claim (HIC) numbers terminated in 95, a one percent, simple, random sample (SRS) of all Medicare billing records for calendar year (CY) 1988. The OIG screened out interim bills, exempt States, non-acute care hospitals, and nongeriatric DRGs as described above (n=88,455). Starting from a random seed, the second step systematically sampled 1 out of every 33 of the billing records selected in the first step for a final sample size of 2,680. This process resulted in a self-weighting SRS. Oversimplified, each sample billing record represented 3,300 billing records in the total population of billing records.

These discharges came from 1,744 hospitals, 26.0 percent of the acute care, short-stay hospitals that accept Medicare patients. The hospitals represented 47 of the 54 States or other jurisdictions (District of Columbia, Puerto Rico, Guam, Virgin Islands) that the HCFA recognizes. Since there was no stratification or clustering, most hospitals

contributed only one discharge to the sample. No hospital contributed more than nine discharges.

DATA COLLECTION

The OIG ran SAS on the HCFA's mainframe IBM 3090 to sort the sample by HCFA hospital identification numbers and match-merge the sample with the HCFA file of provider addresses. It then used WordPerfect software running on a Zenith Z-248 personal computer to produce mailing labels and "personalized" letters from the resulting address file. Each letter requested that the hospital's medical records department send complete copies of the sampled medical records to the OIG's contractor, HDI. Each mailing included a franked, addressed envelope and promised to reimburse the hospital 10¢ per page for its copying costs. The OIG made additional mailings and the HDI made follow up telephone calls to those medical records departments which did not provide the requested records. Although phrased as a request, all contacts communicated that hospital participation was mandatory.

The majority of hospitals promptly supplied the requested medical records. Four hospitals declined to participate as requested, so the OIG issued subpoenas compelling their cooperation. Medical records departments could not provide 229 sampled records principally because they were missing, destroyed, or otherwise physically unavailable.

The OIG contracted (HHS-100-86-0054) with the HDI to log-in and secure the arriving medical records. The HDI matched medical records to the sample billing records, checked medical records for completeness and legibility, inserted each medical record in an individually labeled folder, and counted the pages to be reimbursed. It also followed up incomplete medical records and handled similar administrative obstacles.

Unfortunately, a change in ownership and reorganization of Baxter, the parent company of the HDI, delayed some payments to hospitals. Although both the HDI and this contract apparently garnered profits for the parent, Baxter elected to disband the HDI for insufficient profitability. The HDI ceased operations prior to completing its contracted tasks, compelling the government to terminate the HDI contract for default.

DRG REABSTRACTION

The HDI transmitted the accumulated records to the AMRA. The OIG separately contracted (HHS-100-89-0022) with the AMRA to reabstract the ICD-9-CM codes supported by the medical record, select the principal diagnosis, and group to select the DRG. To ensure that the original ICD-9-CM codes and DRGs did not affect the AMRA's reabstraction, the AMRA coders conducted this reabstraction without knowledge of the original ICD-9-CM codes and DRGs. The AMRA also identified

the reasons why a hospital's bill differed from the correct codes. Finally, it entered its reabstracted codes into a personal computer database provided by the OIG.

As the credentialing body for medical records practitioners the AMRA had expert knowledge of coding intricacies and access to nationally recognized RRAs (Registered Records Administrators) and ARTs (Accredited Records Technicians) who were experienced ICD-9-CM coders. Unlike most other organizations that employed expert coders, the AMRA was (and is) independent of the hospital industry. The AMRA used the official HCFA GROUPER software (3M's Codefinder) to determine the DRG for each reabstracted record. The AMRA compared the DRGs that Codefinder produced from the reabstracted ICD-9-CM codes with the DRGs supplied by providers and noted the results of these comparisons in the database.

An RRA who was a nationally recognized expert in ICD-9-CM coding and who had not participated in the initial reabstraction reviewed all records where the AMRA DRG differed from the provider DRG. The AMRA then grouped the revised codes and made the appropriate changes in the database. The OIG also contracted with a physician with current knowledge of coding and clinical issues (SA-90-0633) to identify the principal diagnosis, secondary diagnosis, and appropriate procedures in cases where the resultant DRG differed from the provider's DRG (whether the same as the initial AMRA coder or different from both the initial AMRA coder and provider).

An RRA who had not been involved in the initial reabstraction and coding or the expert review compared all records reviewed by the physician to the provider's data and the AMRA's data. Where the physician had agreed with the AMRA, the AMRA did not change the database. Where the physician had agreed with the provider and provided additional information overlooked by the AMRA or provided special insight with which the third RRA agreed, the AMRA changed the database to reflect the codes of the DRG of the provider. Where the third reviewer was not convinced that there should be a change from the AMRA's coding and DRG assignment, the OIG medical officer reviewed the case and made a final determination. The AMRA entered this determination as the final code and DRG determination.

The AMRA also classified every coding error as mis-specification, miscoding, resequencing, or "other." The AMRA entered its coding selections into a series of database files. Its small personal computers could not hold all its coding output at once. Computer experts from the OEI's office in Region V helped the AMRA set up and maintain the databases. Upon completion of the AMRA reabstraction and data entry, the OIG-OEI-Region V office off-loaded the files for transmission to headquarters.

ANALYSIS

The OIG contracted with BOTEC (HHS-100-90-0023) to analyze the results of AMRA's reabstraction of ICD-9-CM codes and DRGs. BOTEC has extensive experience in the statistical analysis of reabstracted data. It has conducted such

analyses for OIG on several previous occasions (HHS-100-89-0019, HHS-100-88-0019, HHS-100-88-0624). BOTEC's work in this area has included the processing of medical records, the construction of reabstraction databases, the statistical analysis of reabstraction data, and policy analysis.

The OIG provided BOTEC with a SAS data set containing merged billing records and the AMRA reabstraction data. The OIG also provided BOTEC with a spreadsheet file containing DRG weights for all DRGs for the years 1985 through 1989. Finally, the AMRA provided BOTEC with an updated set of reabstraction data and billing record data that contained additional information.

BOTEC match-merged these three data sets into one comprehensive SAS data set. At this point BOTEC constructed simple frequency distributions of all variables and cross-tabulations of certain pairs of variables to examine the data set for incorrect or inappropriate codes and/or logical inconsistencies. All such ambiguities were resolved or corrected in consultation with the OIG.

BOTEC then used SAS to create several additional variables that the current analysis required. These variables include exact age of patient at the time of admission, change in DRG weight as a result of reabstraction, location of provider (metropolitan if in an Standard Metropolitan Area, nonmetropolitan if not), teaching status of provider (teaching if the hospital had any interns, nonteaching otherwise), controlling agency of provider, and bed size of provider (small if 1-99 beds, medium if 100-299 beds, and large if 300 or more beds). Throughout this process BOTEC kept electronic and printed copies of the programs used to create intermediate data sets, documentation of these data sets, and the data sets themselves.

BOTEC began its analysis of the 1988 calendar year data by ensuring that the sample accurately represented the population from which it was drawn with respect to both provider and patient demographics. It compared the distribution of billing records in the 1988 sample with the population of billing records from which it was drawn using the variables provider size, location, control, and teaching status and patient age, sex, and race. BOTEC used a σ statistic to reject the null hypothesis that the distributions were different.

Hospitals were unable to provide medical records for 229 billing records in the original sample. This 8.5 percent nonresponse rate could have introduced systematic bias into the sample. BOTEC therefore repeated the tests for representativeness to determine whether there were differences in the distributions of responses and nonresponses. It also retested for representativeness using the same procedures as before, but with nonresponses removed. This slightly smaller sample still accurately represented the general population.

BOTEC then conducted "breakdown" analyses for a series of dependent variables. In the first analysis it constructed a cross-tabulation table by cross-tabulating the four provider demographic categories. The resulting table contained 144 cells. For each

cell BOTEC calculated and displayed for a given dependent variable that variable's mean, standard error, and the number of cases in the cell.

In the second "breakdown" analysis BOTEC constructed a cross-tabulation table by cross-tabulating the three patient demographic categories. The resulting table contained 75 cells. Again, for each cell BOTEC calculated and displayed the dependent variable's mean, standard error, and number of cases. By examining the eight resulting tables for confidence intervals which had little or no overlap, BOTEC determined which provider and patient demographics has a significant impact on these dependent variables.

BOTEC conducted three additional analyses on the 1988 data. The first estimated the total financial impact of DRG errors by hospital and patient demographics. The second analysis examined DRGs to determine which DRGs seemed to present the most coding difficulty. The third analysis estimated the financial impact of DRG errors by DRG.

To estimate the total financial impact of DRG miscoding by demographic categories, BOTEC multiplied the mean change in case mix index by Medicare standardized amount in 1988 for each cell in the analysis tables. This was an estimate of the mean change per bill in each cell. BOTEC then multiplied this by the number of bills in each cell to get an estimate of the overall financial impact of DRG errors within each cell. They also calculated standard errors of these estimates.

To estimate which DRGs represented the most coding difficulty BOTEC organized DRGs in the 1988 sample by several different criteria: by frequency of occurrence in the sample, by errors in DRG group, and by relative weight change.

To estimate the financial impact of DRG miscoding by DRG, BOTEC multiplied the mean change in case mix index by Medicare standardized amount in 1988 for each observation in the sample and by the weight which each observation represents in the population from which the sample was drawn. The mean by DRG was then calculated to give an estimate of the overall financial impact of DRG errors for each DRG. BOTEC also calculated standard errors of these estimates. A fuller description of the calculation formulas appears in Appendix 3.

REPRESENTATIVENESS

The final sample of 2,451 medical records accurately represented the characteristics of the underlying population. Distributed by hospital demography, it did not differ from the population in bed size, teaching status, location, or control. [Table 1].

The sample also accurately represented the underlying population by patient age and sex. However, the OIG made remedial efforts to classify unknowns by race. This match to other government files reduced the proportion of sample unknowns in comparison to the underlying population.[22] The volume of cases precluded a similar

reclassification of unknowns for the entire population. Without the OIG's reclassification, the sample would also have conformed to racial distribution of the underlying population.

Comparing the 2,680 "selected" discharges with the population of all CY 1988 Medicare discharges (minus the exclusions for specialty institutions, exempt States, and specialty DRGs) revealed no significant differences in hospital or patient demography, except for the OIG's remedial efforts to classify unknowns by race. [Appendix 4].

The representativeness verification also checked for response bias by comparing the 2,451 "sample" discharges with the 229 nonsample discharges, excluded because no medical records matched to these bills. Larger hospitals lost significantly more of their records than did smaller hospitals. The more voluminous and complex medical records systems of larger hospitals probably offered greater opportunity for charts to disappear: more personnel had access to the files, more departments requested the charts, larger record rooms had more shelves on which to misfile charts, more patients had the same names, etc. [Appendix 5].

Unsurprisingly, response bias also occurred for hospital demographic characteristics that correlated with hospital size. Metropolitan hospitals and teaching hospitals tended to have more beds.

Hospital demography	Medicare n [%]	Responses n [%]
1-99 beds	1,333,250 [14.2]	359 [14.6]
100-299 beds	3,454,578 [36.3]	893 [36.4]
300+ beds	4,718,527 [49.6]	1,199 [48.9]
Chi-square 0.9, 2 df, P=0.626.		
Teaching	4,076,175 [42.9]	1,008 [41.1]
Non-teaching	5,430,180 [57.1]	1,443 [58.9]
Chi-square 3.1, 1 df, P=0.080.		
Profit	1,022,922 [10.8]	272 [11.1]
Nonprofit	6,858,338 [72.1]	1,769 [72.2]
Government	1,625,095 [17.1]	410 [16.7]
Chi-square 0.5, 2 df, P=0.798.		
Metropolitan	7,270,147 [76.5]	1,845 [75.3]
Non-metropolitan	2,236,208 [23.5]	606 [24.7]
Chi-square 2.0, 1 df, P=0.161.		
Patient demography		
0-64 years	940,650 [9.9]	232 [9.5]
65-74 years	3,932,293 [41.4]	1,007 [41.1]
75-84 years	3,263,952 [34.3]	854 [34.8]
85+ years	1,369,466 [14.4]	358 [14.6]
Chi-square 0.8, 3 df, P=0.860.		
Male	4,304,256 [45.3]	1,094 [44.6]
Female	5,202,105 [54.7]	1,357 [55.4]
Chi-square 0.4, 1 df, P=0.523.		
White	8,261,646 [86.9]	2,205 [90.0]
Black	827,204 [8.7]	188 [7.7]
Other	150,380 [1.6]	35 [1.4]
Unknown	267,131 [2.8]	23 [0.9]
Chi-square 30.9, 3 df, P<0.0001.		
Total	9,506,361* [100.0]	2,451 [100.0]

*. Hospital demography totals to 9,506,365 because six bill lacked data on hospital control.

Table 1: Representativeness of sample bills by hospital and patient demography, 1988

Therefore, they also had more nonresponses. The response bias in metropolitan (Mantel-Haenszel 1.6, 1 df, P=0.20) and teaching hospitals (Mantel-Haenszel 1.4, 1 df, P=0.23) disappeared upon controlling for hospital size. In contrast, hospital control produced no significant response bias.

No response bias occurred with respect to age or sex. The OIG's reclassification of unknowns identified significantly more whites. Controlling for hospital size did not remove this nonresponse bias. However, upon excluding nonresponses, the sample still accurately represented all discharges with respect to hospital demographic characteristics.

FINDINGS

DRG CODING ERROR REDUCED

Upon blinded ICD-9-CM reabstraction, 14.7 ± 0.7 percent of discharges had coding errors that changed their DRGs. The standard error of 0.7 indicated this point estimate to be quite precise, a secondary effect of the sample size. This proportion was significantly lower than the 20.8 ± 0.5 percent errors found in 1985 (1985-1988 difference = 0.061, 95% CI 0.043 to 0.079). [Table 2].

No hospital demographic characteristics had a significant effect upon the proportion of DRG coding errors. Smaller hospitals appeared to have higher proportions of miscodes, but this apparent difference did not attain statistical significance. [Appendix 6].

Similarly, no patient characteristics significantly affected the proportion of DRG coding errors. Younger patients appeared to have higher error rates, but this difference also failed to attain statistical significance. [Appendix 7].

Crosstabulations of demographic characteristics for interaction potential identified no credible effects. [Appendix 8].

EQUAL NUMBERS OF DRG ERRORS OVER-REIMBURSE AND UNDER-REIMBURSE

The 361 DRG errors divided evenly between errors that had over-reimbursed the hospital (50.7 ± 2.6 percent) and under-reimbursed the hospital (49.3 percent). This inspection's proportion of over-reimbursements differed significantly

Hospital demography	Proportion ± standard error	(n)
1-99 beds	17.0 ± 1.9	(359)
100-299 beds	14.9 ± 1.2	(893)
300+ beds	13.9 ± 1.0	(1,199)
Chi-square 2.1, 2 df, P=0.351. Phi 0.029.		
Teaching	15.5 ± 1.1	(1,008)
Nonteaching	14.2 ± 0.9	(1,443)
Chi-square 0.8, 1 df, P=0.383. Phi 0.018.		
Profit	17.3 ± 2.3	(272)
Nonprofit	14.1 ± 0.8	(1,769)
Government	15.6 ± 1.8	(410)
Chi-square 2.2, 2 df, P=0.339. Phi 0.030.		
Metropolitan	14.9 ± 0.8	(1,845)
Nonmetropolitan	14.4 ± 1.4	(606)
Chi-square 0.1, 1 df, P=0.766. Phi 0.006.		
Patient demography		
0-64 years	16.4 ± 2.4	(232)
65-74 years	14.9 ± 1.1	(1007)
75-84 years	14.6 ± 1.2	(854)
85+ years	13.4 ± 1.8	(358)
Chi-square 1.0, 3 df, P=0.794. Phi 0.020.		
Male	14.5 ± 1.1	(1094)
Female	14.9 ± 1.0	(1357)
Chi-square 0.1, 1 df, P=0.807. Phi 0.005.		
White	14.8 ± 0.8	(2205)
Black	14.4 ± 2.6	(188)
Other	14.3 ± 6.0	(35)
Unknown	8.7 ± 6.0	(23)
Chi-square 0.7, 3 df, P=0.871. Phi 0.017.		
Total	14.7 ± 0.7	(2451)

Table 2: Proportion of coding errors by hospital and patient demography, 1988

from the 61.7 ± 1.4 percent for 1985 (1985-1988 difference = 0.110, 95% CI 0.051 to 0.168). [Table 3].

For-profit hospitals over-reimbursed themselves the more than did other types of hospitals. However, these differences did not attain statistical significance. This trend applied across all hospital characteristics. The direction of coding error also exhibited no significant trend by patient characteristics. This result suggested that little net over-reimbursement occurred because of coding direction.

DRG CREEP ELIMINATED

This inspection used the case-mix index (CMI) to calculate the overall financial effect of DRG coding errors. The CMI quantified the complexity of PPS discharges by annually averaging the relative weights of all bills submitted by each hospital. Those hospitals with higher mean relative weights served Medicare patients with more complex conditions and that therefore consumed more resources. This inspection calculated CMI as (1) submitted to the FIs for reimbursement, (2) reabstracted by the AMRA on a blinded basis, and (3) the difference or mean weight change due to coding inaccuracy.

Hospital demography	Over-reimbursed n [%]	Under-reimbursed n [%]	Total n [%]
1-99 beds	31 [50.8]	30 [49.2]	61 [100.0]
100-299 beds	71 [53.4]	62 [46.6]	133 [100.0]
300+ beds	81 [48.5]	86 [51.5]	167 [100.0]
Chi-square 0.7, 2 df, P=0.703. Phi 0.044.			
Teaching	79 [50.6]	77 [49.4]	156 [100.0]
Nonteaching	104 [50.7]	101 [49.3]	205 [100.0]
Chi-square 0.0, 1 df, P=0.986. Phi 0.001.			
Profit	27 [57.4]	20 [42.6]	47 [100.0]
Nonprofit	123 [49.2]	127 [50.8]	250 [100.0]
Government	33 [51.6]	31 [48.4]	64 [100.0]
Chi-square 1.2, 2 df, P=0.577. Phi 0.055.			
Metropolitan	138 [50.4]	136 [49.6]	274 [100.0]
Nonmetropolitan	45 [51.7]	42 [48.3]	87 [100.0]
Chi-square 0.1, 1 df, P=0.825. Phi -0.012.			
Patient demography			
0-64 years	17 [44.7]	21 [55.3]	38 [100.0]
65-74 years	77 [51.3]	73 [48.7]	150 [100.0]
75-84 years	66 [52.8]	59 [47.2]	125 [100.0]
85+ years	23 [47.9]	25 [52.1]	48 [100.0]
Chi-square 0.9, 3 df, P=0.817. Phi 0.051.			
Male	85 [53.5]	74 [46.5]	159 [100.0]
Female	98 [48.5]	104 [51.5]	202 [100.0]
Chi-square 0.8, 1 df, P=0.351. Phi -0.049.			
White	166 [50.8]	161 [49.2]	327 [100.0]
Black	14 [51.9]	13 [48.1]	27 [100.0]
Other	2 [40.0]	3 [60.0]	5 [100.0]
Unknown	1 [50.0]	1 [50.0]	2 [100.0]
Chi-square 0.2, 3 df, P=0.970. Phi 0.026.			
Total	183 [50.7]	178 [49.3]	361 [100.0]

Table 3: Direction of DRG errors by hospital and patient demography, 1988

Hospital demography	Mean ± standard error Before	After	Change	(n)
1-99 beds	1.0914 ± 0.0312	1.0889 ± 0.0312	-0.0025 ± 0.0139	(359)
100-299 beds	1.3285 ± 0.0314	1.3335 ± 0.0311	0.0049 ± 0.0116	(893)
300+ beds	1.3576 ± 0.0289	1.3595 ± 0.0285	0.0019 ± 0.0106	(1,199)
Teaching	1.3851 ± 0.0327	1.3841 ± 0.0322	-0.0010 ± 0.0125	(1,008)
Nonteaching	1.2542 ± 0.0222	1.2590 ± 0.0222	0.0047 ± 0.0081	(1,443)
Profit	1.3112 ± 0.0605	1.3274 ± 0.0621	0.0162 ± 0.0207	(272)
Nonprofit	1.3304 ± 0.0226	1.3333 ± 0.0223	0.0028 ± 0.0085	(1,769)
Government	1.2095 ± 0.0383	1.2005 ± 0.0378	-0.0090 ± 0.0145	(410)
Metropolitan	1.3479 ± 0.0230	1.3508 ± 0.0227	0.0029 ± 0.0086	(1,845)
Nonmetropolitan	1.1868 ± 0.0293	1.1874 ± 0.0291	0.0006 ± 0.0107	(606)
Patient demography				
0-64	1.2958 ± 0.0644	1.3249 ± 0.0655	0.0291 ± 0.0215	(232)
65-74	1.3769 ± 0.0329	1.3632 ± 0.0319	-0.0137 ± 0.0120	(1,007)
75-84	1.2535 ± 0.0291	1.257 ± 0.0292	0.0035 ± 0.0110	(854)
85+	1.2523 ± 0.0374	1.2799 ± 0.0392	0.0275 ± 0.0161	(358)
Male	1.3613 ± 0.0298	1.3589 ± 0.0294	-0.0024 ± 0.0109	(1,094)
Female	1.2651 ± 0.0240	1.2713 ± 0.0238	0.0062 ± 0.0090	(1,357)
White	1.3180 ± 0.0201	1.3192 ± 0.0199	0.0012 ± 0.0074	(2,205)
Black	1.1838 ± 0.0544	1.1865 ± 0.0537	0.0026 ± 0.0241	(188)
Other	1.4152 ± 0.1598	1.4890 ± 0.1603	0.0737 ± 0.0538	(35)
Unknown	1.2028 ± 0.1769	1.2053 ± 0.1762	0.0025 ± 0.0097	(23)
Total	1.3080 ± 0.0188	1.3104 ± 0.0186	0.0023 ± 0.0070	(2,451)

Table 4: Estimated case-mix index change by hospital and patient demography, 1988

After reabstraction, the CMI increased 0.0023 ± 0.0070, not a statistically significant difference. Hospitals slightly under-reimbursed themselves. This CMI increase differed significantly from the previous inspection's over-reimbursement, a 0.0194 ± 0.0060 CMI decrease (1985-1988 difference = 0.0171, 95% CMI 0.0158 to 0.0184). [Table 4].

This inspection found that only small, teaching, and government hospitals continued to over-reimburse themselves. [Appendix 13]. Smaller and government institutions had lower absolute CMIs, while teaching institutions had higher absolute CMIs. [Appendices 9 and 11].

Discharges of patients aged 65-74 and males over-reimbursed the hospitals. [Appendix 14]. These groups of patients also had higher absolute CMIs than other patient demographic categories. [Appendices 10 & 12].

DRG OVER-REIMBURSEMENT ELIMINATED

Extrapolating this inspection's results to all 10.8 million bills, Medicare under-reimbursed hospitals by $69.8 million. This difference amounted to only 0.1 percent of the $52 billion in 1988 PPS expenditures.[23] In contrast, the previous inspection found PPS over-reimbursement of $308 million or 1.9 percent of 1985 PPS disbursements. [Table 5].

Hospital and patient demographic trend largely paralleled this trend. Small, teaching, and government hospitals received up to $70.8 million in over-reimbursement from DRG coding errors. [Appendices 15 and 16].

Hospital demography	$ million ± standard error	Number of bills
1-99 beds	-14.8 ± 51.5	1,333,250
100-299 beds	59.4 ± 121.5	3,454,578
300+ beds	26.0 ± 156.3	4,718,527
Teaching	-13.4 ± 158.9	4,076,175
Nonteaching	80.1 ± 131.0	5,430,180
Profit	51.0 ± 62.2	1,022,922
Nonprofit	58.8 ± 180.9	6,858,338
Government	-42.6 ± 69.2	1,625,095
Metropolitan	67.0 ± 195.4	7,270,147
Nonmetropolitan	3.6 ± 63.4	2,236,208
Patient demography		
0-64	80.5 ± 62.7	940,650
65-74	-171.4 ± 145.5	3,932,293
75-84	46.9 ± 109.7	3,263,952
85+	113.9 ± 66.4	1,369,466
Male	-30.8 ± 144.2	4,304,256
Female	99.0 ± 144.0	5,202,105
White	32.7 ± 188.1	8,261,646
Black	6.4 ± 62.2	827,204
Other	32.4 ± 24.5	150,380
Unknown	2.8 ± 7.7	267,131
Total	69.8 ± 203.5	9,506,361

Table 5: Net financial change by hospital and patient demography, 1988

MIS-SPECIFICATION UNDER-REIMBURSES, WHILE RESEQUENCING OVER-REIMBURSES

Each stage of the reimbursement process had the potential for introducing error into the PPS. When performing its reabstractions, the AMRA identified the reason for each DRG error.

Mis-specification: The attending physician wrote down the wrong narrative diagnoses or procedures on the attestation.

Miscoding: The medical records department selected an incorrect ICD-9-CM, numeric code for a correct attestation.

Resequencing: The billing department substituted a secondary diagnosis for the correct, principal diagnosis.

Reason	Subtotal n [%]	Total n [%]
MIS-SPECIFICATION		227 [63.2]
Changed principal diagnosis	75 [20.8]	
Altered principal diagnosis, more or less specific	30 [8.3]	
Added complication-comorbidity or other diagnosis	46 [12.7]	
Deleted complication-comorbidity or other diagnosis	36 [10.0]	
Added operating room procedure	19 [5.3]	
Deleted operating room procedure	14 [3.9]	
Changed operating room procedure	7 [1.9]	
MISCODING		33 [9.1]
Change due to ICD-9-CM rule	30 [8.3]	
Change due to ICD-9-CM rule, changed C.C. status	1 [0.3]	
Change due to ICD-9-CM rule, changed OR status	2 [0.6]	
RESEQUENCING		96 [26.6]
Moved secondary diagnosis to first diagnosis	71 [19.7]	
Changed codes to more or less specific	15 [4.2]	
ICD-9-CM code differs	10 [2.8]	
OTHER		5 [1.4]
Changed destination	1 [0.3]	
Provider-FI made data entry error in DRG	4 [1.1]	
TOTAL		361 [100.0]

Table 6: Reasons for errors affecting DRG assignment, 1988

In addition, 1,352 other coding changes did not alter the DRG and did not count as errors for the purposes of this study. [Table 6].

Narrative changes accounted for 63.2 percent of DRG errors. Examples of mis-specification included writing down the wrong principal diagnosis; selecting too nonspecific a principal diagnosis; and adding or deleting a complication, comorbidity, or operating room procedure.

Miscoding made up 9.1 percent of the DRG errors. These changes primarily took the form of changes in the principal diagnosis, rather than of complications, comorbidities, or operating room procedures. A few errors represented the AMRA reviewers disagreeing with the providers' assigned discharge destinations or apparent typographical errors.

Resequencing comprised 26.6 percent of the DRG errors. In all cases, the AMRA reviewers in all cases disagreed with the providers listing sequence. In most cases, the

billing department had substituted a secondary diagnosis for the correctly attested and coded principal diagnosis. In other cases, the diagnosis should have been more specific. ICD-9-CM ruling changes accounted for the remaining sequence changes.

Mis-specification significantly under-reimbursed hospitals; while resequencing significantly over-reimbursed them. Thus, the attending physicians select their patients' diagnoses and procedures with caution, earning their hospitals less reimbursement than they should have received. The billing department behaved more aggressively, obtaining greater reimbursement that the PPS entitled their employers to receive. Either the hospitals had greater influence over employees, or the employees identified closely with the economic interests of the hospital. The attestation requirement apparently deterred upcoding due to mis-specification, but the sentinel effect of Peer Review Organization surveillance did not fully prevent over-reimbursement due to resequencing. [Table 7].

n [%]	Over-reimbursed	Under-reimbursed	Total
Mis-specification	98 [43.2]	129 [56.8]	227 [100.0]
Miscoding	18 [54.5]	15 [45.5]	33 [100.0]
Resequencing	64 [66.7]	32 [33.3]	96 [100.0]
Other	3 [60.0]	2 [40.0]	5 [100.0]
Total	183 [50.7]	178 [49.3]	361 [100.0]

Chi-square 15.3, 3 df, P=0.002. Phi 0.206.

Table 7: Reason for DRG changes by direction of DRG change, 1988

These two trends, mis-specification resulting in under-reimbursement and resequencing causing over-reimbursement, offset each other. So, overall hospitals received the correct reimbursement. This inspection cannot predict whether this equilibrium will continue in the future.

CERTAIN DRGS ARE MORE SUSCEPTIBLE TO ERROR

In this random sample of discharges, vascular disorders such as heart failure, angina, stroke, and arrhythmias cause Medicare hospitalizations most frequently. Overall, 28 of the 476 DRGs accounted for half of the total bills, and 10 DRGs accounted for 28.1 percent of all bills. Most coding errors fell into these DRGs, but not in direct ratio to the DRGs' volume. [Table 8].

This report identified DRGs with high proportions of coding errors by dividing the number of errors by the frequency of bills for specific DRGs. Many of these DRGs covered vague or nonspecific diagnoses such as atherosclerosis (DRG 132), other circulatory system procedures (DRG 120), respiratory signs and symptoms (DRG 99), and other nervous system disorders (DRG 34). This indeterminateness suggests inherent ambiguities in medical taxonomy. For example, DRG 99 includes apnea, dyspnea, hemoptysis, hypercapnia, pleurodynia, stridor, and ventilatory failure. [Table 9].

#	DRG description	n [%]
127	Heart failure and shock	133 [5.4]
140	Angina pectoris	89 [3.6]
14	Specific cerebrovascular disorders except TIA	75 [3.1]
89	Simple pneumonia	74 [3.0]
182	Esophagitis, gastrointestinal, and miscellaneous digestive disorders	66 [2.7]
96	Bronchitis and asthma with complications	63 [2.6]
209	Major joint procedure	55 [2.2]
15	Transient ischemic attacks	47 [1.9]
138	Cardiac arrhythmia and conduction disorders	45 [1.8]
296	Nutritional and miscellaneous metabolic disorders with complications	44 [1.8]
	Other	1,760 [71.8]
	Total	2,451 [100.0]

Table 8: DRGs billed most frequently, 1988

#	DRG description	n	Miscoded Number [%]
132	Atherosclerosis	4	3 [75.0]
413	Myeloproliferative	3	4 [66.7]
185	Dental except extractions	3	2 [66.7]
120	Other circulatory system procedures	2	3 [66.7]
99	Respiratory signs and symptoms	8	5 [62.5]
403	Lymphoma and nonacute leukemia	5	3 [60.0]
34	Other nervous system disorders	5	3 [60.0]
	Other	2,420	341 [14.1]
	Total	2,451	361 [14.7]

Table 9: DRGs with high proportions of coding errors, 1988

Over-reimbursement concentrated in selected DRGs and certain types of hospitals. This report identified DRGs with maximum savings potential by multiplying the error frequency by reimbursement change for each DRG. Although this inspection found no overall over-reimbursement to hospitals, certain DRGs still significantly over-reimbursed the hospitals. In particular, 13 DRGs each had over $20 million in projected overpayments. This group consisted primarily of DRGs with operating room procedures, probably because of their high relative weights. [Table 10].

Additionally, small and for-profit hospitals made more errors that over-reimbursed themselves than did other types of hospitals. This net over-reimbursement totaled $842.2 million.

#	DRG description	n	Over-reimbursement	
			$ per discharge	$ million total
104	Cardiac valve procedure with pump & cath	5	4915	81.1
468	Unrelated operating room procedures	21	1128	78.2
475	Respiratory system diagnosis with ventilator	19	791	49.6
110	Major reconstructive vascular procedures	21	682	47.3
191	Major pancreas, liver, & shunt procedures	4	3313	43.7
154	Stomach, esophageal, & duodenal procedures	11	1114	40.5
87	Pulmonary edema & respiratory failure	20	571	37.7
76	Respiratory system operating room procedures	10	764	25.2
82	Respiratory neoplasms	24	306	24.2
121	Myocardial infarction discharged alive	38	189	23.7
415	Operating room procedure for infection	8	858	22.6
148	Major large & small bowel procedures	33	202	22.0
217	Wound debridement & skin graft	2	333	22.0
	Other	2,235	-263	-587.6
	Total	2,451	-29	-69.8

Table 10: DRGs with maximum savings potential, 1988

RECOMMENDATIONS

- **The Peer Review Organizations should continue their surveillance of hospital coding for DRG reimbursement accuracy.**

  The attestation requirement appears to have deterred over-reimbursement due to mis-specification by attending physicians, causing their hospitals to be under-reimbursed. However, the sentinel effect did not fully prevent over-reimbursement due to resequencing by hospitals. Although these two trends approximately offset each other, this equilibrium may not continue in the future.

  The Agency for Health Care Policy Research plans to reabstract the ICD-9-CM codes from a large sample of Medicare charts to determine their diagnostic accuracy for health services research purposes. Using 1991 data, grouping these ICD-9-CM codes to DRGs, and selecting reasons for any differences would provide a third time point with which to track trends in reimbursement accuracy. The OIG supports this effort.

AGENCY COMMENTS

In its May 29, 1992 comments to the draft of this inspection, the HCFA concurred with the OIG recommendation. The HCFA noted that the improvement in DRG coding accuracy may be attributable to increased hospital experience with PPS, PRO review, and HCFA educational efforts.

The HCFA also made a number of technical comments. Based on these comments, the OIG made several changes to this inspection. The full text of the HCFA comments appear as an appendix.

ENDNOTES

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Appendix 1: Contract information

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Firm-Fixed Price Contract
$203,257

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2. Now at Health Audit Services, Ellicott City, MD.
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Appendix 3: Calculation formulas

Proportion of bills with coding errors

Appendixes 6-7 display for various subsets of hospitals and patients, the proportion of sample discharges whose DRGs were changed by AMRA (i.e., whose original DRG was incorrect). Since the 1988 Study self-weights, these proportions comprise unbiased direct estimates of the proportion of all CY 1988 billing records within each subset which have an incorrectly coded DRG. Each presentation includes the proportion, its standard error, and the number of sampled bills in the cell.

Because the proportions in these tables derive from a sample there exists a quantifiable possibility that the actual proportions of all Medicare bills with miscoded DRGs may differ by some amount from the proportions presented in the appendixes. The standard error is a statistic that allows calculation of the probability that the true population proportion differs from the sample proportion. Put over-simply if p is the sample proportion and s is the standard error, then there is a 95 percent chance that the true population proportion lies between p - (2.04 * s) and p + (2.04 * s), and there is a 99 percent chance that the true population proportion lies between p - (2.72 * s) and p + (2.72 * s).

The relation among the sample proportion, the standard error, and the number of sample bills is as follows: assume there are n bills in a subset of the sample and e of these bills have DRG coding errors. Then the sample proportion is: $p = e / n$. The standard error is: $s = (p * (1 - p) / (n - 1))^{1/2}$.

For example, in Appendix 6 the upper left-most cell gives the percent of miscoded bills from large, for-profit, teaching hospitals in metropolitan areas. There are eight records in this subset of the sample. Two of these discharges have miscoded DRGs. Therefore the proportion of DRG coding errors in the sample is $p = 2 / 8 = 0.25 =$ 25 percent. This also comprises the unbiased estimate of the proportion of billing records which large, metropolitan, for-profit, teaching hospitals submitted in CY 1988 and which contained miscoded DRGs.

The standard error of this proportion is: $s = ((0.25 * (1 - 0.25)) / (8 - 1))^{1/2} = 0.164 =$ 16.4 percent. This means that there is a 95 percent probability that the proportion of miscoded billing records submitted by all these hospitals in CY 1988 was between 0 percent (0.25 - (2.04 * 0.164)) and 58 percent (0.25 + (2.04 * 0.164)). There is a 99 percent probability that this proportion is between 0 percent (0.25 - (2.72 * 0.164)) and 69 percent (0.25 + (2.72 * 0.164)).

Researchers can combine particular cells of these appendixes in the following manner: if the cells have proportions of billing errors p_1 and p_2, standard errors of s_1 and s_2, and numbers of sample bills n_1 and n_2 respectively; then the combined proportion of errors: $p_t = ((n_1 * p_1) + (n_2 * p_2)) / (n_1 + n_2)$. The standard error of this proportion: $s_t = ((p_t * (1 - p_t)) / (n_1 + n_2 - 1))^{1/2}$.

For example, the proportion of errors among billing records submitted by large and medium, for-profit, teaching hospitals in metropolitan areas is $p_t = ((8 * 0.25) + (15 * 0.20)) / (8 + 15) = 0.217 = 21.7$ percent. This calculation is based on data from the first and thirteenth cells in column one of the appendix in the preceding example. This combined proportion has a standard error: $s_t = ((0.217 * (1.000 - 0.217)) / (8 + 15 - 1))^{½} = 0.088 = 8.8$ percent.

Significance testing

By calculating the frequencies summarized by these proportions, researchers constructed the underlying contingency table and calculated its statistical significance, measures of the degree of association between dependent and independent variable. Appendix 8 displayed the interaction analysis for coding error.

These calculations deleted certain cases and collapsed certain categories of independent variables to simplify the analysis. To decrease the degrees of freedom, this testing ignored bills that coded patient race as "other" or "unknown." These 58 cases comprised too small a cell to determine whether billing records with these race codes showed statistically significant propensities to miscode DRGs. Furthermore it did not make sense to combine these billing records with billing records with race codes of either "white" or "black". Evidence from other sources suggested that billing records of "other" and "unknown" differed in significant ways both from billing records of "white" and "black".

Preliminary analysis suggested that age affected differences in the propensity to miscode DRGs, particularly in two age groups. The first comprised patients under 65 (i.e., those eligible for Medicare because of disabilities). The second comprised patients 85 and over (i.e., those patients who were extremely elderly). Therefore we recoded patient age into three categories for these tables: <65, 65-84, and 85+.

Table 2 summarizes data from Appendixes 6-7. Thus, rather than reporting the within-cell distribution of cases between miscoded and correctly coded billing records, these tables report only the proportion of incorrectly coded billing records within each cell. Researchers can construct the original three-way contingency tables from these summary tables if they wish.

Each of these tables calculates two statistics: chi-square and phi. Chi-square measures only statistical significance. It quantifies the relationship between variables poorly. The phi statistic measures the strength of relationship between variables in a table better. Phi is the square root of chi-square divided by the number of cases in a table. Phi ranges between 0 and 1. The closer phi is to 0 the weaker the relation displayed in a table. The closer phi is to 1 the stronger the relation.

Case mix index and changes

Appendixes 9-12 show for various subsets of hospitals and patients the average DRG weight or CMI, before and after AMRA reabstraction. This information also includes the CMI standard error and cell size. The following formulas calculate the CMI, assuming n billing records in cell and the ith billing record has a relative weight of w_i, then: CMI = $\Sigma\ w_i / n$. This CMI has a standard error: SE = $\sigma / n^{½}$, where $\sigma = ((\Sigma (CMI - w_i)^2) / (n - 1))^{½}$.

Appendixes 13-14 calculation of the CMI change used identical formulas, but substituted the relative weight after recoding minus the relative weight before recoding for the DRG weights. Negative mean values suggest that the original reimbursement to be higher than it should have been, while positive values suggest original under-reimbursement. For individual billing records this calculation provides the change in DRG weight. Averaged over a subset of billing records it provides the change in CMI as a result of DRG recoding. The difference between the CMI in any cell of a "before" table and the corresponding cell of an "after" table appears in the same cell of the "change" table. Each corresponding cell has the same n. However, no simple formula relates the standard errors of corresponding cells.

Researchers can combine particular cells within any of these appendixes as follows: If the cells have CMIs C_1 and C_2, CMI standard errors of s_1 and s_2, and numbers of sample bills n_1 and n_2 respectively; then the combined CMI: $c_t = ((n_1 * c_1) + (n_2 * c_2)) / (n_1 + n_2)$. This CMI has standard error: $s_t = (((n_1 * (n_1 - 1) * s_1^2) + (n_2 * (n_2 - 1) * s_2^2)) / ((n_1 + n_2) * (n_1 + n_2 - 2)))^{½}$. For an explanation of these formulas see McNemar Q, Psychological statistics, 4th ed., New York, NY: John Wiley, 1969: 114-15.

For example, the CMI before recoding for billing records submitted by large and medium, for-profit, teaching hospitals in metropolitan areas is $c_t = ((8 * 1.0205) + (15 * 1.2991)) / (8 + 15) = 1.2022$. This calculation is based on data from the first and thirteenth cells in column one. The standard error of this CMI is $s_t = (((8 * (8 - 1) * 0.1390^2) + (15 * (15 - 1) * 0.2401^2)) / ((8 + 15) * (8 + 15 - 2)))^{½} = 0.1652$.

Mean change in reimbursement

Appendixes 15-16 show for various subsets of hospitals and patients the average change in dollar reimbursement per bill that would have resulted from correct DRG coding. Negative means suggest that the government's reimbursements to providers were higher than they should have been, while positive means suggest that the government's reimbursements to providers were lower than they should have been. In other words negative means in these tables suggest that the government has lost money as a result of DRG coding errors while positive means suggest that the government has gained money as a result of DRG coding errors.

These appendixes incorporate a simplifying assumption: that the actual reimbursement hospitals receive for patients is the standardized amount times the DRG weight. A variety of factors can slightly modify the standardized amount including whether a hospital is metropolitan or nonmetropolitan, teaching or nonteaching, etc. Most of these modifications have minor overall effects on reimbursement and in the aggregate tend to cancel each other.

The exception is the difference between the standardized amount paid to metropolitan hospitals versus the standardized amount paid to nonmetropolitan hospitals. The standardized amount to metropolitan hospitals averaged $3,118 (current dollars) in CY 1988, while the standardized amount to nonmetropolitan hospitals averaged $2,637 (current dollars) during the same period. These averages were based on a total of 10.8 million billing records.

The means, standard deviations, and difference for reimbursement use formulas identical to the CMI calculations. Combining cells also uses the same calculations as for combining CMI entries.

Projections of national reimbursement change

Appendixes 17-18 show the total number of bills submitted to HCFA in CY 1988 for various subsets of hospitals and patients. These appendixes provide the basis for projecting total savings or losses due to improper DRG coding. Negative amounts constitute an estimated loss to the government (over-reimbursement), while positive amounts represent too low a payment by the government (under-reimbursement).

Appendixes 19-20 contain the average under-reimbursement or over-reimbursement to the government per billing record as a result of DRG coding errors for a particular type of hospital or patient as well as the standard error. The corresponding cell in this appendix gives the total number of bills submitted by this particular type of hospital or for this particular type of patient in CY 1988. Multiplying the average dollar change per bill by the corresponding number of bills in each cell estimates the total dollar effect on the government. Multiplying the standard error per bill by the corresponding number of bills in each cell produces the standard errors of the dollar projection.

This technique has one important caveat. The 1988 Study final sample excluded certain CY 1988 billing records a priori and certain other CY 1988 billing records because of nonresponse. Thus the means and standard errors in apply to slightly different populations of billing records from appendixes to appendix. Practically this means that the standard errors in the projections of dollar change may actually be a very small amount smaller than an extremely conservative estimate would make them. However, this limitation has no impact upon the findings of this study.

Appendix 4: Representativeness of selected discharges, 1988

Hospital demography	Population n [%]	Selected n [%]	Chi-square
1-99 beds	1,333,250 [14.0]	385 [14.4]	1.6, 2 df, P=0.459
100-299 beds	3,454,578 [36.3]	943 [35.2]	
300+ beds	4,718,527 [49.6]	1,352 [50.4]	
Teaching	4,076,175 [42.9]	1,130 [42.2]	0.6, 1 df, P=0.455
Nonteaching	5,430,180 [57.1]	1,550 [57.8]	
Profit	1,022,922 [10.8]	291 [10.9]	0.03, 2 df, P=0.983
Nonprofit	6,858,338 [72.1]	1,933 [72.1]	
Government	1,625,095 [17.1]	456 [17.0]	
Metropolitan	7,270,147 [76.5]	2,038 [76.0]	0.3, 1 df, P=0.598
Nonmetropolitan	2,236,208 [23.5]	642 [24.0]	
Patient demography			
0-64 years	940,650 [9.9]	254 [9.5]	0.6, 3 df, P=0.901
65-74 years	3,932,293 [41.4]	1,110 [41.4]	
75-84 years	3,263,952 [34.3]	924 [34.5]	
85+ years	1,369,466 [14.4]	392 [14.6]	
Male	4,304,256 [45.3]	1,202 [44.9]	0.2, 1 df, P=0.657
Female	5,202,105 [54.7]	1,478 [55.1]	
White	8,261,646 [86.9]	2,398 [89.5]	38.4, 3 df, P<0.0001
Black	827,204 [8.7]	215 [8.0]	
Other	150,380 [1.6]	43 [1.6]	
Unknown	267,131 [2.8]	24 [0.9]	
Total	9,506,361* [100.0]	2,680 [100.0]	not applicable

*. Hospital demography totals to 9,506,355 because six bills lacked data on hospital control.

Appendix 5: Nonresponses, 1988

Hospital demography	Responses n [%]	Nonresponses n [%]	Chi-square
1-99 beds	359 [14.6]	26 [11.4]	27.5, 2 df, P<0.0001
100-299 beds	893 [36.4]	50 [21.8]	
300+ beds	1,199 [48.9]	153 [66.8]	
Teaching	1,008 [41.4]	122 [53.3]	12.7, 1 df, P<0.0001
Nonteaching	1,443 [58.9]	107 [46.7]	
Profit	272 [11.1]	19 [8.3]	2.9, 2 df, P=0.233
Nonprofit	1,769 [72.2]	164 [71.6]	
Government	410 [16.7]	46 [20.1]	
Metropolitan	1,845 [75.3]	193 [84.3]	9.3, 1 df, P=0.002
Nonmetropolitan	606 [24.7]	36 [15.7]	
Patient demography			
0-64 years	232 [9.5]	22 [9.6]	1.9, 3 df, P=0.596
65-74 years	1,007 [41.1]	103 [45.0]	
75-84 years	854 [34.8]	70 [30.6]	
85+ years	358 [14.6]	34 [14.8]	
Male	1,094 [44.6]	108 [47.2]	0.5, 1 df, P=0.462
Female	1,357 [55.4]	121 [52.8]	
White	2,205 [90.0]	193 [84.3]	8.8, 3 df, P=0.032
Black	188 [7.7]	27 [11.8]	
Other	58 [2.4]	9 [3.9]	
Unknown	35 [1.4]	1 [0.4]	
Total	2,451 [100.0]	229 [100.0]	not applicable

Appendix 6: Proportion of DRG coding errors by hospital demography, 1988

Proportion ± standard error (n)		Metropolitan	Nonmetropolitan	Metropolitan & nonmetropolitan
1-99 beds				
	Teaching	16.7 ± 16.7 (6)	no cases	16.7 ± 16.7 (6)
Profit	Nonteaching	10.0 ± 6.9 (20)	30.3 ± 8.1 (33)	22.7 ± 5.8 (53)
	Teaching & nonteaching	11.5 ± 6.4 (26)	30.3 ± 8.1 (33)	22.0 ± 5.4 (59)
	Teaching	50.0 ± 50.0 (2)	0.0 ± 0.0 (1)	33.3 ± 33.3 (3)
Nonprofit	Nonteaching	25.7 ± 7.5 (35)	17.1 ± 3.4 (123)	19.0 ± 3.1 (158)
	Teaching & nonteaching	27.0 ± 7.4 (37)	16.9 ± 3.4 (124)	19.3 ± 3.1 (161)
	Teaching	0.0 ± 0.0 (1)	33.3 ± 33.3 (3)	25.0 ± 25.0 (4)
Government	Nonteaching	15.4 ± 7.2 (26)	11.0 ± 3.0 (109)	11.9 ± 2.8 (135)
	Teaching & nonteaching	14.8 ± 7.0 (27)	11.6 ± 3.0 (112)	12.2 ± 2.8 (139)
	Teaching	22.2 ± 14.7 (9)	25.0 ± 25.0 (4)	23.1 ± 12.2 (13)
All	Nonteaching	18.5 ± 4.3 (81)	16.2 ± 2.3 (265)	16.8 ± 2.0 (346)
	Teaching & nonteaching	18.9 ± 4.1 (90)	16.4 ± 2.3 (269)	17.0 ± 2.0 (359)
100-299 beds				
	Teaching	20.0 ± 10.7 (15)	no cases	20.0 ± 10.7 (15)
Profit	Nonteaching	13.7 ± 3.2 (117)	12.5 ± 5.9 (32)	13.4 ± 2.8 (149)
	Teaching & nonteaching	14.4 ± 3.1 (132)	12.5 ± 5.9 (32)	14.0 ± 2.7 (164)
	Teaching	17.3 ± 3.1 (145)	4.8 ± 4.8 (21)	15.7 ± 2.8 (166)
Nonprofit	Nonteaching	15.4 ± 2.2 (267)	13.2 ± 2.7 (159)	14.6 ± 1.7 (426)
	Teaching & nonteaching	16.0 ± 1.8 (412)	12.2 ± 2.4 (180)	14.9 ± 1.5 (592)
	Teaching	27.8 ± 10.9 (18)	33.3 ± 33.3 (3)	28.6 ± 10.1 (21)
Government	Nonteaching	13.1 ± 5.0 (46)	14.3 ± 4.2 (70)	13.8 ± 3.2 (116)
	Teaching & nonteaching	17.2 ± 4.8 (64)	15.1 ± 4.2 (73)	16.1 ± 3.1 (137)
	Teaching	18.5 ± 2.9 (178)	8.3 ± 5.8 (24)	17.3 ± 2.7 (202)
All	Nonteaching	14.7 ± 1.7 (430)	13.4 ± 2.1 (261)	14.2 ± 1.3 (691)
	Teaching & nonteaching	15.8 ± 1.5 (608)	13.0 ± 2.0 (285)	14.9 ± 1.2 (893)
300+ beds				
	Teaching	25.0 ± 16.4 (8)	no cases	25.0 ± 16.4 (8)
Profit	Nonteaching	22.0 ± 6.5 (41)	no cases	22.0 ± 6.5 (41)
	Teaching & nonteaching	22.5 ± 6.0 (49)	no cases	22.5 ± 6.0 (49)
	Teaching	14.5 ± 1.3 (703)	6.7 ± 6.7 (15)	14.4 ± 1.3 (718)
Nonprofit	Nonteaching	8.7 ± 1.7 (276)	18.2 ± 8.4 (22)	9.4 ± 1.7 (298)
	Teaching & nonteaching	12.9 ± 1.1 (979)	13.5 ± 5.7 (37)	12.9 ± 1.1 (1016)
	Teaching	20.0 ± 5.0 (65)	0.0 ± 0.0 (2)	19.4 ± 4.9 (67)
Government	Nonteaching	20.4 ± 5.5 (54)	7.7 ± 7.7 (13)	17.9 ± 4.7 (67)
	Teaching & nonteaching	20.2 ± 3.7 (119)	6.7 ± 6.7 (15)	18.7 ± 3.4 (134)
	Teaching	15.1 ± 1.3 (776)	5.9 ± 5.9 (17)	14.9 ± 1.3 (793)
All	Nonteaching	11.9 ± 1.7 (371)	14.3 ± 6.0 (35)	12.1 ± 1.6 (406)
	Teaching & nonteaching	14.0 ± 1.0 (1147)	11.5 ± 4.5 (52)	13.9 ± 1.0 (1199)
All hospitals				
	Teaching	20.7 ± 7.7 (29)	no cases	20.7 ± 7.7 (29)
Profit	Nonteaching	15.2 ± 2.7 (178)	21.5 ± 5.1 (65)	16.9 ± 2.4 (243)
	Teaching & nonteaching	16.0 ± 2.6 (207)	21.5 ± 5.1 (65)	17.3 ± 2.3 (272)
	Teaching	15.1 ± 1.2 (850)	5.4 ± 3.8 (37)	14.7 ± 1.2 (887)
Nonprofit	Nonteaching	12.8 ± 1.4 (578)	15.1 ± 2.1 (304)	13.6 ± 1.2 (882)
	Teaching & nonteaching	14.2 ± 0.9 (1428)	14.1 ± 1.9 (341)	14.1 ± 0.8 (1769)
	Teaching	21.4 ± 4.5 (84)	25.0 ± 16.4 (8)	21.7 ± 4.3 (92)
Government	Nonteaching	16.7 ± 3.3 (126)	12.0 ± 2.3 (192)	13.8 ± 1.9 (318)
	Teaching & nonteaching	18.6 ± 2.7 (210)	12.5 ± 2.3 (200)	15.6 ± 1.8 (410)
	Teaching	15.8 ± 1.2 (963)	8.9 ± 4.3 (45)	15.5 ± 1.1 (1008)
All	Nonteaching	13.8 ± 1.2 (882)	14.8 ± 1.5 (561)	14.2 ± 0.9 (1443)
	Teaching & nonteaching	14.9 ± 0.8 (1845)	14.4 ± 1.4 (606)	14.7 ± 0.7 (2451)

Appendix 7: Proportion of DRG coding errors by patient demography, 1988

Proportion ± standard error (n)

	Male	Female	Male & female
0-64 years			
White	19.5 ± 3.7 (113)	16.2 ± 4.5 (68)	18.2 ± 2.9 (181)
Black	9.5 ± 6.6 (21)	5.6 ± 5.6 (18)	7.7 ± 4.3 (39)
Other	12.5 ± 12.5 (8)	33.3 ± 33.3 (3)	18.2 ± 12.2 (11)
Unknown	no cases	0.0 ± 0.0 (1)	0.0 ± 0.0 (1)
All races	17.6 ± 3.2 (142)	14.5 ± 3.7 (90)	16.4 ± 2.4 (232)
65-74 years			
White	14.0 ± 1.6 (458)	16.2 ± 1.7 (464)	15.1 ± 1.2 (922)
Black	13.3 ± 6.3 (30)	15.8 ± 6.0 (38)	14.7 ± 4.3 (68)
Other	0.0 ± 0.0 (5)	12.5 ± 12.5 (8)	7.7 ± 7.7 (13)
Unknown	0.0 ± 0.0 (3)	0.0 ± 0.0 (1)	0.0 ± 0.0 (4)
All races	13.7 ± 1.5 (496)	16.1 ± 1.6 (511)	14.9 ± 1.1 (1007)
75-84 years			
White	13.7 ± 1.9 (328)	15.4 ± 1.7 (456)	14.7 ± 1.3 (784)
Black	15.4 ± 7.2 (26)	18.5 ± 7.6 (27)	17.0 ± 5.2 (53)
Other	20.0 ± 20.0 (5)	0.0 ± 0.0 (2)	14.3 ± 14.3 (7)
Unknown	0.0 ± 0.0 (4)	0.0 ± 0.0 (6)	0.0 ± 0.0 (10)
All races	13.8 ± 1.8 (363)	15.3 ± 1.6 (491)	14.6 ± 1.2 (854)
85+ years			
White	17.1 ± 4.2 (82)	11.0 ± 2.0 (236)	12.6 ± 1.9 (318)
Black	25.0 ± 16.4 (8)	15.0 ± 8.2 (20)	17.9 ± 7.4 (28)
Other	0.0 ± 0.0 (2)	50.0 ± 50.0 (2)	25.0 ± 25.0 (4)
Unknown	0.0 ± 0.0 (1)	28.6 ± 18.4 (7)	25.0 ± 16.4 (8)
All races	17.2 ± 3.9 (93)	12.1 ± 2.0 (265)	13.4 ± 1.8 (358)
All ages			
White	14.8 ± 1.1 (981)	14.9 ± 1.0 (1224)	14.8 ± 0.8 (2205)
Black	14.1 ± 3.8 (85)	14.6 ± 3.5 (103)	14.4 ± 2.6 (188)
Other	10.0 ± 6.9 (20)	20.0 ± 10.7 (15)	14.3 ± 6.0 (35)
Unknown	0.0 ± 0.0 (8)	13.3 ± 9.1 (15)	8.7 ± 6.0 (23)
All races	14.5 ± 1.1 (1094)	14.9 ± 1.0 (1357)	14.7 ± 0.7 (2451)

Appendix 8: Interaction potential by hospital and patient demography, 1988

Proportion (n)

Race by bed size	1-99 beds	100-299 beds	300+ beds	Total
White	17.18 (326)	15.15 (812)	13.87 (1067)	14.83 (2205)
Black	10.00 (20)	11.11 (63)	17.14 (105)	14.36 (188)
Total	16.76 (346)	14.86 (875)	14.16 (1172)	14.79 (2393)
[Chi-square]	[0.696, 2 df, P=0.404]	[0.753, 2 df, P=0.385]	[0.842, 2 df, P=0.359]	[0.030, 2 df, P=0.862]
{Phi}	{0.045}	{0.029}	{0.027}	{0.004}

Race by location	Metropolitan	Nonmetropolitan	Total
White	14.85 (1657)	14.78 (548)	14.83 (2205)
Black	17.45 (149)	2.56 (39)	14.36 (188)
Total	15.06 (1806)	13.97 (587)	14.79 (2393)
[Chi-square]	[0.724, 1 df, P=0.395]	[4.522, 1 df, P=0.033]	[0.030, 1 df, P=0.862]
{Phi}	{0.020}	{0.088}	{0.004}

Race by control	Nonprofit	Profit	Government	Total
White	14.37 (1621)	17.01 (241)	15.45 (343)	14.83 (2205)
Black	13.27 (113)	22.73 (22)	13.21 (53)	14.36 (188)
Total	14.30 (1734)	17.49 (263)	15.15 (396)	14.79 (2393)
[Chi-square]	[0.104, 2 df, P=0.747]	[0.456, 2 df, P=0.499]	[0.180, 2 df, P=0.671]	[0.030, 2 df, P=0.862]
{Phi}	{0.008}	{0.042}	{0.021}	{0.004}

Race by teaching status	Teaching	Nonteaching	Total
White	15.82 (885)	14.17 (1320)	14.83 (2205)
Black	15.15 (99)	13.48 (89)	14.36 (188)
Total	15.75 (984)	14.12 (1409)	14.79 (2393)
[Chi-square]	[0.030, 1 df, P=0.863]	[0.032, 1 df, P=0.858]	[0.030, 1 df, P=0.862]
{Phi}	{0.006}	{0.005}	{0.004}

Race by sex	Male	Female	Total
White	14.78 (981)	14.87 (1224)	14.83 (2205)
Black	14.12 (85)	14.56 (103)	14.36 (188)
Total	14.23 (1066)	14.85 (1327)	14.79 (2393)
[Chi-square]	[0.027, 1 df, P=0.869]	[0.007, 1 df, P=0.933]	[0.030, 1 df, P=0.862]
{Phi}	{0.005}	{0.002}	{0.004}

Race by age	0-64	65-84	85+	Total
White	18.23 (181)	14.89 (1706)	12.58 (318)	14.83 (2205)
Black	7.69 (39)	15.70 (121)	17.86 (28)	14.36 (188)
Total	16.36 (220)	14.94 (1827)	13.01 (346)	14.79 (2393)
[Chi-square]	[2.604, 2 df, P=0.107]	[0.059, 2 df, P=0.808]	[0.634, 2 df, P=0.426]	[0.030, 2 df, P=0.862]
{Phi}	{0.109}	{0.006}	{0.043}	{0.004}

Sex by bed size	1-99 beds	100-299 beds	300+ beds	Total
Male	16.56 (151)	15.32 (385)	13.77 (530)	14.73 (1066)
Female	16.92 (195)	14.49 (490)	14.49 (642)	14.85 (1327)
Total	16.76 (346)	14.86 (875)	14.16 (1172)	14.79 (2393)
[Chi-square]	[0.008, 2 df, P=0.928]	[0.119, 2 df, P=0.730]	[0.121, 2 df, P=0.728]	[0.006, 2 df, P=0.936]
{Phi}	{0.005}	{0.012}	{0.010}	{0.002}

Sex by location	Metropolitan	Nonmetropolitan	Total
Male	14.61 (801)	15.09 (265)	14.73 (1066)
Female	15.42 (1005)	13.04 (322)	14.85 (1327)
Total	15.06 (1806)	13.97 (587)	14.79 (2393)
[Chi-square]	[0.232, 1 df, P=0.630]	[0.509, 1 df, P=0.476]	[0.006, 1 df, P=0.936]
{Phi}	{0.011}	{0.029}	{0.002}

Sex by control	Nonprofit	Profit	Government	Total
Male	14.53 (771)	19.13 (115)	12.78 (180)	14.73 (1066)
Female	14.12 (963)	16.22 (148)	17.13 (216)	14.85 (1327)
Total	14.30 (1734)	17.49 (263)	15.15 (396)	14.79 (2393)
[Chi-square]	[0.057, 2 df, P=0.811]	[0.381, 2 df, P=0.537]	[1.446, 2 df, P=0.229]	[0.006, 2 df, P=0.936]
{Phi}	{0.006}	{0.038}	{0.060}	{0.002}

Sex by teaching status	Teaching	Nonteaching	Total
Male	16.16 (427)	13.77 (639)	14.73 (1066)
Female	15.44 (557)	14.42 (770)	14.85 (1327)
Total	15.75 (984)	14.12 (1409)	14.79 (2393)
[Chi-square]	[0.094, 1 df, P=0.759]	[0.119, 1 df, P=0.730]	[0.006, 1 df, P=0.936]
{Phi}	{0.010}	{0.009}	{0.002}

Sex by age	0-64	65-84	85+	Total
Male	17.91 (134)	13.90 (842)	17.78 (90)	14.73 (1066)
Female	13.95 (86)	15.84 (985)	11.33 (256)	14.85 (1327)
Total	16.36 (220)	14.94 (1827)	13.01 (346)	14.79 (2393)
[Chi-square]	[0.599, 2 df, P=0.439]	[1.347, 2 df, P=0.246]	[2.448, 2 df, P=0.118]	[0.006, 2 df, P=0.936]
{Phi}	{0.052}	{0.027}	{0.084}	{0.002}

Age by bed size	1-99 beds	100-299 beds	300+ beds	Total
0-64	18.75 (32)	13.24 (68)	17.50 (120)	16.36 (220)
65-84	16.94 (242)	15.24 (676)	14.19 (909)	14.94 (1827)
85+	15.28 (72)	13.74 (131)	11.19 (143)	13.01 (346)
Total	16.76 (346)	14.86 (875)	14.16 (1172)	14.79 (2393)
[Chi-square]	[0.210, 4 df, P=0.900]	[0.348, 4 df, P=0.840]	[2.140, 4 df, P=0.343]	[1.340, 4 df, P=0.512]
{Phi}	{0.025}	{0.020}	{0.043}	{0.024}

Age by location	Metropolitan	Nonmetropolitan	Total
0-64	16.67 (168)	15.38 (52)	16.36 (220)
65-84	15.41 (1402)	13.41 (425)	14.94 (1827)
85+	11.86 (236)	15.45 (110)	13.01 (346)
Total	15.06 (1806)	13.97 (587)	14.79 (2393)
[Chi-square]	[2.355, 2 df, P=0.308]	[0.399, 2 df, P=0.819]	[1.340, 2 df, P=0.512]
{Phi}	{0.043}	{0.026}	{0.024}

Age by control	Nonprofit	Profit	Government	Total
0-64	16.78 (149)	17.86 (28)	13.95 (43)	16.36 (220)
65-84	13.98 (1345)	16.41 (195)	18.47 (287)	14.94 (1827)
85+	14.58 (240)	22.50 (40)	1.52 (66)	13.01 (346)
Total	14.30 (1734)	17.49 (263)	15.15 (396)	14.79 (2393)
[Chi-square]	[0.876, 4 df, P=0.645]	[0.856, 4 df, P=0.652]	[12.048, 4 df, P=0.002]	[1.340, 4 df, P=0.512]
{Phi}	{0.022}	{0.057}	{0.174}	{0.024}

Age by teaching status	Teaching	Nonteaching	Total
0-64	17.17 (99)	15.70 (121)	16.36 (220)
65-84	16.09 (758)	14.13 (1069)	14.94 (1827)
85+	12.60 (127)	13.24 (219)	13.01 (346)
Total	15.75 (984)	14.12 (1409)	14.79 (2393)
[Chi-square]	[1.169, 2 df, P=0.557]	[0.389, 2 df, P=0.823]	[1.340, 2 df, P=0.512]
{Phi}	{0.034}	{0.017}	{0.024}

Bed size by location	Metropolitan	Nonmetropolitan	Total
1-99 beds	19.77 (86)	15.77 (260)	16.76 (346)
100-299 beds	15.72 (598)	13.00 (277)	14.86 (875)
300+ beds	14.35 (1122)	10.00 (50)	14.16 (1172)
Total	15.06 (1806)	13.97 (587)	14.79 (2393)
[Chi-square]	[2.136, 2 df, P=0.344]	[1.575, 2 df, P=0.455]	[1.436, 2 df, P=0.488]
{Phi}	{0.034}	{0.052}	{0.024}

Bed size by control	Nonprofit	Profit	Government	Total
1-99 beds	19.75 (157)	23.21 (56)	10.53 (133)	16.76 (346)
100-299 beds	14.95 (582)	13.66 (161)	15.91 (132)	14.86 (875)
300+ beds	13.07 (995)	23.91 (46)	19.08 (131)	14.16 (1172)
Total	14.30 (1734)	17.49 (263)	15.15 (396)	14.79 (2393)
[Chi-square]	[5.235, 4 df, P=0.073]	[4.219, 4 df, P=0.121]	[3.848, 4 df, P=0.146]	[1.436, 4 df, P=0.488]
{Phi}	{0.055}	{0.127}	{0.099}	{0.024}

Bed size by teaching status	Teaching	Nonteaching	Total
1-99 beds	25.00 (12)	16.47 (334)	16.76 (346)
100-299 beds	17.17 (198)	14.18 (677)	14.86 (875)
300+ beds	15.25 (774)	12.06 (398)	14.16 (1172)
Total	15.75 (984)	14.12 (1409)	14.79 (2393)
[Chi-square]	[1.224, 2 df, P=0.542]	[2.911, 2 df, P=0.233]	[1.436, 2 df, P=0.488]
{Phi}	{0.035}	{0.045}	{0.024}

Location by control	Nonprofit	Profit	Government	Total
Metropolitan	14.33 (1403)	16.08 (199)	19.12 (204)	15.06 (1806)
Nonmetropolitan	14.20 (331)	21.87 (64)	10.94 (192)	13.97 (587)
Total	14.30 (1734)	17.49 (263)	15.15 (396)	14.79 (2393)
[Chi-square]	[0.004, 2 df, P=0.953]	[1.127, 2 df, P=0.288]	[5.148, 2 df, P=0.023]	[0.419, 2 df, P=0.518]
{Phi}	{0.001}	{0.065}	{0.114}	{0.013}

Location by teaching status	Teaching	Nonteaching	Total
Metropolitan	16.08 (939)	13.96 (867)	15.06 (1806)
Nonmetropolitan	8.89 (45)	14.39 (542)	13.97 (587)
Total	15.75 (984)	14.12 (1409)	14.79 (2393)
[Chi-square]	[1.674, 1 df, P=0.196]	[0.052, 1 df, P=0.820]	[0.419, 1 df, P=0.518]
{Phi}	{0.041}	{0.006}	{0.013}

Control by teaching status	Teaching	Nonteaching	Total
Profit	22.22 (27)	16.95 (236)	17.49 (263)
Nonprofit	14.86 (868)	13.74 (866)	14.30 (1734)
Government	22.47 (89)	13.03 (307)	15.15 (396)
Total	15.75 (984)	14.12 (1409)	14.79 (2393)
[Chi-square]	[4.399, 2 df, P=0.111]	[1.961, 2 df, P=0.375]	[1.890, 2 df, P=0.389]
{Phi}	{0.067}	{0.037}	{0.028}

Appendix 9: Projected national CMI before recoding by hospital demography, 1988

CMI ± standard error (n)

		Metropolitan	Nonmetropolitan	Metropolitan & nonmetropolitan
1-99 beds				
Profit	Teaching	0.9102 ± 0.2400 (6)	no cases	0.9102 ± 0.2400 (6)
	Nonteaching	1.2243 ± 0.1764 (20)	1.2091 ± 0.1121 (33)	1.2148 ± 0.0954 (53)
	Teaching & nonteaching	1.1518 ± 0.1468 (26)	1.2091 ± 0.1121 (33)	1.1839 ± 0.0893 (59)
Nonprofit	Teaching	1.0622 ± 0.1379 (2)	1.0774 ± 0.0000 (1)	1.0673 ± 0.0798 (3)
	Nonteaching	1.1817 ± 0.1162 (35)	1.0646 ± 0.0538 (123)	1.0906 ± 0.0491 (158)
	Teaching & nonteaching	1.1752 ± 0.1101 (37)	1.0647 ± 0.0533 (124)	1.0901 ± 0.0482 (161)
Government	Teaching	0.5912 ± 0.0000 (1)	1.0969 ± 0.3745 (3)	0.9705 ± 0.2934 (4)
	Nonteaching	1.0317 ± 0.1165 (26)	1.0620 ± 0.0483 (109)	1.0561 ± 0.0448 (135)
	Teaching & nonteaching	1.0154 ± 0.1132 (27)	1.0629 ± 0.0478 (112)	1.0537 ± 0.0441 (139)
All	Teaching	0.9086 ± 0.1630 (9)	1.0920 ± 0.2648 (4)	0.9650 ± 0.1351 (13)
	Nonteaching	1.1441 ± 0.0758 (81)	1.0815 ± 0.0348 (265)	1.0962 ± 0.0320 (346)
	Teaching & nonteaching	1.1205 ± 0.0703 (90)	1.0817 ± 0.0344 (269)	1.0914 ± 0.0312 (359)
100-299 beds				
Profit	Teaching	1.2991 ± 0.2401 (15)	no cases	1.2991 ± 0.2401 (15)
	Nonteaching	1.4367 ± 0.1194 (117)	1.4473 ± 0.1248 (32)	1.4390 ± 0.0973 (149)
	Teaching & nonteaching	1.4210 ± 0.1091 (132)	1.4473 ± 0.1248 (32)	1.4262 ± 0.0910 (164)
Nonprofit	Teaching	1.3973 ± 0.0798 (145)	1.4606 ± 0.2593 (21)	1.4053 ± 0.0767 (166)
	Nonteaching	1.2974 ± 0.0520 (267)	1.2000 ± 0.0654 (159)	1.2611 ± 0.0407 (426)
	Teaching & nonteaching	1.3326 ± 0.0438 (412)	1.2304 ± 0.0652 (180)	1.3015 ± 0.0364 (592)
Government	Teaching	1.4597 ± 0.2500 (18)	1.0029 ± 0.1518 (3)	1.3944 ± 0.2171 (21)
	Nonteaching	1.2830 ± 0.1287 (46)	1.3385 ± 0.0960 (70)	1.3165 ± 0.0769 (116)
	Teaching & nonteaching	1.3327 ± 0.1155 (64)	1.3247 ± 0.0925 (73)	1.3284 ± 0.0728 (137)
All	Teaching	1.3953 ± 0.0722 (178)	1.4034 ± 0.2289 (24)	1.3963 ± 0.0690 (202)
	Nonteaching	1.3338 ± 0.0478 (430)	1.2675 ± 0.0499 (261)	1.3087 ± 0.0352 (691)
	Teaching & nonteaching	1.3518 ± 0.0398 (608)	1.2789 ± 0.0495 (285)	1.3285 ± 0.0314 (893)
300+ beds				
Profit	Teaching	1.0205 ± 0.1390 (8)	no cases	1.0205 ± 0.1390 (8)
	Nonteaching	1.0912 ± 0.0952 (41)	no cases	1.0912 ± 0.0952 (41)
	Teaching & nonteaching	1.0797 ± 0.0824 (49)	no cases	1.0797 ± 0.0824 (49)
Nonprofit	Teaching	1.4133 ± 0.0408 (703)	1.1486 ± 0.1257 (15)	1.4078 ± 0.0401 (718)
	Nonteaching	1.3396 ± 0.0544 (276)	1.2235 ± 0.1889 (22)	1.3310 ± 0.0522 (298)
	Teaching & nonteaching	1.3925 ± 0.0331 (979)	1.1931 ± 0.1221 (37)	1.3853 ± 0.0322 (1016)
Government	Teaching	1.2482 ± 0.1190 (65)	0.7684 ± 0.2545 (2)	1.2338 ± 0.1160 (67)
	Nonteaching	1.2360 ± 0.1180 (54)	1.3880 ± 0.1889 (13)	1.2655 ± 0.1016 (67)
	Teaching & nonteaching	1.2426 ± 0.0838 (119)	1.3054 ± 0.1740 (15)	1.2497 ± 0.0768 (134)
All	Teaching	1.3954 ± 0.0384 (776)	1.1039 ± 0.1167 (17)	1.3892 ± 0.0377 (793)
	Nonteaching	1.2970 ± 0.0453 (371)	1.2846 ± 0.1368 (35)	1.2960 ± 0.0430 (406)
	Teaching & nonteaching	1.3636 ± 0.0298 (1147)	1.2255 ± 0.0997 (52)	1.3576 ± 0.0289 (1199)
All hospitals				
Profit	Teaching	1.1418 ± 0.1391 (29)	no cases	1.1418 ± 0.1391 (29)
	Nonteaching	1.3332 ± 0.0843 (178)	1.3264 ± 0.0844 (65)	1.3314 ± 0.0657 (243)
	Teaching & nonteaching	1.3064 ± 0.0751 (207)	1.3264 ± 0.0844 (65)	1.3112 ± 0.0605 (272)
Nonprofit	Teaching	1.4098 ± 0.0364 (850)	1.3237 ± 0.1561 (37)	1.4062 ± 0.0355 (887)
	Nonteaching	1.3105 ± 0.0360 (578)	1.1469 ± 0.0428 (304)	1.2541 ± 0.0279 (882)
	Teaching & nonteaching	1.3696 ± 0.0261 (1428)	1.1661 ± 0.0417 (341)	1.3304 ± 0.0226 (1769)
Government	Teaching	1.2857 ± 0.1065 (84)	0.9795 ± 0.1489 (8)	1.2590 ± 0.0984 (92)
	Nonteaching	1.2110 ± 0.0730 (126)	1.1849 ± 0.0471 (192)	1.1952 ± 0.0405 (318)
	Teaching & nonteaching	1.2409 ± 0.0610 (210)	1.1766 ± 0.0456 (200)	1.2095 ± 0.0383 (410)
All	Teaching	1.3909 ± 0.0337 (963)	1.2625 ± 0.1320 (45)	1.3851 ± 0.0327 (1008)
	Nonteaching	1.3009 ± 0.0309 (882)	1.1807 ± 0.0299 (561)	1.2542 ± 0.0222 (1443)
	Teaching & nonteaching	1.3479 ± 0.0230 (1845)	1.1868 ± 0.0293 (606)	1.3080 ± 0.0188 (2451)

Appendix 10: Projected national CMI before recoding by patient demography, 1988

CMI ± standard error (n)

	Male	Female	Male & female
0-64 years			
White	1.3911 ± 0.1076 (113)	1.2161 ± 0.0972 (68)	1.3253 ± 0.0765 (181)
Black	1.4755 ± 0.2295 (21)	0.9899 ± 0.0781 (18)	1.2514 ± 0.1331 (39)
Other	0.8347 ± 0.1370 (8)	1.5011 ± 0.5568 (3)	1.0165 ± 0.1878 (11)
Unknown	no cases	0.7493 ± 0.0000 (1)	0.7493 ± 0.0000 (1)
All races	1.3722 ± 0.0928 (142)	1.1751 ± 0.0774 (90)	1.2958 ± 0.0644 (232)
65-74 years			
White	1.4345 ± 0.0526 (458)	1.3235 ± 0.0455 (464)	1.3786 ± 0.0348 (922)
Black	1.5131 ± 0.1795 (30)	1.0543 ± 0.1014 (38)	1.2567 ± 0.1005 (68)
Other	1.4375 ± 0.1785 (5)	2.2316 ± 0.5628 (8)	1.9262 ± 0.3609 (13)
Unknown	1.3814 ± 0.2750 (3)	0.8535 ± 0.0000 (1)	1.2494 ± 0.2350 (4)
All races	1.4389 ± 0.0498 (496)	1.3168 ± 0.0432 (511)	1.3769 ± 0.0329 (1007)
75-84 years			
White	1.2776 ± 0.0432 (328)	1.2631 ± 0.0434 (456)	1.2692 ± 0.0310 (784)
Black	1.1833 ± 0.1373 (26)	0.9396 ± 0.0689 (27)	1.0591 ± 0.0771 (53)
Other	1.1585 ± 0.0675 (5)	1.3692 ± 0.3470 (2)	1.2187 ± 0.0970 (7)
Unknown	0.7977 ± 0.1495 (4)	1.2602 ± 0.5112 (6)	1.0752 ± 0.3095 (10)
All races	1.2639 ± 0.0403 (363)	1.2457 ± 0.0410 (491)	1.2535 ± 0.0291 (854)
85+ years			
White	1.3333 ± 0.0934 (82)	1.2326 ± 0.0425 (236)	1.2586 ± 0.0396 (318)
Black	1.1518 ± 0.2088 (8)	1.1477 ± 0.1759 (20)	1.1489 ± 0.1370 (28)
Other	1.1802 ± 0.2574 (2)	1.2104 ± 0.1874 (2)	1.1953 ± 0.1302 (4)
Unknown	1.0222 ± 0.0000 (1)	1.4490 ± 0.3689 (7)	1.3956 ± 0.3239 (8)
All races	1.3110 ± 0.0843 (93)	1.2317 ± 0.0411 (265)	1.2523 ± 0.0374 (358)
All ages			
White	1.3686 ± 0.0320 (981)	1.2775 ± 0.0256 (1224)	1.3180 ± 0.0201 (2205)
Black	1.3689 ± 0.0968 (85)	1.0311 ± 0.0551 (103)	1.1838 ± 0.0544 (188)
Other	1.1009 ± 0.0899 (20)	1.8343 ± 0.3289 (15)	1.4152 ± 0.1598 (35)
Unknown	1.0446 ± 0.1527 (8)	1.2871 ± 0.2602 (15)	1.2028 ± 0.1769 (23)
All races	1.3613 ± 0.0298 (1094)	1.2651 ± 0.0240 (1357)	1.3080 ± 0.0188 (2451)

Appendix 11: Projected national CMI after recoding by hospital demography, 1988

CMI ± standard error (n)

		Metropolitan	Nonmetropolitan	Metropolitan & nonmetropolitan
1-99 beds				
	Teaching	0.9536 ± 0.2322 (6)	no cases	0.9536 ± 0.2322 (6)
Profit	Nonteaching	1.2292 ± 0.1749 (20)	1.2343 ± 0.1266 (33)	1.2323 ± 0.1018 (53)
	Teaching & nonteaching	1.1656 ± 0.1446 (26)	1.2343 ± 0.1266 (33)	1.2040 ± 0.0945 (59)
	Teaching	1.0630 ± 0.1371 (2)	1.0774 ± 0.0000 (1)	1.0678 ± 0.0793 (3)
Nonprofit	Nonteaching	1.1402 ± 0.1156 (35)	1.0664 ± 0.0510 (123)	1.0827 ± 0.0471 (158)
	Teaching & nonteaching	1.1360 ± 0.1095 (37)	1.0664 ± 0.0506 (124)	1.0824 ± 0.0463 (161)
	Teaching	0.5912 ± 0.0000 (1)	1.1222 ± 0.3998 (3)	0.9894 ± 0.3123 (4)
Government	Nonteaching	0.9450 ± 0.0859 (26)	1.0742 ± 0.0522 (109)	1.0493 ± 0.0454 (135)
	Teaching & nonteaching	0.9319 ± 0.0836 (27)	1.0755 ± 0.0516 (112)	1.0476 ± 0.0448 (139)
	Teaching	0.9376 ± 0.1585 (9)	1.1110 ± 0.2829 (4)	0.9910 ± 0.1352 (13)
All	Nonteaching	1.0995 ± 0.0717 (81)	1.0905 ± 0.0356 (265)	1.0926 ± 0.0320 (346)
	Teaching & nonteaching	1.0833 ± 0.0664 (90)	1.0908 ± 0.0353 (269)	1.0889 ± 0.0312 (359)
100-299 beds				
	Teaching	1.3773 ± 0.2935 (15)	no cases	1.3773 ± 0.2935 (15)
Profit	Nonteaching	1.4339 ± 0.1185 (117)	1.4354 ± 0.1410 (32)	1.4342 ± 0.0976 (149)
	Teaching & nonteaching	1.4274 ± 0.1099 (132)	1.4354 ± 0.1410 (32)	1.4290 ± 0.0924 (164)
	Teaching	1.3990 ± 0.0771 (145)	1.4546 ± 0.2599 (21)	1.4061 ± 0.0746 (166)
Nonprofit	Nonteaching	1.3214 ± 0.0521 (267)	1.2061 ± 0.0643 (159)	1.2783 ± 0.0406 (426)
	Teaching & nonteaching	1.3487 ± 0.0433 (412)	1.2351 ± 0.0643 (180)	1.3141 ± 0.0360 (592)
	Teaching	1.5520 ± 0.2440 (18)	0.9806 ± 0.1726 (3)	1.4704 ± 0.2140 (21)
Government	Nonteaching	1.2494 ± 0.1211 (46)	1.2877 ± 0.0868 (70)	1.2725 ± 0.0707 (116)
	Teaching & nonteaching	1.3345 ± 0.1111 (64)	1.2751 ± 0.0837 (73)	1.3028 ± 0.0682 (137)
	Teaching	1.4127 ± 0.0714 (178)	1.3954 ± 0.2297 (24)	1.4106 ± 0.0684 (202)
All	Nonteaching	1.3443 ± 0.0474 (430)	1.2561 ± 0.0488 (261)	1.3110 ± 0.0348 (691)
	Teaching & nonteaching	1.3643 ± 0.0395 (608)	1.2678 ± 0.0486 (285)	1.3335 ± 0.0311 (893)
300+ beds				
	Teaching	0.9125 ± 0.1588 (8)	no cases	0.9125 ± 0.1588 (8)
Profit	Nonteaching	1.1798 ± 0.1092 (41)	no cases	1.1798 ± 0.1092 (41)
	Teaching & nonteaching	1.1362 ± 0.0955 (49)	no cases	1.1362 ± 0.0955 (49)
	Teaching	1.4062 ± 0.0399 (703)	1.1499 ± 0.1255 (15)	1.4008 ± 0.0392 (718)
Nonprofit	Nonteaching	1.3516 ± 0.0550 (276)	1.2490 ± 0.1870 (22)	1.3440 ± 0.0527 (298)
	Teaching & nonteaching	1.3908 ± 0.0325 (979)	1.2088 ± 0.1211 (37)	1.3842 ± 0.0317 (1016)
	Teaching	1.2723 ± 0.1232 (65)	0.7684 ± 0.2545 (2)	1.2573 ± 0.1200 (67)
Government	Nonteaching	1.2095 ± 0.1189 (54)	1.4267 ± 0.1883 (13)	1.2517 ± 0.1026 (67)
	Teaching & nonteaching	1.2438 ± 0.0859 (119)	1.3389 ± 0.1747 (15)	1.2545 ± 0.0786 (134)
	Teaching	1.3899 ± 0.0376 (776)	1.1050 ± 0.1166 (17)	1.3838 ± 0.0369 (793)
All	Nonteaching	1.3120 ± 0.0460 (371)	1.3150 ± 0.1358 (35)	1.3122 ± 0.0436 (406)
	Teaching & nonteaching	1.3647 ± 0.0295 (1147)	1.2463 ± 0.0993 (52)	1.3595 ± 0.0285 (1199)
All hospitals				
	Teaching	1.1614 ± 0.1667 (29)	no cases	1.1614 ± 0.1667 (29)
Profit	Nonteaching	1.3524 ± 0.0843 (178)	1.3333 ± 0.0947 (65)	1.3473 ± 0.0666 (243)
	Teaching & nonteaching	1.3256 ± 0.0762 (207)	1.3333 ± 0.0947 (65)	1.3274 ± 0.0621 (272)
	Teaching	1.4041 ± 0.0355 (850)	1.3209 ± 0.1563 (37)	1.4007 ± 0.0346 (887)
Nonprofit	Nonteaching	1.3248 ± 0.0363 (578)	1.1527 ± 0.0418 (304)	1.2655 ± 0.0279 (882)
	Teaching & nonteaching	1.3720 ± 0.0257 (1428)	1.1709 ± 0.0409 (341)	1.3333 ± 0.0223 (1769)
	Teaching	1.3241 ± 0.1091 (84)	0.9806 ± 0.1591 (8)	1.2943 ± 0.1009 (92)
Government	Nonteaching	1.1695 ± 0.0700 (126)	1.1759 ± 0.0458 (192)	1.1734 ± 0.0391 (318)
	Teaching & nonteaching	1.2314 ± 0.0606 (210)	1.1681 ± 0.0444 (200)	1.2005 ± 0.0378 (410)
	Teaching	1.3899 ± 0.0331 (963)	1.2604 ± 0.1324 (45)	1.3841 ± 0.0322 (1008)
All	Nonteaching	1.3082 ± 0.0309 (882)	1.1815 ± 0.0296 (561)	1.2590 ± 0.0222 (1443)
	Teaching & nonteaching	1.3508 ± 0.0227 (1845)	1.1874 ± 0.0291 (606)	1.3104 ± 0.0186 (2451)

Appendix 12: Projected national CMI after recoding by patient demography, 1988

CMI ± standard error (n)

	Male	Female	Male & female
0-64 years			
White	1.4053 ± 0.1070 (113)	1.2675 ± 0.1083 (68)	1.3535 ± 0.0782 (181)
Black	1.4144 ± 0.2245 (21)	1.0006 ± 0.0796 (18)	1.2234 ± 0.1293 (39)
Other	1.1342 ± 0.2483 (8)	1.6164 ± 0.4901 (3)	1.2657 ± 0.2216 (11)
Unknown	no cases	0.7493 ± 0.0000 (1)	0.7493 ± 0.0000 (1)
All races	1.3914 ± 0.0921 (142)	1.2200 ± 0.0855 (90)	1.3249 ± 0.0655 (232)
65-74 years			
White	1.4063 ± 0.0508 (458)	1.3233 ± 0.0444 (464)	1.3646 ± 0.0337 (922)
Black	1.4652 ± 0.1741 (30)	1.0727 ± 0.0998 (38)	1.2459 ± 0.0971 (68)
Other	1.4375 ± 0.1785 (5)	2.2121 ± 0.5697 (8)	1.9142 ± 0.3639 (13)
Unknown	1.3814 ± 0.2750 (3)	0.8535 ± 0.0000 (1)	1.2494 ± 0.2350 (4)
All races	1.4101 ± 0.0481 (496)	1.3177 ± 0.0422 (511)	1.3632 ± 0.0319 (1007)
75-84 years			
White	1.2778 ± 0.0444 (328)	1.2653 ± 0.0428 (456)	1.2705 ± 0.0310 (784)
Black	1.2286 ± 0.1409 (26)	0.9794 ± 0.0837 (27)	1.1017 ± 0.0822 (53)
Other	1.1055 ± 0.1100 (5)	1.3692 ± 0.3470 (2)	1.1808 ± 0.1177 (7)
Unknown	0.7977 ± 0.1495 (4)	1.2602 ± 0.5112 (6)	1.0752 ± 0.3095 (10)
All races	1.2666 ± 0.0414 (363)	1.2500 ± 0.0405 (491)	1.2570 ± 0.0292 (854)
85+ years			
White	1.4226 ± 0.1010 (82)	1.2418 ± 0.0436 (236)	1.2884 ± 0.0417 (318)
Black	1.2314 ± 0.1964 (8)	1.1191 ± 0.1788 (20)	1.1512 ± 0.1379 (28)
Other	1.1802 ± 0.2574 (2)	1.3409 ± 0.0569 (2)	1.2605 ± 0.1172 (4)
Unknown	1.0222 ± 0.0000 (1)	1.4573 ± 0.3642 (7)	1.4029 ± 0.3201 (8)
All races	1.3966 ± 0.0908 (93)	1.2390 ± 0.0421 (265)	1.2799 ± 0.0392 (358)
All ages			
White	1.3646 ± 0.0317 (981)	1.2829 ± 0.0254 (1224)	1.3192 ± 0.0199 (2205)
Black	1.3583 ± 0.0943 (85)	1.0447 ± 0.0563 (103)	1.1865 ± 0.0537 (188)
Other	1.2075 ± 0.1127 (20)	1.8644 ± 0.3240 (15)	1.4890 ± 0.1603 (35)
Unknown	1.0446 ± 0.1527 (8)	1.2910 ± 0.2591 (15)	1.2053 ± 0.1762 (23)
All races	1.3589 ± 0.0294 (1094)	1.2713 ± 0.0238 (1357)	1.3104 ± 0.0186 (2451)

Appendix 13: Mean CMI change by hospital demography, 1988

CMI change ± standard error (n)		Metropolitan	Nonmetropolitan	Metropolitan & nonmetropolitan
1-99 beds				
Profit	Teaching	0.0433 ± 0.0433 (6)	no cases	0.0433 ± 0.0433 (6)
	Nonteaching	0.0048 ± 0.0145 (20)	0.0251 ± 0.0929 (33)	0.0175 ± 0.0578 (53)
	Teaching & nonteaching	0.0137 ± 0.0148 (26)	0.0251 ± 0.0929 (33)	0.0201 ± 0.0520 (59)
Nonprofit	Teaching	0.0008 ± 0.0008 (2)	0.0000 ± 0.0000 (1)	0.0005 ± 0.0005 (3)
	Nonteaching	-0.0415 ± 0.0538 (35)	0.0017 ± 0.0200 (123)	-0.0078 ± 0.0195 (158)
	Teaching & nonteaching	-0.0392 ± 0.0509 (37)	0.0017 ± 0.0198 (124)	-0.0077 ± 0.0192 (161)
Government	Teaching	0.0000 ± 0.0000 (1)	0.0252 ± 0.0252 (3)	0.0189 ± 0.0189 (4)
	Nonteaching	-0.0867 ± 0.0605 (26)	0.0122 ± 0.0177 (109)	-0.0068 ± 0.0186 (135)
	Teaching & nonteaching	-0.0835 ± 0.0583 (27)	0.0125 ± 0.0172 (112)	-0.0060 ± 0.0180 (139)
All	Teaching	0.0290 ± 0.0288 (9)	0.0189 ± 0.0189 (4)	0.0259 ± 0.0203 (13)
	Nonteaching	-0.0445 ± 0.0304 (81)	0.0089 ± 0.0164 (265)	-0.0035 ± 0.0144 (346)
	Teaching & nonteaching	-0.0372 ± 0.0276 (90)	0.0091 ± 0.0161 (269)	-0.0025 ± 0.0139 (359)
100-299 beds				
Profit	Teaching	0.0782 ± 0.1457 (15)	no cases	0.0782 ± 0.1457 (15)
	Nonteaching	-0.0027 ± 0.0231 (117)	-0.0119 ± 0.0589 (32)	-0.0047 ± 0.0220 (149)
	Teaching & nonteaching	0.0064 ± 0.0261 (132)	-0.0119 ± 0.0589 (32)	0.0028 ± 0.0239 (164)
Nonprofit	Teaching	0.0017 ± 0.0341 (145)	-0.0059 ± 0.0059 (21)	0.0007 ± 0.0298 (166)
	Nonteaching	0.0239 ± 0.0245 (267)	0.0061 ± 0.0194 (159)	0.0172 ± 0.0170 (426)
	Teaching & nonteaching	0.0160 ± 0.0199 (412)	0.0047 ± 0.0172 (180)	0.0126 ± 0.0148 (592)
Government	Teaching	0.0923 ± 0.0915 (18)	-0.0222 ± 0.0222 (3)	0.0759 ± 0.0786 (21)
	Nonteaching	-0.0335 ± 0.0373 (46)	-0.0508 ± 0.0451 (70)	-0.0439 ± 0.0309 (116)
	Teaching & nonteaching	0.0018 ± 0.0374 (64)	-0.0496 ± 0.0433 (73)	-0.0256 ± 0.0289 (137)
All	Teaching	0.0173 ± 0.0316 (178)	-0.0080 ± 0.0058 (24)	0.0143 ± 0.0278 (202)
	Nonteaching	0.0105 ± 0.0169 (430)	-0.0113 ± 0.0184 (261)	0.0022 ± 0.0126 (691)
	Teaching & nonteaching	0.0124 ± 0.0151 (608)	-0.0110 ± 0.0168 (285)	0.0049 ± 0.0116 (893)
300+ beds				
Profit	Teaching	-0.1080 ± 0.0752 (8)	no cases	-0.1080 ± 0.0752 (8)
	Nonteaching	0.0886 ± 0.0621 (41)	no cases	0.0886 ± 0.0621 (41)
	Teaching & nonteaching	0.0565 ± 0.0541 (49)	no cases	0.0565 ± 0.0541 (49)
Nonprofit	Teaching	-0.0071 ± 0.0157 (703)	0.0013 ± 0.0013 (15)	-0.0069 ± 0.0154 (718)
	Nonteaching	0.0120 ± 0.0158 (276)	0.0254 ± 0.0206 (22)	0.0130 ± 0.0147 (298)
	Teaching & nonteaching	-0.0017 ± 0.0121 (979)	0.0156 ± 0.0123 (37)	-0.0011 ± 0.0117 (1016)
Government	Teaching	0.0241 ± 0.0309 (65)	0.0000 ± 0.0000 (2)	0.0234 ± 0.0300 (67)
	Nonteaching	-0.0264 ± 0.0560 (54)	0.0386 ± 0.0386 (13)	-0.0138 ± 0.0458 (67)
	Teaching & nonteaching	0.0012 ± 0.0305 (119)	0.0334 ± 0.0334 (15)	0.0048 ± 0.0273 (134)
All	Teaching	-0.0055 ± 0.0145 (776)	0.0011 ± 0.0011 (17)	-0.0054 ± 0.0142 (793)
	Nonteaching	0.0149 ± 0.0159 (371)	0.0303 ± 0.0190 (35)	0.0162 ± 0.0146 (406)
	Teaching & nonteaching	0.0010 ± 0.0110 (1147)	0.0208 ± 0.0129 (52)	0.0019 ± 0.0106 (1199)
All hospitals				
Profit	Teaching	0.0196 ± 0.0786 (29)	no cases	0.0196 ± 0.0786 (29)
	Nonteaching	0.0191 ± 0.0210 (178)	0.0068 ± 0.0550 (65)	0.0158 ± 0.0212 (243)
	Teaching & nonteaching	0.0192 ± 0.0211 (207)	0.0068 ± 0.0550 (65)	0.0162 ± 0.0207 (272)
Nonprofit	Teaching	-0.0056 ± 0.0142 (850)	-0.0028 ± 0.0034 (37)	-0.0055 ± 0.0136 (887)
	Nonteaching	0.0142 ± 0.0140 (578)	0.0057 ± 0.0130 (304)	0.0113 ± 0.0102 (882)
	Teaching & nonteaching	0.0024 ± 0.0102 (1428)	0.0048 ± 0.0116 (341)	0.0028 ± 0.0085 (1769)
Government	Teaching	0.0384 ± 0.0308 (84)	0.0011 ± 0.0134 (8)	0.0352 ± 0.0281 (92)
	Nonteaching	-0.0414 ± 0.0301 (126)	-0.0089 ± 0.0195 (192)	-0.0218 ± 0.0167 (318)
	Teaching & nonteaching	-0.0095 ± 0.0220 (210)	-0.0085 ± 0.0187 (200)	-0.0090 ± 0.0145 (410)
All	Teaching	-0.0010 ± 0.0130 (963)	-0.0021 ± 0.0036 (45)	-0.0010 ± 0.0125 (1008)
	Nonteaching	0.0073 ± 0.0110 (882)	0.0008 ± 0.0116 (561)	0.0047 ± 0.0081 (1443)
	Teaching & nonteaching	0.0029 ± 0.0086 (1845)	0.0006 ± 0.0107 (606)	0.0023 ± 0.0070 (2451)

Appendix 14: Mean CMI change by patient demography, 1988

CMI change ± standard error (n)	Male	Female	Male & female
0-64 years			
White	0.0142 ± 0.0338 (113)	0.0514 ± 0.0344 (68)	0.0281 ± 0.0247 (181)
Black	-0.0611 ± 0.0595 (21)	0.0107 ± 0.0107 (18)	-0.0279 ± 0.0325 (39)
Other	0.2995 ± 0.2172 (8)	0.1153 ± 0.1153 (3)	0.2492 ± 0.1594 (11)
Unknown	no cases	0.0000 ± 0.0000 (1)	0.0000 ± 0.0000 (1)
All races	0.0191 ± 0.0311 (142)	0.0448 ± 0.0263 (90)	0.0291 ± 0.0215 (232)
65-74 years			
White	-0.0281 ± 0.0166 (458)	-0.0001 ± 0.0192 (464)	-0.0140 ± 0.0127 (922)
Black	-0.0479 ± 0.0919 (30)	0.0184 ± 0.0434 (38)	-0.0108 ± 0.0470 (68)
Other	0.0000 ± 0.0000 (5)	-0.0194 ± 0.0194 (8)	-0.0119 ± 0.0119 (13)
Unknown	0.0000 ± 0.0000 (3)	0.0000 ± 0.0000 (1)	0.0000 ± 0.0000 (4)
All races	-0.0288 ± 0.0163 (496)	0.0009 ± 0.0177 (511)	-0.0137 ± 0.0120 (1007)
75-84 years			
White	0.0001 ± 0.0179 (328)	0.0022 ± 0.0147 (456)	0.0013 ± 0.0114 (784)
Black	0.0453 ± 0.0775 (26)	0.0398 ± 0.0797 (27)	0.0425 ± 0.0551 (53)
Other	-0.0530 ± 0.0530 (5)	0.0000 ± 0.0000 (2)	-0.0379 ± 0.0379 (7)
Unknown	0.0000 ± 0.0000 (4)	0.0000 ± 0.0000 (6)	0.0000 ± 0.0000 (10)
All races	0.0026 ± 0.0171 (363)	0.0042 ± 0.0143 (491)	0.0035 ± 0.0110 (854)
85+ years			
White	0.0892 ± 0.0535 (82)	0.0091 ± 0.0156 (236)	0.0298 ± 0.0180 (318)
Black	0.0795 ± 0.0538 (8)	-0.0286 ± 0.0165 (20)	0.0022 ± 0.0209 (28)
Other	0.0000 ± 0.0000 (2)	0.1305 ± 0.1305 (2)	0.0652 ± 0.0652 (4)
Unknown	0.0000 ± 0.0000 (1)	0.0083 ± 0.0335 (7)	0.0072 ± 0.0291 (8)
All races	0.0855 ± 0.0474 (93)	0.0072 ± 0.0140 (265)	0.0275 ± 0.0161 (358)
All ages			
White	-0.0039 ± 0.0115 (981)	0.0053 ± 0.0097 (1224)	0.0012 ± 0.0074 (2205)
Black	-0.0106 ± 0.0429 (85)	0.0135 ± 0.0263 (103)	0.0026 ± 0.0241 (188)
Other	0.1065 ± 0.0918 (20)	0.0300 ± 0.0307 (15)	0.0737 ± 0.0538 (35)
Unknown	0.0000 ± 0.0000 (8)	0.0038 ± 0.0150 (15)	0.0025 ± 0.0097 (23)
All races	-0.0024 ± 0.0109 (1094)	0.0062 ± 0.0090 (1357)	0.0023 ± 0.0070 (2451)

Appendix 15: Mean reimbursement change by hospital demography, 1988

$ ± standard error (n)		Metropolitan	Nonmetropolitan	Metropolitan & nonmetropolitan
1-99 beds				
Profit	Teaching	135.16 ± 135.16 (6)	no cases	135.16 ± 135.16 (6)
	Nonteaching	15.16 ± 45.22 (20)	66.38 ± 245.17 (33)	47.06 ± 152.72 (53)
	Teaching & nonteaching	42.86 ± 46.27 (26)	66.38 ± 245.17 (33)	56.02 ± 137.68 (59)
Nonprofit	Teaching	2.49 ± 2.49 (2)	0.00 ± 0.00 (1)	1.66 ± 1.66 (3)
	Nonteaching	-129.47 ± 167.91 (35)	4.53 ± 52.79 (123)	-25.15 ± 55.30 (158)
	Teaching & nonteaching	-122.34 ± 158.79 (37)	4.49 ± 52.37 (124)	-24.65 ± 54.27 (161)
Government	Teaching	0.00 ± 0.00 (1)	66.62 ± 66.62 (3)	49.97 ± 49.97 (4)
	Nonteaching	-270.58 ± 188.75 (26)	32.26 ± 46.67 (109)	-26.06 ± 52.95 (135)
	Teaching & nonteaching	-260.56 ± 181.90 (27)	33.18 ± 45.44 (112)	-23.87 ± 51.45 (139)
All	Teaching	90.66 ± 90.04 (9)	49.97 ± 49.97 (4)	78.14 ± 62.95 (13)
	Nonteaching	-139.05 ± 94.94 (81)	23.64 ± 43.28 (265)	-14.44 ± 40.01 (346)
	Teaching & nonteaching	-116.08 ± 86.13 (90)	24.03 ± 42.64 (269)	-11.09 ± 38.63 (359)
100-299 beds				
Profit	Teaching	243.82 ± 454.56 (15)	no cases	243.82 ± 454.56 (15)
	Nonteaching	-8.66 ± 72.29 (117)	-31.56 ± 155.51 (32)	-13.58 ± 65.61 (149)
	Teaching & nonteaching	20.02 ± 81.61 (132)	-31.56 ± 155.51 (32)	9.95 ± 72.16 (164)
Nonprofit	Teaching	5.34 ± 106.40 (145)	-15.74 ± 15.74 (21)	2.67 ± 92.92 (166)
	Nonteaching	74.55 ± 76.64 (267)	16.11 ± 51.38 (159)	52.74 ± 51.69 (426)
	Teaching & nonteaching	50.19 ± 62.14 (412)	12.39 ± 45.41 (180)	38.70 ± 45.38 (592)
Government	Teaching	287.84 ± 285.36 (18)	-58.62 ± 58.62 (3)	238.34 ± 245.18 (21)
	Nonteaching	-104.64 ± 116.31 (46)	-134.08 ± 119.18 (70)	-122.41 ± 85.11 (116)
	Teaching & nonteaching	5.73 ± 116.70 (64)	-130.98 ± 114.28 (73)	-67.11 ± 81.64 (137)
All	Teaching	54.00 ± 98.64 (178)	-21.10 ± 15.32 (24)	45.08 ± 86.93 (202)
	Nonteaching	32.74 ± 52.97 (430)	-30.01 ± 48.56 (261)	9.03 ± 37.71 (691)
	Teaching & nonteaching	38.96 ± 47.26 (608)	-29.26 ± 44.48 (285)	17.19 ± 35.17 (893)
300+ beds				
Profit	Teaching	-336.74 ± 234.56 (8)	no cases	-336.74 ± 234.56 (8)
	Nonteaching	276.34 ± 193.68 (41)	no cases	276.34 ± 193.68 (41)
	Teaching & nonteaching	176.24 ± 168.93 (49)	no cases	176.24 ± 168.93 (49)
Nonprofit	Teaching	-22.32 ± 49.12 (703)	3.51 ± 3.51 (15)	-21.78 ± 48.10 (718)
	Nonteaching	37.63 ± 49.48 (276)	67.19 ± 54.46 (22)	39.81 ± 45.99 (298)
	Teaching & nonteaching	-5.42 ± 37.93 (979)	41.37 ± 32.52 (37)	-3.71 ± 36.56 (1016)
Government	Teaching	75.38 ± 96.50 (65)	0.00 ± 0.00 (2)	73.13 ± 93.61 (67)
	Nonteaching	-82.48 ± 174.91 (54)	101.86 ± 101.86 (13)	-46.71 ± 142.29 (67)
	Teaching & nonteaching	3.74 ± 95.11 (119)	88.28 ± 88.28 (15)	13.21 ± 85.00 (134)
All	Teaching	-17.38 ± 45.30 (776)	3.10 ± 3.10 (17)	-16.94 ± 44.33 (793)
	Nonteaching	46.53 ± 49.62 (371)	80.07 ± 50.20 (35)	49.42 ± 45.54 (406)
	Teaching & nonteaching	3.29 ± 34.59 (1147)	54.91 ± 34.02 (52)	5.52 ± 33.12 (1199)
All hospitals				
Profit	Teaching	61.18 ± 245.20 (29)	no cases	61.18 ± 245.20 (29)
	Nonteaching	59.65 ± 65.64 (178)	18.16 ± 145.13 (65)	48.56 ± 61.64 (243)
	Teaching & nonteaching	59.87 ± 65.79 (207)	18.16 ± 145.13 (65)	49.90 ± 60.77 (272)
Nonprofit	Teaching	-17.54 ± 44.47 (850)	-7.51 ± 9.08 (37)	-17.12 ± 42.62 (887)
	Nonteaching	44.57 ± 43.73 (578)	15.12 ± 34.49 (304)	34.42 ± 31.01 (882)
	Teaching & nonteaching	7.59 ± 31.84 (1428)	12.67 ± 30.76 (341)	8.57 ± 26.38 (1769)
Government	Teaching	120.01 ± 96.04 (84)	2.99 ± 35.56 (8)	109.84 ± 87.76 (92)
	Nonteaching	-129.39 ± 94.07 (126)	-23.66 ± 51.50 (192)	-65.55 ± 48.54 (318)
	Teaching & nonteaching	-29.62 ± 68.64 (210)	-22.60 ± 49.45 (200)	-26.20 ± 42.59 (410)
All	Teaching	-3.17 ± 40.80 (963)	-5.64 ± 9.57 (45)	-3.28 ± 38.98 (1008)
	Nonteaching	22.76 ± 34.34 (882)	2.20 ± 30.62 (561)	14.76 ± 24.12 (1443)
	Teaching & nonteaching	9.22 ± 26.88 (1845)	1.61 ± 28.36 (606)	7.34 ± 21.41 (2451)

Appendix 16: Mean reimbursement change by patient demography, 1988

$ ± standard error (n)	Male	Female	Male & female
0-64 years			
White	40.71 ± 104.51 (113)	155.88 ± 107.13 (68)	83.98 ± 76.58 (181)
Black	-190.50 ± 185.56 (21)	33.43 ± 33.43 (18)	-87.15 ± 101.57 (39)
Other	891.56 ± 667.32 (8)	304.13 ± 304.13 (3)	731.35 ± 488.46 (11)
Unknown	no cases	0.00 ± 0.00 (1)	0.00 ± 0.00 (1)
All races	54.45 ± 96.00 (142)	134.60 ± 81.73 (90)	85.54 ± 66.69 (232)
65-74 years			
White	-84.72 ± 50.63 (458)	-5.02 ± 59.08 (464)	-44.61 ± 38.94 (922)
Black	-149.44 ± 286.54 (30)	57.57 ± 135.40 (38)	-33.75 ± 146.61 (68)
Other	0.00 ± 0.00 (5)	-60.68 ± 60.68 (8)	-37.34 ± 37.34 (13)
Unknown	0.00 ± 0.00 (3)	0.00 ± 0.00 (1)	0.00 ± 0.00 (4)
All races	-87.26 ± 49.77 (496)	-1.23 ± 54.57 (511)	-43.60 ± 36.99 (1007)
75-84 years			
White	1.27 ± 55.41 (328)	12.31 ± 44.47 (456)	7.69 ± 34.71 (784)
Black	141.35 ± 241.91 (26)	121.36 ± 248.39 (27)	131.17 ± 171.81 (53)
Other	-139.91 ± 139.91 (5)	0.00 ± 0.00 (2)	-99.94 ± 99.94 (7)
Unknown	0.00 ± 0.00 (4)	0.00 ± 0.00 (6)	0.00 ± 0.00 (10)
All races	9.35 ± 52.94 (363)	18.11 ± 43.44 (491)	14.38 ± 33.60 (854)
85+ years			
White	272.41 ± 159.53 (82)	26.74 ± 47.21 (236)	90.09 ± 54.21 (318)
Black	247.99 ± 167.79 (8)	-89.17 ± 51.65 (20)	7.16 ± 65.46 (28)
Other	0.00 ± 0.00 (2)	344.12 ± 344.12 (2)	172.06 ± 172.06 (4)
Unknown	0.00 ± 0.00 (1)	34.32 ± 99.43 (7)	30.03 ± 86.22 (8)
All races	261.53 ± 141.30 (93)	20.59 ± 42.39 (265)	83.18 ± 48.49 (358)
All ages			
White	-11.66 ± 35.07 (981)	16.50 ± 29.89 (1224)	3.96 ± 22.77 (2205)
Black	-33.23 ± 133.82 (85)	41.58 ± 82.19 (103)	7.75 ± 75.25 (188)
Other	321.64 ± 279.65 (20)	74.34 ± 83.35 (15)	215.65 ± 163.21 (35)
Unknown	0.00 ± 0.00 (8)	16.01 ± 44.70 (15)	10.44 ± 28.84 (23)
All races	-7.16 ± 33.50 (1094)	19.03 ± 27.69 (1357)	7.34 ± 21.41 (2451)

Appendix 17: Number of bills by hospital demography, 1988

		Metropolitan	Nonmetropolitan	Metropolitan & nonmetropolitan
1-99 beds				
Profit	Teaching	8,876	1,691	10,567
	Nonteaching	83,977	91,264	175,241
	Teaching & nonteaching	92,853	92,955	185,808
Nonprofit	Teaching	21,384	9,037	30,421
	Nonteaching	174,928	439,549	614,477
	Teaching & nonteaching	196,312	448,586	644,898
Government	Teaching	4,569	6,419	10,988
	Nonteaching	86,337	405,219	491,556
	Teaching & nonteaching	90,906	411,638	502,544
All	Teaching	34,829	17,147	51,976
	Nonteaching	345,242	936,032	1,281,274
	Teaching & nonteaching	380,071	953,179	1,333,250
100-299 beds				
Profit	Teaching	50,948	2,646	53,594
	Nonteaching	450,101	116,651	566,752
	Teaching & nonteaching	501,049	119,297	620,346
Nonprofit	Teaching	593,874	74,009	667,883
	Nonteaching	1,048,692	590,859	1,639,551
	Teaching & nonteaching	1,642,566	664,868	2,307,434
Government	Teaching	52,050	11,592	63,642
	Nonteaching	211,194	251,962	463,156
	Teaching & nonteaching	263,244	263,554	526,798
All	Teaching	696,872	88,247	785,119
	Nonteaching	1,709,987	959,472	2,669,459
	Teaching & nonteaching	2,406,859	1,047,719	3,454,578
300+ beds				
Profit	Teaching	39,320	0	39,320
	Nonteaching	176,753	695	177,448
	Teaching & nonteaching	216,073	695	216,768
Nonprofit	Teaching	2,751,312	79,639	2,830,951
	Nonteaching	984,754	90,301	1,075,055
	Teaching & nonteaching	3,736,066	169,940	3,906,006
Government	Teaching	345,560	23,249	368,809
	Nonteaching	185,518	41,426	226,944
	Teaching & nonteaching	531,078	64,675	595,753
All	Teaching	3,136,192	102,888	3,239,080
	Nonteaching	1,347,025	132,422	1,479,447
	Teaching & nonteaching	4,483,217	235,310	4,718,527
All hospitals				
Profit	Teaching	99,144	4,337	103,481
	Nonteaching	710,831	208,610	919,441
	Teaching & nonteaching	809,975	212,947	1,022,922
Nonprofit	Teaching	3,366,570	162,685	3,529,255
	Nonteaching	2,208,374	1,120,709	3,329,083
	Teaching & nonteaching	5,574,944	1,283,394	6,858,338
Government	Teaching	402,179	41,260	443,439
	Nonteaching	483,049	698,607	1,181,656
	Teaching & nonteaching	885,228	739,867	1,625,095
All	Teaching	3,867,893	208,282	4,076,175
	Nonteaching	3,402,254	2,027,926	5,430,180
	Teaching & nonteaching	7,270,147	2,236,208	9,506,355

Appendix 18: Number of bills by patient demography, 1988

	Male	Female	Male & female
0-64 years			
White	433,869	286,341	720,210
Black	92,765	77,408	170,173
Other	18,413	13,761	32,174
Unknown	10,621	7,472	18,093
All races	555,668	384,982	940,650
65-74 years			
White	1,688,067	1,736,299	3,424,366
Black	142,841	170,281	313,122
Other	32,047	36,889	68,936
Unknown	59,395	66,474	125,869
All races	1,922,350	2,009,943	3,932,293
75-84 years			
White	1,234,017	1,660,303	2,894,320
Black	100,353	137,871	238,224
Other	20,111	16,006	36,117
Unknown	39,761	55,530	95,291
All races	1,394,242	1,869,710	3,263,952
85+ years			
White	383,775	838,975	1,222,750
Black	33,695	71,990	105,685
Other	6,338	6,815	13,153
Unknown	8,188	19,690	27,878
All races	431,996	937,470	1,369,466
All ages			
White	3,739,728	4,521,918	8,261,646
Black	369,654	457,550	827,204
Other	76,909	73,471	150,380
Unknown	117,965	149,166	267,131
All races	4,304,256	5,202,105	9,506,361*

*. This total includes six bills not in the previous table because they could not be classified by hospital control.

Appendix 19: Projected reimbursement effect by hospital demography, 1988

$1,000s ± standard error		Metropolitan	Nonmetropolitan	Metropolitan & nonmetropolitan
1-99 beds				
Profit	Teaching	1,200 ± 1,200	no cases	1,428 ± 1,428
	Nonteaching	1,273 ± 3,797	6,058 ± 22,375	8,247 ± 26,763
	Teaching & nonteaching	3,980 ± 4,296	6,170 ± 22,790	10,409 ± 25,582
Nonprofit	Teaching	53 ± 53	0 ± 0	50 ± 50
	Nonteaching	-22,648 ± 29,372	1,991 ± 23,204	-15,454 ± 33,981
	Teaching & nonteaching	-24,017 ± 31,172	2,014 ± 23,492	-15,897 ± 34,999
Government	Teaching	0 ± 0	428 ± 428	549 ± 549
	Nonteaching	-23,361 ± 16,296	13,072 ± 18,912	-12,810 ± 26,028
	Teaching & nonteaching	-23,686 ± 16,536	13,658 ± 18,705	-11,996 ± 25,856
All	Teaching	3,158 ± 3,136	857 ± 857	4,061 ± 3,272
	Nonteaching	-48,006 ± 32,777	22,128 ± 40,511	-18,502 ± 51,264
	Teaching & nonteaching	-44,119 ± 32,736	22,905 ± 40,644	-14,786 ± 51,503
100-299 beds				
Profit	Teaching	12,422 ± 23,159	no cases	13,067 ± 24,362
	Nonteaching	-3,898 ± 32,538	-3,682 ± 18,140	-7,696 ± 37,185
	Teaching & nonteaching	10,031 ± 40,891	-3,765 ± 18,552	6,172 ± 44,764
Nonprofit	Teaching	3,171 ± 63,188	-1,165 ± 1,165	1,783 ± 62,060
	Nonteaching	78,180 ± 80,372	9,519 ± 30,358	86,470 ± 84,748
	Teaching & nonteaching	82,440 ± 102,069	8,238 ± 30,192	89,298 ± 104,711
Government	Teaching	14,982 ± 14,853	-680 ± 680	15,168 ± 15,604
	Nonteaching	-22,099 ± 24,564	-33,783 ± 30,029	-56,695 ± 39,419
	Teaching & nonteaching	1,508 ± 30,721	-34,520 ± 30,119	-35,353 ± 43,008
All	Teaching	37,631 ± 68,739	-1,862 ± 1,352	35,393 ± 68,250
	Nonteaching	55,985 ± 90,578	-28,794 ± 46,592	24,105 ± 100,665
	Teaching & nonteaching	93,771 ± 113,748	-30,656 ± 46,603	59,384 ± 121,498
300+ beds				
Profit	Teaching	-13,241 ± 9,223	no cases	-13,241 ± 9,223
	Nonteaching	48,844 ± 34,234	no cases	49,036 ± 34,368
	Teaching & nonteaching	38,081 ± 36,501	no cases	38,203 ± 36,619
Nonprofit	Teaching	-61,409 ± 135,144	280 ± 280	-61,658 ± 136,169
	Nonteaching	37,056 ± 48,726	6,067 ± 4,918	42,798 ± 49,442
	Teaching & nonteaching	-20,249 ± 141,709	7,030 ± 5,526	-14,491 ± 142,804
Government	Teaching	26,048 ± 33,347	0 ± 0	26,971 ± 34,524
	Nonteaching	-15,302 ± 32,449	4,220 ± 4,220	-10,601 ± 32,292
	Teaching & nonteaching	1,986 ± 50,511	5,710 ± 5,710	7,870 ± 50,639
All	Teaching	-54,507 ± 142,069	319 ± 319	-54,870 ± 143,588
	Nonteaching	62,677 ± 66,839	10,603 ± 6,648	73,114 ± 67,374
	Teaching & nonteaching	14,750 ± 155,074	12,921 ± 8,005	26,046 ± 156,278
All hospitals				
Profit	Teaching	6,066 ± 24,310	no cases	6,331 ± 25,374
	Nonteaching	42,401 ± 46,659	3,788 ± 30,276	44,648 ± 56,674
	Teaching & nonteaching	48,493 ± 53,288	3,867 ± 30,905	51,044 ± 62,163
Nonprofit	Teaching	-59,050 ± 149,711	-1,222 ± 1,477	-60,421 ± 150,417
	Nonteaching	98,427 ± 96,572	16,945 ± 38,653	114,587 ± 103,235
	Teaching & nonteaching	42,314 ± 177,506	16,261 ± 39,477	58,776 ± 180,923
Government	Teaching	48,266 ± 38,625	123 ± 1,467	48,707 ± 38,916
	Nonteaching	-62,502 ± 45,440	-16,529 ± 35,978	-77,458 ± 57,358
	Teaching & nonteaching	-26,220 ± 60,762	-16,721 ± 36,586	-42,577 ± 69,213
All	Teaching	-12,261 ± 157,810	-1,175 ± 1,993	-13,370 ± 158,889
	Nonteaching	77,435 ± 116,833	4,461 ± 62,095	80,149 ± 130,976
	Teaching & nonteaching	67,031 ± 195,422	3,600 ± 63,419	69,777 ± 203,531

Appendix 20: Projected reimbursement effect by patient demography, 1988

$1,000s ± standard error	Male	Female	Male & female
0-64 years			
White	17,663 ± 45,344	44,635 ± 30,676	60,483 ± 55,154
Black	-17,672 ± 17,213	2,588 ± 2,588	-14,831 ± 17,284
Other	16,416 ± 12,287	4,185 ± 4,185	23,530 ± 15,716
Unknown	no cases	0 ± 0	0 ± 0
All races	30,256 ± 53,344	51,819 ± 31,465	80,463 ± 62,732
65-74 years			
White	-143,013 ± 85,467	-8,716 ± 102,581	-152,761 ± 133,345
Black	-21,346 ± 40,930	9,803 ± 23,056	-10,568 ± 45,907
Other	0 ± 0	-2,238 ± 2,238	-2,574 ± 2,574
Unknown	0 ± 0	0 ± 0	0 ± 0
All races	-167,744 ± 95,675	-2,472 ± 109,683	-171,448 ± 145,456
75-84 years			
White	1,567 ± 68,377	20,438 ± 73,834	22,257 ± 100,462
Black	14,185 ± 24,276	16,732 ± 34,246	31,248 ± 40,929
Other	-2,814 ± 2,814	0 ± 0	-3,610 ± 3,610
Unknown	0 ± 0	0 ± 0	0 ± 0
All races	13,036 ± 73,811	33,860 ± 81,220	46,936 ± 109,669
85+ years			
White	104,544 ± 61,224	22,434 ± 39,608	110,158 ± 66,285
Black	8,356 ± 5,654	-6,419 ± 3,718	757 ± 6,918
Other	0 ± 0	2,345 ± 2,345	2,263 ± 2,263
Unknown	0 ± 0	676 ± 1,958	837 ± 2,404
All races	112,980 ± 61,041	19,303 ± 39,739	113,912 ± 66,405
All ages			
White	-43,605 ± 131,152	74,612 ± 135,160	32,716 ± 188,118
Black	-12,284 ± 49,467	19,025 ± 37,606	6,411 ± 62,247
Other	24,737 ± 21,508	5,462 ± 6,124	32,429 ± 24,544
Unknown	0 ± 0	2,388 ± 6,668	2,789 ± 7,704
All races	-30,818 ± 144,193	98,996 ± 144,046	69,777 ± 203,531

Appendix 21: DRG frequency, error frequency, and error proportion by proportion of errors, 1988

#	DRG description	n\x [%]
2	Craniotomy for trauma age >=18	1\0 [0.0]
4	Spinal procedures	1\0 [0.0]
7	Peripheral & cranial nerve & other nervous system procedures age >=70 &/or cc	1\0 [0.0]
16	Nonspecific cerebrovascular disorders with cc	1\0 [0.0]
17	Nonspecific cerebrovascular disorders w/o cc	1\0 [0.0]
27	Traumatic stupor & coma, coma >1 hr	1\0 [0.0]
31	Concussion age >=70 and/or cc	1\0 [0.0]
32	Concussion age 18-69 w/o cc	1\0 [0.0]
47	Other disorders of the eye age >=18 w/o cc	1\0 [0.0]
51	Salivary gland procedures except sialoadenectomy	1\0 [0.0]
64	Ear, nose & throat malignancy	1\0 [0.0]
72	Nasal trauma & deformity	1\0 [0.0]
84	Major chest trauma age <70 w/o cc	1\0 [0.0]
94	Pneumothorax age >=70 and/or cc	1\0 [0.0]
95	Pneumothorax age <70 w/o cc	1\0 [0.0]
102	Other respiratory diagnoses age <70	1\0 [0.0]
118	Cardiac pacemaker pulse generator replacement only	1\0 [0.0]
126	Acute & subacute endocarditis	1\0 [0.0]
152	Minor small & large bowel procedures age >=70 and/or cc	1\0 [0.0]
164	Appendectomy with complicated principal diagnosis age>=70 and/or cc	1\0 [0.0]
173	Digestive malignancy age <70 w/o cc	1\0 [0.0]
178	Uncomplicated peptic ulcer <70 w/o cc	1\0 [0.0]
187	Dental extractions & restorations	1\0 [0.0]
193	Biliary tract procedure except total cholecystectomy age >=70 &/or cc	1\0 [0.0]
194	Biliary tract procedure except total cholecystectomy age <70 w/o cc	1\0 [0.0]
199	Hepatobiliary diagnostic procedure for malignancy	1\0 [0.0]
201	Other hepatobiliary or pancreas OR procedures	1\0 [0.0]
202	Cirrhosis & alcoholic hepatitis	1\0 [0.0]
221	Knee procedures age >=70 and/or cc	1\0 [0.0]
224	Upper extremity procedures except humerus & hand age <70 w/o cc	1\0 [0.0]
227	Soft tissue procedures age <70 w/o cc	1\0 [0.0]
232	Arthroscopy	1\0 [0.0]
235	Fractures of femur	1\0 [0.0]
237	Sprains, strains, & dislocations of hip, pelvis & thigh	1\0 [0.0]
238	Osteomyelitis	1\0 [0.0]
242	Septic arthritis	1\0 [0.0]
259	Subtotal mastectomy for malignancy age >=70 and/or cc	1\0 [0.0]
262	Breast biopsy & local excision for non-malignancy	1\0 [0.0]
264	Skin grafts for skin ulcer or cellulitis age <70 w/o cc	1\0 [0.0]
269	Other skin, subcutaneous tissue & breast OR procedure age >=70 &/or cc	1\0 [0.0]
274	Malignant breast disorders age >=70 and/or cc	1\0 [0.0]
285	Amputations for endocrine, nutritional & metabolic disorders	1\0 [0.0]
287	Skin grafts & wound debride for endocrine, nutritional & metabolic disorders	1\0 [0.0]
292	Other endocrine, nutritional & metabolic OR procedure age >70 &/or cc	1\0 [0.0]
300	Endocrine disorders age >=70 and/or cc	1\0 [0.0]
301	Endocrine disorders age <70 w/o cc	1\0 [0.0]
304	Kidney, ureter & major bladder procedure for non-malignancy age >=70 &/or cc	1\0 [0.0]
318	Kidney & urinary tract neoplasms age >=70 and/or cc	1\0 [0.0]
323	Urinary stones age >=70 and/or cc	1\0 [0.0]
334	Major male pelvic procedures with cc	1\0 [0.0]
339	Testes procedures, non-malignant age >=18	1\0 [0.0]
342	Circumcision age >=18	1\0 [0.0]
357	Uterus & adnexa procedures, for malignancy	1\0 [0.0]
363	D&C, conization & radioimplant, for malignancy	1\0 [0.0]
368	Infections, female reproductive system	1\0 [0.0]
394	Other OR procedures of the blood & blood forming organs	1\0 [0.0]
397	Coagulation disorders	1\0 [0.0]
399	Reticuloendothelial & immunity disorders age <70 w/o cc	1\0 [0.0]
420	Fever of unknown origin age 18-69 w/o cc	1\0 [0.0]
447	Allergic reactions age >=18	1\0 [0.0]
464	Signs & symptoms w/o cc	1\0 [0.0]
471	Bilateral or multiple major joint procedure of lower extremities	1\0 [0.0]
474	Respiratory system diagnosis with tracheostomy	1\0 [0.0]
476	Prostatic or procedure unrelated to principal diagnosis	1\0 [0.0]
8	Peripheral & cranial nerve & other nervous system procedure age <70 w/o cc	2\0 [0.0]
13	Multiple sclerosis & cerebellar ataxia	2\0 [0.0]

19	Cranial & peripheral nerve disorders age <70 w/o cc	2\0 [0.0]
35	Other disorders of nervous system age <70 w/o cc	2\0 [0.0]
40	Extraocular procedures except orbit age >=18	2\0 [0.0]
44	Acute major eye infections	2\0 [0.0]
53	Sinus & mastoid procedures age >=18	2\0 [0.0]
73	Other ear, nose & throat diagnoses age >=18	2\0 [0.0]
83	Major chest trauma age >=70 and/or cc	2\0 [0.0]
100	Respiratory signs & symptoms age <70 w/o cc	2\0 [0.0]
168	Procedures on the mouth age >=70 and/or cc	2\0 [0.0]
189	Other digestive system diagnoses age 18-69 w/o cc	2\0 [0.0]
217	Wound debridement & skin graft except hand for musculoskeletal & connective tissue disorders	2\0 [0.0]
230	Local excision & removal of internal fixation devices of hip & femur	2\0 [0.0]
231	Local excision & removal of internal fixation devices except hip & femur	2\0 [0.0]
233	Other musculoskeletal system & connective tissue OR procedure age >=70 &/or cc	2\0 [0.0]
245	Bone diseases & septic arthropathy age <70 w/o cc	2\0 [0.0]
253	Fractures, sprains, strains & dislocations of upper arm, lower leg except foot age >=70 &/or cc	2\0 [0.0]
280	Trauma to the skin, subcutaneous tissue & breast age >=70 &/or cc	2\0 [0.0]
302	Kidney transplant	2\0 [0.0]
324	Urinary stones age <70 w/o cc	2\0 [0.0]
338	Testes procedures, for malignancy	2\0 [0.0]
354	Non-radical hysterectomy age >=70 and/or cc	2\0 [0.0]
355	Non-radical hysterectomy age <70 w/o cc	2\0 [0.0]
408	Myeloproliferative disorder or poorly differentiated neoplasm with minor OR procedure	2\0 [0.0]
418	Postoperative & post-traumatic infections	2\0 [0.0]
22	Hypertensive encephalopathy	3\0 [0.0]
45	Neurological eye disorders	3\0 [0.0]
49	Major head & neck procedures	3\0 [0.0]
66	Epistaxis	3\0 [0.0]
105	Cardiac valve procedure with pump & w/o cardiac catheterization	3\0 [0.0]
115	Permanent cardiac pacemaker implant with AMI or CHF	3\0 [0.0]
146	Rectal resection age >=70 and/or cc	3\0 [0.0]
159	Hernia procedures except inguinal & femoral age >=70 and/or cc	3\0 [0.0]
179	Inflammatory bowel disease	3\0 [0.0]
208	Disorders of the biliary tract age <70 w/o cc	3\0 [0.0]
219	Lower extremity & humerus procedures except hip, foot, femur age 18-69 w/o cc	3\0 [0.0]
225	Foot procedures	3\0 [0.0]
228	Ganglion (hand) procedures	3\0 [0.0]
249	Aftercare, musculoskeletal system & connective tissue	3\0 [0.0]
261	Breast procedure for non-malignancy except biopsy & local excision	3\0 [0.0]
271	Skin ulcers	3\0 [0.0]
283	Minor skin disorders age >=70 and/or cc	3\0 [0.0]
290	Thyroid procedures	3\0 [0.0]
308	Minor bladder procedures age >=70 and/or cc	3\0 [0.0]
400	Lymphoma or leukemia with major OR procedure	3\0 [0.0]
404	Lymphoma or leukemia age 18-69 w/o cc	3\0 [0.0]
42	Intraocular procedures except retina, iris & lens	4\0 [0.0]
172	Digestive malignancy age >=70 and/or cc	4\0 [0.0]
223	Upper extremity procedure except humerus & hand age >=70 and/or cc	4\0 [0.0]
247	Signs & symptoms of musculoskeletal system & connective tissue	4\0 [0.0]
341	Penis procedures	4\0 [0.0]
350	Inflammation of the male reproductive system	4\0 [0.0]
443	Other OR procedures for injuries age <70 w/o cc	4\0 [0.0]
113	Amputation for circulatory system disorders except upper limb & toe	5\0 [0.0]
128	Deep vein thrombophlebitis	5\0 [0.0]
134	Hypertension	5\0 [0.0]
157	Anal procedures age >=70 and/or cc	5\0 [0.0]
158	Anal procedures age <70 w/o cc	5\0 [0.0]
181	Gastrointestinal Obstruction age <70 w/o cc	5\0 [0.0]
218	Lower extremity & humerus procedures except hip, foot, femur age >=70 &/or cc	5\0 [0.0]
325	Kidney & urinary tract signs & symptoms age >=70 and/or cc	5\0 [0.0]
356	Female reproductive system reconstructive procedures	5\0 [0.0]
1	Craniotomy age >=18 except for trauma	6\0 [0.0]
10	Nervous system neoplasms age >=70 and/or cc	6\0 [0.0]
39	Lens procedures	6\0 [0.0]
129	Cardiac arrest	6\0 [0.0]
205	Disorders of liver except malignancy, cirrhosis, alcoholic hepatitis age >=70 and/or cc	6\0 [0.0]
244	Bone diseases & septic arthropathy age >=70 and/or cc	6\0 [0.0]
358	Uterus & adnexa procedure for non-malignancy except tubal interrupt	6\0 [0.0]
75	Major chest procedures	7\0 [0.0]
160	Hernia procedures except inguinal & femoral age 18-69 w/o cc	7\0 [0.0]

278	Cellulitis age 18-69 w/o cc	7\0 [0.0]
316	Renal failure w/o dialysis	7\0 [0.0]
5	Extracranial vascular procedures	8\0 [0.0]
131	Peripheral vascular disorders age <70 w/o cc	8\0 [0.0]
257	Total mastectomy for malignancy age >=70 and/or cc	9\0 [0.0]
321	Kidney & urinary tract infections age 18-69 w/o cc	9\0 [0.0]
236	Fractures of hip & pelvis	10\0 [0.0]
116	Permanent cardiac pacemaker implant w/o AMI or CHF	14\0 [0.0]
395	Red blood cell disorders age >=18	14\0 [0.0]
123	Circulatory disorders with AMI, expired	25\0 [0.0]
410	Chemotherapy	34\0 [0.0]
209	Major joint procedures	55\1 [1.8]
140	Angina pectoris	89\2 [2.2]
14	Specific cerebrovascular disorders except tia	75\2 [2.7]
336	Transurethral prostatectomy age >=70 and/or cc	31\1 [3.2]
337	Transurethral prostatectomy age <70 w/o cc	29\1 [3.4]
79	Respiratory infections & inflammations age >=70 and/or cc	23\1 [4.3]
106	Coronary bypass with cardiac catheterization	17\1 [5.9]
294	Diabetes age >=36	17\1 [5.9]
15	Transient ischemic attacks	47\3 [6.4]
296	Nutritional & miscellaneous metabolic disorders age >=70 and/or cc	44\3 [6.8]
239	Pathological fractures & musculoskeletal malignancy	14\1 [7.1]
125	Circulatory disorders except AMI, with cardiac catheterization without complex diagnosis	25\2 [8.0]
89	Simple pneumonia & pleurisy age >=70 and/or cc	74\6 [8.1]
107	Coronary bypass w/o cardiac catheterization	12\1 [8.3]
78	Pulmonary embolism	11\1 [9.1]
96	Bronchitis & asthma age >=70 and/or cc	63\6 [9.5]
127	Heart failure & shock	133\13 [9.8]
215	Back & neck procedures age <70 w/o cc	10\1 [10.0]
24	Seizure & headache age >=70 and/or cc	20\2 [10.0]
122	Circulatory disorders with AMI w/o CV complications discharged alive	30\3 [10.0]
475	Respiratory system diagnosis with ventilator	19\2 [10.5]
197	Total cholecystectomy w/o CDE Age >=70 and/or cc	18\2 [11.1]
148	Major small & large bowel procedures age >=70 and/or cc	33\4 [12.1]
174	Gastrointestinal Hemorrhage age >=70 and/or cc	33\4 [12.1]
311	Transurethral procedures age <70 w/o cc	8\1 [12.5]
415	OR procedure for infectious & parasitic diseases	8\1 [12.5]
112	Vascular procedures except major reconstruction	32\4 [12.5]
143	Chest pain	32\4 [12.5]
121	Circulatory disorders with AMI & CV complications discharged alive	38\5 [13.2]
243	Medical back problems	22\3 [13.6]
214	Back & neck procedures age >=70 and/or cc	7\1 [14.3]
303	Kidney, ureter & major bladder procedure for neoplasm	7\1 [14.3]
310	Transurethral procedures age >=70 and/or cc	7\1 [14.3]
110	Major reconstructive vascular procedures age >=70 and/or cc	21\3 [14.3]
130	Peripheral vascular disorders age >=70 and/or cc	13\2 [15.4]
442	Other OR procedures for injuries age >=70 and/or cc	13\2 [15.4]
138	Cardiac arrhythmia & conduction disorders age >=70 and/or cc	45\7 [15.6]
139	Cardiac arrhythmia & conduction disorders age <70 w/o cc	19\3 [15.8]
416	Septicemia age >=18	31\5 [16.1]
258	Total mastectomy for malignancy age <70 w/o cc	6\1 [16.7]
142	Syncope & collapse age <70 w/o cc	12\2 [16.7]
162	Inguinal & femoral hernia procedures age 18-69 w/o cc	12\2 [16.7]
82	Respiratory neoplasms	24\4 [16.7]
210	Hip & femur procedures except major joint age >=70 and/or cc	23\4 [17.4]
154	Stomach, esophageal & duodenal procedures age >=70 and/or cc	11\2 [18.2]
124	Circulatory disorders except AMI with cardiac catheterization & complex diagnosis	21\4 [19.0]
182	Esophagitis, gastroenteritis & miscellaneous digestive disorders age >=70 &/or cc	66\13 [19.7]
25	Seizure & headache age 18-69 w/o cc	5\1 [20.0]
109	Cardiothoracic procedures w/o pump	5\1 [20.0]
150	Peritoneal adhesiolysis age >=70 and/or cc	5\1 [20.0]
161	Inguinal & femoral hernia procedures age >=70 and/or cc	5\1 [20.0]
315	Other kidney & urinary tract OR procedures	5\1 [20.0]
331	Other kidney & urinary tract diagnoses age >=70 and/or cc	5\1 [20.0]
398	Reticuloendothelial & immunity disorders age >=70 and/or cc	5\1 [20.0]
204	Disorders of pancreas except malignancy	10\2 [20.0]
320	Kidney & urinary tract infections age >=70 and/or cc	40\8 [20.0]
141	Syncope & collapse age >=70 and/or cc	19\4 [21.1]
65	Disequilibrium	9\2 [22.2]
195	Total cholecystectomy with CDE Age >=70 and/or cc	9\2 [22.2]

359	Tubal interruption for non-malignancy	9\2 [22.2]
452	Complications of treatment age >=70 and/or cc	9\2 [22.2]
183	Esophagitis, gastroenteritis & miscellaneous digestive disorders age 18-69 w/o cc	22\5 [22.7]
36	Retinal procedures	4\1 [25.0]
69	Otitis media & upper respiratory infection age 18-69 w/o cc	4\1 [25.0]
177	Uncomplicated peptic ulcer >=70 and/or cc	4\1 [25.0]
234	Other musculoskeletal system & connective tissue OR procedure age <70 w/o cc	4\1 [25.0]
254	Fractures, sprains, strains & dislocations of upper arm, lower leg except foot age 18-69 w/o cc	4\1 [25.0]
461	OR procedure with diagnoses of other contact with health services	4\1 [25.0]
466	Aftercare w/o history of malignancy as secondary diagnosis	4\1 [25.0]
80	Respiratory infections & inflammations age 18-69 w/o cc	8\2 [25.0]
207	Disorders of the biliary tract age >=70 and/or cc	8\2 [25.0]
188	Other digestive system diagnoses age >=70 and/or cc	11\3 [27.3]
449	Toxic effects of drugs age >=70 and/or cc	7\2 [28.6]
297	Nutritional & miscellaneous metabolic disorders age 18-69 w/o cc	14\4 [28.6]
468	Unrelated or procedure	21\6 [28.6]
76	OR procedure on the respiratory system except major chest with cc	10\3 [30.0]
6	Carpal tunnel release	3\1 [33.3]
85	Pleural effusion age >=70 and/or cc	3\1 [33.3]
111	Major reconstructive vascular procedures age <70 w/o cc	3\1 [33.3]
155	Stomach, esophageal & duodenal procedures age 18-69 w/o cc	3\1 [33.3]
170	Other digestive system procedures age >=70 and/or cc	3\1 [33.3]
176	Complicated peptic ulcer	3\1 [33.3]
306	Prostatectomy age >=70 and/or cc	3\1 [33.3]
332	Other kidney & urinary tract diagnoses age 18-69 w/o cc	3\1 [33.3]
450	Toxic effects of drugs age 18-69 w/o cc	3\1 [33.3]
12	Degenerative nervous system disorders	6\2 [33.3]
149	Major small & large bowel procedures age <70 w/o cc	6\2 [33.3]
175	Gastrointestinal Hemorrhage age <70 w/o cc	6\2 [33.3]
203	Malignancy of hepatobiliary system or pancreas	6\2 [33.3]
263	Skin grafts for skin ulcer or cellulitis age >=70 and/or cc	6\2 [33.3]
419	Fever of unknown origin age >=70 and/or cc	6\2 [33.3]
180	Gastrointestinal Obstruction age >=70 and/or cc	15\5 [33.3]
87	Pulmonary edema & respiratory failure	20\7 [35.0]
97	Bronchitis & asthma age 18-69 w/o cc	14\5 [35.7]
277	Cellulitis age >=70 and/or cc	19\7 [36.8]
104	Cardiac valve procedure with pump & with cardiac catheterization	5\2 [40.0]
144	Other circulatory diagnoses with cc	10\4 [40.0]
198	Total cholecystectomy w/o CDE Age <70 w/o cc	10\4 [40.0]
88	Chronic obstructive pulmonary disease	21\9 [42.9]
211	Hip & femur procedures except major joint age 18-69 w/o cc	9\4 [44.4]
90	Simple pneumonia & pleurisy age 18-69 w/o cc	22\10 [45.5]
68	Otitis media & uri age >=70 and/or cc	2\1 [50.0]
77	OR procedure on the respiratory system except major chest w/o cc	2\1 [50.0]
135	Cardiac congenital & valvular disorders age >=70 and/or cc	2\1 [50.0]
151	Peritoneal adhesiolysis age <70 w/o cc	2\1 [50.0]
216	Biopsies of musculoskeletal system & connective tissue	2\1 [50.0]
222	Knee procedures age <70 w/o cc	2\1 [50.0]
241	Connective tissue disorders age <70 w/o cc	2\1 [50.0]
248	Tendonitis, myositis & bursitis	2\1 [50.0]
270	Other skin, subcutaneous tissue & breast OR procedure age <70 w/o cc	2\1 [50.0]
284	Minor skin disorders age <70 w/o cc	2\1 [50.0]
299	Inborn errors of metabolism	2\1 [50.0]
305	Kidney, ureter & major bladder procedure for non-malignancy age <70 w/o cc	2\1 [50.0]
440	Wound debridements for injuries	2\1 [50.0]
455	Other injuries, poisonings & toxic effects diagnosis age <70 w/o cc	2\1 [50.0]
462	Rehabilitation	2\1 [50.0]
473	Acute leukemia w/o major or procedure age>17	2\1 [50.0]
11	Nervous system neoplasms age <70 w/o cc	4\2 [50.0]
18	Cranial & peripheral nerve disorders age >=70 and/or cc	4\2 [50.0]
101	Other respiratory diagnoses age >=70 and/or cc	4\2 [50.0]
191	Major pancreas, liver & shunt procedures	4\2 [50.0]
346	Malignancy, male reproductive system, age >=70 and/or cc	4\2 [50.0]
421	Viral illness age >=18	6\3 [50.0]
34	Other disorders of nervous system age >=70 and/or cc	5\3 [60.0]
403	Lymphoma or leukemia age >=70 and/or cc	5\3 [60.0]
99	Respiratory signs & symptoms age >=70 and/or cc	8\5 [62.5]
120	Other OR procedures on the circulatory system	3\2 [66.7]
185	Dental & oral disease except extractions & restorations age >=18	3\2 [66.7]
413	Other myeloproliferative disorder or poorly differentiated neoplasm diagnosis age>=70 &/or cc	3\2 [66.7]

132	Atherosclerosis age >=70 and/or cc	4\3 [75.0]
28	Traumatic stupor & coma, coma <1 hr age >=70 and/or cc	1\1 [100.0]
55	Miscellaneous ear, nose & throat procedures	1\1 [100.0]
92	Interstitial lung disease age >=70 and/or cc	1\1 [100.0]
93	Interstitial lung disease age <70 w/o cc	1\1 [100.0]
133	Atherosclerosis age <70 w/o cc	1\1 [100.0]
136	Cardiac congenital & valvular disorders age 18-69 w/o cc	1\1 [100.0]
200	Hepatobiliary diagnostic procedure for non-malignancy	1\1 [100.0]
240	Connective tissue disorders age >=70 and/or cc	1\1 [100.0]
265	Skin grafts except for skin ulcer or cellulitis with cc	1\1 [100.0]
268	Skin, subcutaneous tissue & breast plastic procedures	1\1 [100.0]
307	Prostatectomy age <70 w/o cc	1\1 [100.0]
335	Major male pelvic procedures w/o cc	1\1 [100.0]
348	Benign prostatic hypertrophy age >=70 and/or cc	1\1 [100.0]
365	Other female reproductive system OR procedures	1\1 [100.0]
366	Malignancy, female reproductive system age >=70 and/or cc	1\1 [100.0]
367	Malignancy, female reproductive system age <70 w/o cc	1\1 [100.0]
401	Lymphoma or leukemia with minor OR procedure age >=70 and/or cc	1\1 [100.0]
406	Myeloproliferative disorder or neoplasm with major OR procedure & cc	1\1 [100.0]
463	Signs & symptoms with cc	1\1 [100.0]
23	Nontraumatic stupor & coma	2\2 [100.0]
117	Cardiac pacemaker replace & revision except pulse generator replacement only	2\2 [100.0]
145	Other circulatory diagnoses w/o cc	2\2 [100.0]
153	Minor small & large bowel procedures age <70 w/o cc	2\2 [100.0]
213	Amputations for musculoskeletal system & connective tissue disorders	2\2 [100.0]
453	Complications of treatment age <70 w/o cc	3\3 [100.0]
	Total	2451\361 [14.7]

Appendix 22: Mean weight, dollar change, and estimated national financial effect by DRG, 1988

#	DRG description	Mean change ± standard error		National effect
		Relative weight	$1	($1,000)
1	Craniotomy age >=18 except for trauma	0.0000 ± 0.0000	0 ± 0	0 ± 0
2	Craniotomy for trauma age >=18	0.0000 ± 0.0000	0 ± 0	0 ± 0
4	Spinal procedures	0.0000 ± 0.0000	0 ± 0	0 ± 0
5	Extracranial vascular procedures	0.0000 ± 0.0000	0 ± 0	0 ± 0
6	Carpal tunnel release	0.0270 ± 0.0270	84 ± 84	832 ± 832
7	Peripheral & cranial nerve age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
8	Peripheral & cranial nerve procedure age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
10	Nervous system neoplasms age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
11	Nervous system neoplasms age <70 w/o cc	0.1481 ± 0.1036	461 ± 322	6,095 ± 4,263
12	Degenerative nervous system disorders	-0.1054 ± 0.0679	-328 ± 211	-6,509 ± 4,195
13	Multiple sclerosis & cerebellar ataxia	0.0000 ± 0.0000	0 ± 0	0 ± 0
14	Specific cerebrovascular disorders except tia	0.0178 ± 0.0281	59 ± 86	14,804 ± 21,381
15	Transient ischemic attacks	0.0455 ± 0.0395	138 ± 122	21,539 ± 19,033
16	Nonspecific cerebrovascular with cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
17	Nonspecific cerebrovascular disorders w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
18	Peripheral nerve age >=70 and/or cc	-0.1366 ± 0.0834	-425 ± 260	-5,621 ± 3,434
19	Cranial & peripheral nerve age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
22	Hypertensive encephalopathy	0.0000 ± 0.0000	0 ± 0	0 ± 0
23	Nontraumatic stupor & coma	0.2099 ± 0.2376	660 ± 734	4,362 ± 4,845
24	Seizure & headache age >=70 and/or cc	-0.0052 ± 0.0244	-16 ± 76	-1,062 ± 5,019
25	Seizure & headache age 18-69 w/o cc	-0.0157 ± 0.0157	-49 ± 49	-809 ± 809
27	Traumatic stupor & coma >1 hr	0.0000 ± 0.0000	0 ± 0	0 ± 0
28	Traumatic stupor <1 hr age >=70 and/or cc	-0.2466 ± 0.0000	-650 ± 0	-2,146 ± 0
31	Concussion age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
32	Concussion age 18-69 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
34	Nervous system age >=70 and/or cc	-0.0591 ± 0.1383	-120 ± 392	-1,986 ± 6,478
35	Other nervous system age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
36	Retinal procedures	0.0071 ± 0.0071	22 ± 22	292 ± 292
39	Lens procedures	0.0000 ± 0.0000	0 ± 0	0 ± 0
40	Extraocular procedures except orbit age >=18	0.0000 ± 0.0000	0 ± 0	0 ± 0
42	Intraocular procedures except retina, iris	0.0000 ± 0.0000	0 ± 0	0 ± 0
44	Acute major eye infections	0.0000 ± 0.0000	0 ± 0	0 ± 0
45	Neurological eye disorders	0.0000 ± 0.0000	0 ± 0	0 ± 0
47	Other disorders of the eye age >=18 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
49	Major head & neck procedures	0.0000 ± 0.0000	0 ± 0	0 ± 0
51	Salivary gland except sialoadenectomy	0.0000 ± 0.0000	0 ± 0	0 ± 0
53	Sinus & mastoid procedures age >=18	0.0000 ± 0.0000	0 ± 0	0 ± 0
55	Miscellaneous ear, nose & throat procedures	0.1561 ± 0.0000	411 ± 0	1,358 ± 0
64	Ear, nose & throat malignancy	0.0000 ± 0.0000	0 ± 0	0 ± 0
65	Disequilibrium	0.0175 ± 0.0116	54 ± 36	1,619 ± 1,071
66	Epistaxis	0.0000 ± 0.0000	0 ± 0	0 ± 0
68	Otitis media & uri age >=70 and/or cc	-0.0334 ± 0.0334	-87 ± 87	-580 ± 580
69	Otitis media & uri age 18-69 w/o cc	0.0198 ± 0.0198	61 ± 61	816 ± 816
72	Nasal trauma & deformity	0.0000 ± 0.0000	0 ± 0	0 ± 0
73	Other ear, nose & throat diagnoses age >=18	0.0000 ± 0.0000	0 ± 0	0 ± 0
75	Major chest procedures	0.0000 ± 0.0000	0 ± 0	0 ± 0
76	OR respiratory except major chest with cc	-0.2452 ± 0.1329	-764 ± 414	-25,227 ± 13,673
77	OR procedure on the respiratory except chest w/o cc	0.0465 ± 0.0465	122 ± 122	808 ± 808
78	Pulmonary embolism	0.0542 ± 0.0542	142 ± 142	5,186 ± 5,186
79	Respiratory infections age >=70 and/or cc	-0.0388 ± 0.0388	-120 ± 120	-9,174 ± 9,174
80	Respiratory infections age 18-69 w/o cc	0.0870 ± 0.0940	271 ± 293	7,158 ± 7,737
82	Respiratory neoplasms	-0.0982 ± 0.0494	-306 ± 154	-24,248 ± 12,209
83	Major chest trauma age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
84	Major chest trauma age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
85	Pleural effusion age >=70 and/or cc	-0.0410 ± 0.0410	-108 ± 108	-1,069 ± 1,069
87	Pulmonary edema & respiratory failure	-0.1915 ± 0.0684	-570 ± 206	-37,671 ± 13,643
88	Chronic obstructive pulmonary disease	-0.0083 ± 0.0540	-22 ± 168	-1,572 ± 11,647
89	Simple pneumonia age >=70 and/or cc	0.0442 ± 0.0246	134 ± 74	32,832 ± 18,153
90	Simple pneumonia age 18-69 w/o cc	0.2442 ± 0.0756	704 ± 205	51,158 ± 14,955
92	Interstitial lung disease age >=70 and/or cc	-0.4557 ± 0.0000	-1,420 ± 0	-4,689 ± 0
93	Interstitial lung disease age <70 w/o cc	-0.0461 ± 0.0000	-143 ± 0	-474 ± 0
94	Pneumothorax age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
95	Pneumothorax age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
96	Bronchitis & asthma age >=70 and/or cc	-0.0006 ± 0.0104	2 ± 30	447 ± 6,388
97	Bronchitis & asthma age 18-69 w/o cc	0.0570 ± 0.0356	168 ± 107	7,794 ± 4,948

99	Respiratory signs age >=70 and/or cc	0.2896 ± 0.1515	804 ± 397	21,229 ± 10,496
100	Respiratory signs & symptoms age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
101	Other respiratory age >=70 and/or cc	-0.0898 ± 0.0703	-279 ± 219	-3,694 ± 2,895
102	Other respiratory diagnoses age <70	0.0000 ± 0.0000	0 ± 0	0 ± 0
104	Cardiac valve with pump & cardiac catheterization	-1.5763 ± 1.2239	-4,914 ± 3,816	-81,096 ± 62,966
105	Cardiac valve with pump & w/o cardiac catheterization	0.0000 ± 0.0000	0 ± 0	0 ± 0
106	Coronary bypass with cardiac catheterization	-0.0739 ± 0.0739	-230 ± 230	-12,920 ± 12,920
107	Coronary bypass w/o cardiac catheterization	0.1046 ± 0.1046	326 ± 326	12,920 ± 12,920
109	Cardiothoracic procedures w/o pump	-0.1777 ± 0.1777	-554 ± 554	-9,141 ± 9,141
110	Major vascular age >=70 and/or cc	-0.2189 ± 0.1208	-682 ± 376	-47,295 ± 26,103
111	Major reconstructive vascular age <70 w/o cc	0.4693 ± 0.4693	1,463 ± 1,463	14,486 ± 14,486
112	Vascular procedures except reconstruction	0.0611 ± 0.0693	190 ± 216	20,130 ± 22,812
113	Amputation except upper limb & toe	0.0000 ± 0.0000	0 ± 0	0 ± 0
115	Cardiac pacemaker implant with AMI or CHF	0.0000 ± 0.0000	0 ± 0	0 ± 0
116	Cardiac pacemaker implant w/o AMI or CHF	0.0000 ± 0.0000	0 ± 0	0 ± 0
117	Cardiac pacemaker replacement except pulse generator	0.6697 ± 0.8736	1,765 ± 2,303	11,656 ± 15,204
118	Cardiac pacemaker generator replacement	0.0000 ± 0.0000	0 ± 0	0 ± 0
120	OR procedures on the circulatory system	-0.3202 ± 0.3813	-998 ± 1,188	-9,884 ± 11,770
121	AMI & CV complications discharged alive	-0.0627 ± 0.0269	-188 ± 81	-23,693 ± 10,169
122	AMI w/o CV complications discharged alive	0.0108 ± 0.0344	25 ± 103	2,512 ± 10,235
123	Circulatory disorders with AMI, expired	0.0000 ± 0.0000	0 ± 0	0 ± 0
124	Circulatory except AMI with card catheterization	-0.0396 ± 0.0459	-112 ± 137	-7,777 ± 9,559
125	Circulatory except AMI with card catheterization	0.0189 ± 0.0197	58 ± 61	4,864 ± 5,077
126	Acute & subacute endocarditis	0.0000 ± 0.0000	0 ± 0	0 ± 0
127	Heart failure & shock	0.0491 ± 0.0263	153 ± 81	67,522 ± 35,924
128	Deep vein thrombophlebitis	0.0000 ± 0.0000	0 ± 0	0 ± 0
129	Cardiac arrest	0.0000 ± 0.0000	0 ± 0	0 ± 0
130	Peripheral vascular age >=70 and/or cc	0.0086 ± 0.0071	22 ± 18	974 ± 804
131	Peripheral vascular disorders age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
132	Atherosclerosis age >=70 and/or cc	-0.0801 ± 0.0679	-211 ± 179	-2,788 ± 2,364
133	Atherosclerosis age <70 w/o cc	-0.0745 ± 0.0000	-232 ± 0	-767 ± 0
134	Hypertension	0.0000 ± 0.0000	0 ± 0	0 ± 0
135	Cardiac congenital age >=70 and/or cc	-0.0123 ± 0.0123	-32 ± 32	-213 ± 213
136	Cardiac congenital age 18-69 w/o cc	0.2432 ± 0.0000	758 ± 0	2,502 ± 0
138	Arrhythmias age >=70 and/or cc	-0.0190 ± 0.0215	-59 ± 66	-8,806 ± 9,938
139	Arrhythmia & conduction age <70 w/o cc	0.0480 ± 0.0267	149 ± 83	9,380 ± 5,224
140	Angina pectoris	0.0026 ± 0.0036	6 ± 9	2,035 ± 2,801
141	Syncope & collapse age >=70 and/or cc	0.0126 ± 0.0325	43 ± 100	2,736 ± 6,296
142	Syncope & collapse age <70 w/o cc	0.0217 ± 0.0150	61 ± 41	2,434 ± 1,654
143	Chest pain	0.0640 ± 0.0481	199 ± 150	21,086 ± 15,853
144	Other circulatory diagnoses with cc	-0.0586 ± 0.0255	-182 ± 79	-6,033 ± 2,625
145	Other circulatory diagnoses w/o cc	0.1995 ± 0.3318	653 ± 1,002	4,315 ± 6,618
146	Rectal resection age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
148	Lower GI procedures age >=70 and/or cc	-0.0644 ± 0.0784	-201 ± 221	-21,952 ± 24,142
149	Bowel procedures age <70 w/o cc	0.7018 ± 0.3138	2,075 ± 933	41,096 ± 18,486
150	Peritoneal adhesiolysis age >=70 and/or cc	-0.2382 ± 0.2382	-742 ± 742	-12,257 ± 12,257
151	Peritoneal adhesiolysis age <70 w/o cc	0.5956 ± 0.5956	1,857 ± 1,857	12,257 ± 12,257
152	Minor bowel procedures age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
153	Minor bowel procedures age <70 w/o cc	0.1231 ± 0.6545	383 ± 2,040	2,532 ± 13,468
154	Upper GI procedures age >=70 and/or cc	-0.3760 ± 0.2713	-1,114 ± 827	-40,454 ± 30,029
155	Upper GI procedures age 18-69 w/o cc	-0.3657 ± 0.3657	-964 ± 964	-9,547 ± 9,547
157	Anal procedures age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
158	Anal procedures age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
159	Hernia except inguinal age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
160	Hernia except inguinal age 18-69 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
161	Hernia procedures age >=70 and/or cc	0.4967 ± 0.4967	1,548 ± 1,548	25,554 ± 25,554
162	Inguinal hernia procedures age 18-69 w/o cc	0.1851 ± 0.1634	566 ± 509	22,452 ± 20,164
164	Appendectomy age>=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
168	Procedures on the mouth age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
170	Digestive procedures age >=70 and/or cc	-0.5813 ± 0.5813	-1,812 ± 1,812	-17,943 ± 17,943
172	Digestive malignancy age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
173	Digestive malignancy age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
174	GI hemorrhage age >=70 and/or cc	0.0680 ± 0.0864	216 ± 268	23,525 ± 29,276
175	GI Hemorrhage age <70 w/o cc	0.1093 ± 0.0691	340 ± 215	6,746 ± 4,266
176	Complicated peptic ulcer	-0.0273 ± 0.0273	-85 ± 85	-844 ± 844
177	Uncomplicated peptic ulcer >=70 and/or cc	0.0511 ± 0.0511	134 ± 134	1,779 ± 1,779
178	Uncomplicated peptic ulcer <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
179	Inflammatory bowel disease	0.0000 ± 0.0000	0 ± 0	0 ± 0
180	GI Obstruction age >=70 and/or cc	-0.0714 ± 0.0336	-210 ± 96	-10,400 ± 4,786
181	GI Obstruction age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0

182	Upper gastrointestinal age >=70 and/or cc	0.0414 ± 0.0341	129 ± 106	28,120 ± 23,133
183	Upper gastrointestinal disease age 18-69 w/o cc	0.1923 ± 0.1521	579 ± 473	42,054 ± 34,348
185	Dental & oral except extractions,age >=18	0.5944 ± 0.3884	1,853 ± 1211	18,348 ± 11,989
187	Dental extractions & restorations	0.0000 ± 0.0000	0 ± 0	0 ± 0
188	Other digestive diagnoses age >=70 and/or cc	0.0887 ± 0.0670	271 ± 208	9,839 ± 7,572
189	Other digestive system age 18-69 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
191	Major pancreas, liver & shunt procedures	-1.1514 ± 0.6647	-3,313 ± 1,926	-43,732 ± 25,424
193	Biliary tract procedure age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
194	Biliary tract procedure age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
195	Cholecystectomy & CDE age >=70 and/or cc	-0.1338 ± 0.0899	-390 ± 267	-11,583 ± 7,931
197	Cholecystectomy w/o CDE age >=70 or cc	-0.0846 ± 0.0581	-263 ± 181	-15,673 ± 10,751
198	Cholecystectomy w/o CDE Age <70 w/o cc	0.3046 ± 0.1244	876 ± 359	28,928 ± 11,878
199	Hepatobiliary procedure for malignancy	0.0000 ± 0.0000	0 ± 0	0 ± 0
200	Hepatobiliary procedure for non-malignancy	0.5521 ± 0.0000	1,455 ± 0	4,804 ± 0
201	Hepatobiliary or pancreas OR procedures	0.0000 ± 0.0000	0 ± 0	0 ± 0
202	Cirrhosis & alcoholic hepatitis	0.0000 ± 0.0000	0 ± 0	0 ± 0
203	Malignancy of hepatobiliary or pancreas	-0.1141 ± 0.0928	-346 ± 289	-6,856 ± 5,728
204	Disorders of pancreas except malignancy	-0.0631 ± 0.0504	-172 ± 133	-5,696 ± 4,420
205	Liver except malignancy, age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
207	Biliary tract age >=70 and/or cc	0.2628 ± 0.2626	819 ± 818	21,633 ± 21,615
208	Disorders of the biliary tract age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
209	Major joint procedures	-0.0146 ± 0.0146	-45 ± 45	-8,274 ± 8,274
210	Hip procedure except joint age >=70 and/or cc	-0.0162 ± 0.0734	-50 ± 228	-3,833 ± 17,369
211	Hip procedures except joint age 18-69 w/o cc	0.2521 ± 0.0996	755 ± 300	22,444 ± 8,910
213	Amputations for musculoskeletal	0.3444 ± 0.2686	1,055 ± 855	6,967 ± 5,648
214	Back & neck procedures age >=70 and/or cc	-0.1455 ± 0.1455	-453 ± 453	-10,478 ± 10,478
215	Back & neck procedures age <70 w/o cc	-0.0422 ± 0.0422	-131 ± 131	-4,340 ± 4,340
216	Biopsies of musculoskeletal	-0.0937 ± 0.0937	-292 ± 292	-1,927 ± 1,927
217	Wound debridement & skin graft except hand	-1.0690 ± 1.0690	-3,333 ± 3,333	-21,999 ± 21,999
218	Lower extremity procedure age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
219	Lower extremity & humerus procedure age 18-69 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
221	Knee procedures age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
222	Knee procedures age <70 w/o cc	0.0176 ± 0.0176	46 ± 46	305 ± 305
223	Upper extremity procedure age >=70 and/or cc	0.1256 ± 0.1256	331 ± 331	4,370 ± 4,370
224	Upper extremity procedure age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
225	Foot procedures	0.0000 ± 0.0000	0 ± 0	0 ± 0
227	Soft tissue procedures age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
228	Ganglion (hand) procedures	0.0000 ± 0.0000	0 ± 0	0 ± 0
230	Local excision internal fixation devices of hip & femur	0.0000 ± 0.0000	0 ± 0	0 ± 0
231	Local excision except hip & femur	0.0000 ± 0.0000	0 ± 0	0 ± 0
232	Arthroscopy	0.0000 ± 0.0000	0 ± 0	0 ± 0
233	Musculoskeletal OR procedure age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
234	Musculoskeletal OR procedure age <70 w/o cc	0.0282 ± 0.0282	88 ± 88	1,162 ± 1,162
235	Fractures of femur	0.0000 ± 0.0000	0 ± 0	0 ± 0
236	Fractures of hip & pelvis	0.0000 ± 0.0000	0 ± 0	0 ± 0
237	Sprains, strains, & dislocations	0.0000 ± 0.0000	0 ± 0	0 ± 0
238	Osteomyelitis	0.0000 ± 0.0000	0 ± 0	0 ± 0
239	Musculoskeletal & connective tissue malignancy	0.0062 ± 0.0062	19 ± 19	897 ± 897
240	Connective tissue age >=70 and/or cc	0.1930 ± 0.0000	601 ± 0	1,986 ± 0
241	Connective tissue disorders age <70 w/o cc	0.2310 ± 0.2310	720 ± 720	4,753 ± 4,753
242	Septic arthritis	0.0000 ± 0.0000	0 ± 0	0 ± 0
243	Medical back problems	0.0169 ± 0.0145	52 ± 45	3,818 ± 3,289
244	Bone arthropathy age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
245	Bone & septic arthropathy age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
247	Signs & symptoms of musculoskeletal	0.0000 ± 0.0000	0 ± 0	0 ± 0
248	Tendonitis, myositis & bursitis	0.0391 ± 0.0391	121 ± 121	804 ± 804
249	Aftercare, musculoskeletal & connective tissue	0.0000 ± 0.0000	0 ± 0	0 ± 0
253	Fractures, sprains, strains & dislocations age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
254	Fractures, sprains, strains & dislocations age 18-69 w/o cc	0.2917 ± 0.2917	909 ± 909	12,005 ± 12,005
257	Total mastectomy age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
258	Mastectomy for malignancy age <70 w/o cc	0.0331 ± 0.0331	103 ± 103	2,043 ± 2,043
259	Mastectomy malignancy age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
261	Breast procedure for non-malignancy except biopsy	0.0000 ± 0.0000	0 ± 0	0 ± 0
262	Breast biopsy & excision for non-malignancy	0.0000 ± 0.0000	0 ± 0	0 ± 0
263	Skin grafts for skin ulcer age >=70 and/or cc	-0.2911 ± 0.2679	-777 ± 705	-15,386 ± 13,967
264	Skin grafts for ulcer age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
265	Skin grafts except for ulcer or cellulitis with cc	-0.7044 ± 0.0000	-2,196 ± 0	-7,248 ± 0
268	Skin, subcutaneous tissue & breast procedures	-0.1336 ± 0.0000	-416 ± 0	-1,375 ± 0
269	Skin, subcutaneous & breast procedure age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
270	Skin, subcutaneous & breast OR age <70 w/o cc	-0.1020 ± 0.1020	-317 ± 317	-2,098 ± 2,098

271	Skin ulcers	0.0000 ± 0.0000	0 ± 0	0 ± 0
274	Malignant breast age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
277	Cellulitis age >=70 and/or cc	0.1330 ± 0.1224	373 ± 355	23,409 ± 22,260
278	Cellulitis age 18-69 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
280	Trauma to skin, & breast age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
283	Minor skin disorders age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
284	Minor skin disorders age <70 w/o cc	0.1444 ± 0.1444	450 ± 450	2,971 ± 2,971
285	Amputations for endocrine & metabolic	0.0000 ± 0.0000	0 ± 0	0 ± 0
287	Skin grafts & debridement for metabolic disorders	0.0000 ± 0.0000	0 ± 0	0 ± 0
290	Thyroid procedures	0.0000 ± 0.0000	0 ± 0	0 ± 0
292	Nutritional & metabolic OR procedure age >70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
294	Diabetes age >=36	0.0075 ± 0.0075	23 ± 23	1,320 ± 1,320
296	Nutritional & metabolic age >=70 and/or cc	0.0019 ± 0.0122	1 ± 35	267 ± 5,137
297	Nutritional & metabolic age 18-69 w/o cc	0.2107 ± 0.1388	657 ± 432	30,355 ± 20,001
299	Inborn errors of metabolism	0.1873 ± 0.1873	584 ± 584	3,854 ± 3,854
300	Endocrine disorders age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
301	Endocrine disorders age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
302	Kidney transplant	0.0000 ± 0.0000	0 ± 0	0 ± 0
303	Urinary tract procedure for neoplasm	-0.0438 ± 0.0438	-136 ± 136	-3,157 ± 3,157
304	Urinary procedure non-malignancy age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
305	Urinary procedure for non-malignancy age <70 w/o cc	0.4993 ± 0.4993	1,556 ± 1,556	10,275 ± 10,275
306	Prostatectomy age >=70 and/or cc	-0.1201 ± 0.1201	-316 ± 316	-3,134 ± 3,134
307	Prostatectomy age <70 w/o cc	-0.0095 ± 0.0000	-29 ± 0	-98 ± 0
308	Bladder procedures age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
310	Transurethral procedures age >=70 and/or cc	-0.0287 ± 0.0287	-89 ± 89	-2,064 ± 2,064
311	Transurethral procedures age <70 w/o cc	0.2068 ± 0.2068	644 ± 644	17,023 ± 17,023
315	Other kidney & urinary tract OR procedures	-0.3408 ± 0.3408	-1,062 ± 1,062	17,531 ± 17,531
316	Renal failure w/o dialysis	0.0000 ± 0.0000	0 ± 0	0 ± 0
318	Urinary tract neoplasms age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
320	Urinary tract infections age >=70 and/or cc	-0.0392 ± 0.0202	-122 ± 61	-16,132 ± 8,125
321	Urinary tract infections age 18-69 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
323	Urinary stones age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
324	Urinary stones age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
325	Urinary tract signs age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
331	Other urinary tract age >=70 and/or cc	-0.0311 ± 0.0311	-97 ± 97	-1,602 ± 1,602
332	Urinary tract diagnoses age 18-69 w/o cc	0.1046 ± 0.1046	326 ± 326	3,228 ± 3,228
334	Major male pelvic procedures with cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
335	Major male pelvic procedures w/o cc	0.5157 ± 0.0000	1,607 ± 0	5,306 ± 0
336	Transurethral prostatectomy age >=70 and/or cc	-0.0105 ± 0.0105	-32 ± 32	-3,364 ± 3,364
337	Transurethral prostatectomy age <70 w/o cc	0.0113 ± 0.0113	29 ± 29	2,845 ± 2,845
338	Testes procedures, for malignancy	0.0000 ± 0.0000	0 ± 0	0 ± 0
339	Testes procedures, non-malignant age >=18	0.0000 ± 0.0000	0 ± 0	0 ± 0
341	Penis procedures	0.0000 ± 0.0000	0 ± 0	0 ± 0
342	Circumcision age >=18	0.0000 ± 0.0000	0 ± 0	0 ± 0
346	Malignancy, male reproductive age >=70 and/or cc	-0.1227 ± 0.1194	-323 ± 314	-4,271 ± 4,155
348	Prostatic hypertrophy age >=70 and/or cc	0.2462 ± 0.0000	767 ± 0	2,533 ± 0
350	Inflammation male reproductive system	0.0000 ± 0.0000	0 ± 0	0 ± 0
354	Non-radical hysterectomy age >=70 and/or cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
355	Non-radical hysterectomy age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
356	Female reproductive reconstructive procedures	0.0000 ± 0.0000	0 ± 0	0 ± 0
357	Uterus & adnexa procedures malignancy	0.0000 ± 0.0000	0 ± 0	0 ± 0
358	Uterus & adnexa procedure for non-malignancy	0.0000 ± 0.0000	0 ± 0	0 ± 0
359	Tubal interruption for non-malignancy	0.0870 ± 0.0576	271 ± 179	8,059 ± 5,330
363	D&C, conization & radio-implant malignancy	0.0000 ± 0.0000	0 ± 0	0 ± 0
365	Other female reproductive OR procedures	-1.1077 ± 0.0000	-3,453 ± 0	-11,398 ± 0
366	Malignancy, female reproductive age >=70 or cc	0.1469 ± 0.0000	458 ± 0	1,512 ± 0
367	Malignancy, female reproductive age <70 w/o cc	0.5435 ± 0.0000	1,694 ± 0	5,592 ± 0
368	Infections, female reproductive system	0.0000 ± 0.0000	0 ± 0	0 ± 0
394	OR procedures blood & blood forming organs	0.0000 ± 0.0000	0 ± 0	0 ± 0
395	Red blood cell age >=18	0.0000 ± 0.0000	0 ± 0	0 ± 0
397	Coagulation disorders	0.0000 ± 0.0000	0 ± 0	0 ± 0
398	Reticuloendothelial age >=70 and/or cc	0.0149 ± 0.0149	39 ± 39	650 ± 650
399	Reticuloendothelial age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
400	Lymphoma or leukemia major OR procedure	0.0000 ± 0.0000	0 ± 0	0 ± 0
401	Lymphoma OR procedure age >=70 and/or cc	-0.6495 ± 0.0000	-2,025 ± 0	-6,683 ± 0
403	Lymphoma or leukemia age >=70 and/or cc	-0.3744 ± 0.1534	-1,103 ± 450	-18,202 ± 7,439
404	Lymphoma or leukemia age 18-69 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
406	Myeloproliferative with major OR procedure & cc	1.9735 ± 0.0000	6,153 ± 0	20,306 ± 0
408	Myeloproliferative or neoplastic with minor OR procedure	0.0000 ± 0.0000	0 ± 0	0 ± 0
410	Chemotherapy	0.0000 ± 0.0000	0 ± 0	0 ± 0

413	Myeloproliferative or neoplasm age>=70 or cc	0.6295 ± 0.6540	1,970 ± 2,035	19,510 ± 20,147
415	OR procedure for infectious & parasitic	-0.3252 ± 0.3252	-857 ± 857	-22,640 ± 22,640
416	Septicemia age >=18	0.0207 ± 0.0740	64 ± 230	6,616 ± 23,600
418	Postoperative & post-traumatic infections	0.0000 ± 0.0000	0 ± 0	0 ± 0
419	Fever of unknown origin age >=70 and/or cc	-0.0198 ± 0.0767	-61 ± 239	-1,220 ± 4,734
420	Fever of unknown origin age 18-69 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
421	Viral illness age >=18	0.2911 ± 0.2374	884 ± 740	17,504 ± 14,658
440	Wound debridements for injuries	-0.8681 ± 0.8681	-2,706 ± 2,706	-17,863 ± 17,863
442	Other OR for injuries age >=70 and/or cc	-0.0163 ± 0.0687	-50 ± 214	-2,183 ± 9,189
443	OR procedures for injuries age <70 w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
447	Allergic reactions age >=18	0.0000 ± 0.0000	0 ± 0	0 ± 0
449	Toxic effects of drugs age >=70 and/or cc	0.0276 ± 0.0327	88 ± 101	2,036 ± 2,342
450	Toxic effects of drugs age 18-69 w/o cc	0.1002 ± 0.1002	312 ± 312	3,092 ± 3,092
452	Complications of treatment age >=70 and/or cc	0.2206 ± 0.1868	687 ± 582	20,425 ± 17,301
453	Complications of treatment age <70 w/o cc	0.4903 ± 0.1064	1,416 ± 219	14,020 ± 2,169
455	Injuries, poisonings & toxic age <70 w/o cc	0.0550 ± 0.0550	171 ± 171	1,131 ± 1,131
461	OR procedure with diagnoses of other contact	0.4370 ± 0.4370	1,362 ± 1,362	17,987 ± 17,987
462	Rehabilitation	-0.6397 ± 0.6397	-1,994 ± 1,994	-13,164 ± 13,164
463	Signs & symptoms with cc	0.4442 ± 0.0000	1,385 ± 0	4,571 ± 0
464	Signs & symptoms w/o cc	0.0000 ± 0.0000	0 ± 0	0 ± 0
466	Aftercare w/o history of malignancy	0.0454 ± 0.0454	141 ± 141	1,868 ± 1,868
468	Unrelated OR procedure	-0.3619 ± 0.1434	-1,128 ± 447	-78,196 ± 30,996
471	Multiple major joint procedure of lower extremities	0.0000 ± 0.0000	0 ± 0	0 ± 0
473	Acute leukemia w/o major OR procedure age>17	-0.7123 ± 0.7123	-2,220 ± 2,220	-14,657 ± 14,657
474	Respiratory system with tracheostomy	0.0000 ± 0.0000	0 ± 0	0 ± 0
475	Respiratory with ventilator support	-0.2535 ± 0.1380	-790 ± 430	-49,568 ± 26,981
476	Prostatic OR procedure unrelated to diagnosis	0.0000 ± 0.0000	0 ± 0	0 ± 0
	Total	0.0023 ± 0.0070	7 ± 21	59,401 ± 173,214

Appendix 23: HCFA comments

DEPARTMENT OF HEALTH & HUMAN SERVICES

Health Care
Financing Administration

Memorandum

Date MAY 29 1992

From William Toby, Jr.
Acting Administrator

Subject OIG Draft Reports: "National DRG Validation Study Update: Summary Report" (OEI-12-89-00190) and "National DRG Validation Study Update: Technical Report" (OEI-12-89-00191)

To Inspector General
Office of the Secretary

We have reviewed the above-referenced draft reports which are updates to a previous OIG study which re-abstracted the International Classification of Diseases, 9th Edition, Clinical Modification codes from a sample of 1985 Medicare discharges. These reports update the previous study by: replicating the 1985 work on coding accuracy using 1988 data, comparing the findings from 1985 and 1988, and identifying patterns of coding errors that the Prospective Payment System (PPS) changes could modify. The sample was nationally representative and covered all of calendar year 1988, the most recent year for which data were available.

OIG found a significant improvement in hospital coding of PPS cases between 1985 and 1988. In the 1985 study, OIG found that 20.8 percent of 1985 Part A bills contained coding errors that changed the diagnostic related group (DRG) and that 61.7 percent of these errors over-reimbursed the hospitals. This improper DRG coding increased total PPS disbursements by 1.9 percent or $308 million. During the 1988 study, OIG found that 14.7 percent of the discharges had DRG coding errors, 51 percent of DRG errors over-reimbursed the hospitals, and 49 percent under-reimbursed the hospitals. Taken together, the 1988 DRG errors resulted in no net overpayment of hospitals.

We believe these reports are a useful addition to the continuing research and evaluation of case mix change among hospitals paid under PPS. We agree with OIG's recommendation that Peer Review Organizations continue their surveillance of hospital coding of DRG reimbursement accuracy. Our detailed comments on these two reports are attached for your consideration.

Thank you for the opportunity to review and comment on these draft reports. Please advise us if you agree with our position on the report's recommendation at your earliest convenience.

Attachment

Comments of the Health Care Financing Administration (HCFA) on OIG's Draft Reports: "National DRG Validation Study Update: Summary Report" OEI-12-89-00190 and "National DRG Validation Study Update: Technical Report" OEI-12-89-00191

OIG Recommendation

The Peer Review Organizations (PROs) should continue their surveillance of hospital coding for DRG reimbursement accuracy.

HCFA Response

We agree. The PROs will continue their surveillance of hospital coding of diagnostic related group (DRG) reimbursement accuracy.

We are pleased to note the decrease in DRG coding errors identified by the 1988 study, as compared to the 1985 study. We believe this improvement may be attributed to a combination of factors including increased hospital experience under the prospective payment system (PPS), the impact of PRO review and the effect of HCFA educational efforts to enhance coding accuracy.

General Comments

Summary Report, OEI-12-89-00190

This report includes a brief but excellent description of the payment process, including the role of coding. Three types of errors are defined at each stage of the payment process. However, no statement is made as to whether or not the errors are mutually exclusive, and if the 361 records with errors contained only 1 of each type. We believe this information should be included in the final report.

Although the representativeness of the sample is thoroughly addressed, there is no discussion as to how adequately each DRG is represented. We would like to know how the distribution by DRG of the sample relates to the universe of DRGs, and if any correlation exists between high volume DRGs and errors in the sample. Also, we note that most hospitals contributed only one discharge to the sample. We question whether it is statistically valid for 1 record in 1 hospital to represent 3,300 other records in the total population of records.

It is not made clear in the report how payment projections are calculated. The amount used to estimate payment is not stated, although mention is made

of using a rate of $3,118 for metropolitan hospitals and $2,637 for nonmetropolitan hospitals (page 29, Technical Report). It is stated that these are "current dollars," but there is no discussion as to the actual figures used to project payment amounts. While the calculation for case-mix index (CMI) is clearly defined, as is the DRG difference before and after coding, it is not clear how the payment amount is determined. The final report should include a more complete description of payment calculation.

Executive Summary, page iii - "DRG coding errors, overall, no longer over-reimburse hospitals." The figure for under-reimbursements is stated to be "$2,588.0 billion." The correct figure is $2,588 million (also Executive Summary, page iii, Technical Report).

Findings, pages 5, 9 - While it is unwise to ignore magnitudes and only pay attention to statistical significance, we do not believe effects that are not statistically significant should be highlighted. For example, the report notes that for-profit hospitals "over-reimburse themselves" but that "these results did not attain statistical significance" (also CMI discussion, pages 13, 14, Technical Report).

Findings, page 6 - The narrative incorrectly states that the overall CMI decreased after the study's recoding. For hospitals to have underpaid themselves, the CMI would have to increase after recoding, as is correctly stated on page 13 of the Technical Report.

Findings, page 6, Figure 6 - The 1988 pie chart does not match the numbers in the text immediately below the chart. The resequenced and miscoded pieces of the pie do not represent the 27 percent and 9 percent respective figures and may have been reversed in the pie chart.

Technical Report

Introduction, page 1, paragraph 3 - The original number of DRGs in 1983 was 470, not 476.

Introduction, page 1, paragraph 4 - The narrative implies that there is a fiscal intermediary for each State. The sentence should be rewritten to state: "A fiscal intermediary receives the hospital bills for each State."

Page 2, paragraph 3, under the heading "The HCFA . . . made the following points in commenting on the 1985 Study" - It was HCFA's intent to point out that the 1985 study was published in November 1987, and conclusions set forth in that report were based in part on information and coding conventions which had been updated by the time the report was released. The phrasing ". . . needed a longer learning period to adjust to the new payment and quality monitoring system" does not encompass the concept that changes have been made to the whole International Classification of Diseases, 9th Edition, Clinical Modification/Prospective Payment System/DRG system since its conception. Such changes and improvements continue to be made.

Page 4 - We do not believe the data support some of the assertions and language which the report uses. For example, the report describes the findings of the earlier OIG report as showing "intentional 'gaming' or manipulating [of the] coding process" by hospitals. The note cites unrelated sources while the earlier report used much more restrained language.

The report consistently characterizes coding disagreements as provider "errors." A recent Rand study used charts re-abstracted at SuperPRO to examine the 1987-88 increase in the Medicare CMI. Rand estimated that changes in coding common to SuperPRO and hospitals accounted for almost one-third of the 1987-88 CMI increase. Since SuperPRO coders have no incentive to upcode, this probably reflects changes in explicit and implicit coding rules between original coding (1987) and recoding (1988). While the CMI may increase, payments to hospitals will not. However, disagreements which may reflect the evolution of coding practice over time are not strictly provider "errors." Rand and OIG studied slightly different problems, and the Rand finding may be unique to 1988. However, since American Medical Records Association staff should be able to provide insight on this matter, we recommend that OIG explore and report on the question of whether the increase in the CMI is attributable to provider errors or the evolution of coding practices.

Page 4, paragraph 3 - "Each year, the relative weights change to reflect alterations in resource consumption, DRG title, coding and . . . ." The change in relative weights is not related to the title of the DRG.

Page 10 - The report does not find net overpayment due to coding error. Inclusion of a table of DRGs with "maximum savings potential [to Medicare]" due to upcoding, without a parallel table of DRGs with maximum potential payment increase, gives an impression of lack of balance. Financial impact (savings) estimates could be presented in the context of the argument that, while ". . . trends to over-pay and under-pay approximately offset each other, this equilibrium may not continue in the future."

Page 12 - OIG reports that coding errors (incidence of coding error capable of influencing DRG assignment) declined significantly between 1985 and 1988. While true, the report overstates the change. The 1985 report used a two-stage sampling design and reported error rates for the nation of 20.8 percent (hospital-weighted) and 18.6 percent (case-weighted). The update report finds a 1988 error rate of 14.7 percent but compares it to the 1985 hospital-weighted statistic. The 1988 value, based on a simple random sample of cases, is equivalent to a case-weighted statistic and should not be compared with a hospital-weighted value.

Page 15 - Some PPS details in the draft report are obscured. For example, the report discusses "base payment amounts" when it means standardized amounts. Discussion of reimbursement effects states that financial impacts "paralleled CMI changes" when they are simply calculated from and are logically equivalent to such changes.

Appendix 5 - There appears to be an error for hospitals with 300 or more beds. The response rate of 66.8 percent should be changed to 48.9 percent (1,199 responses of 2,451).

There is some disagreement between the narrative and the appendices. Table 9 illustrates the number of records per DRG and the number miscoded. Appendix 21 lists each DRG with the number of records selected and the error frequency and the proportion of errors. While the number of records selected is consistent between the table and the appendix, the number of errors is not. There is no indication why these numbers differ, the source of this data, or which is correct. However, the errors reported in appendix 21 do total 361, the correct total for the study.