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**DRG 89: SIMPLE PNEUMONIA AND  
PLEURISY**

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## **EXECUTIVE SUMMARY**

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### **BACKGROUND**

Diagnosis related group (DRG) 89 occurred fourth most commonly in Fiscal Year (FY) 1987. The 327,645 DRG 89 bills represented 3.7 percent of all Medicare discharges. The National DRG Validation Study suggested DRG 89 accounted for a substantial portion of the annual overpayment to hospitals due to erroneous coding of Medicare bills.

### **FINDINGS**

- The DRG 89 had a 16.5 percent error rate, lower than the 18.6 percent for all DRGs.
- However, 84.5 percent of these errors resulted in overpayments to the hospitals. This proportion significantly exceeded the 59.7 percent for all DRGs.
- The large number of discharges assigned to DRG 89 and the high proportion of overpayments resulted in hospitals receiving a projected \$20.8 million in PPS overpayments in FY 1987.
- In the majority of errors, the discharge grouped to another DRG pertaining to the respiratory system. The DRG 96 (bronchitis and asthma) should have substituted for DRG 89 in 40.3 percent of errors.
- The DRG 89 had double the general rate of poor quality care. Of poor quality discharges, a disproportionate 57.1 percent came from the non-specific ICD-9-CM codes 485 or 486.

### **RECOMMENDATIONS**

- The Health Care Financing Administration (HCFA) should direct the peer review organizations to educate hospitals and physicians about distinguishing between (1) pneumonia and (2) bronchitis-asthma as principal diagnoses.
- The HCFA should review the non-specific ICD-9-CM codes 485 and 486 in DRG 89 bills for quality of care.

The HCFA concurs with these recommendations.

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## INTRODUCTION

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### BACKGROUND

On October 1, 1983, the Health Care Financing Administration (HCFA) began implementing a new system of payment for inpatient hospital services under the Medicare program. The prospective payment system (PPS) replaced the cost-based reimbursement system. Congress mandated this change because of rapid growth in health care costs, particularly the increase in payments for inpatient expenses under Medicare.

Under PPS, hospitals received a pre-established payment for each discharge, based upon the diagnosis related group (DRG) to which the discharge is assigned. The PPS classified discharges into clinically coherent groups which used similar amounts of hospital resources, based on variables such as diagnosis; evaluation and treatment procedures; and patient age, sex, and discharge status. Each of the 473 DRGs had an associated relative weight, which represented the average cost for its hospitalizations as compared to the average cost for all hospitalizations. The hospital received this payment, independent of the actual length of hospitalization or cost of treatment for the individual patient. The hospital retained any surplus from patients consuming less than the expected amount of resources and suffered losses on those patients consuming more.

The shift from cost-based, retrospective reimbursement to prospective payment constituted one of the most dramatic changes in health care reimbursement since the creation of Medicare. A fixed payment per discharge induced hospitals to implement economies and reduce unnecessary services. The total PPS payments to the hospitals provided the same resources for patient care as cost reimbursement. In effect, PPS reversed the financial incentives for hospitals. Where the cost-reimbursement system rewarded longer hospital stays and more costly treatments for Medicare patients, PPS rewarded earlier discharges and less costly procedures. One of the first consequences of the new payment system came as a drop in average length of hospital stay for Medicare patients.

#### *PPS Vulnerabilities*

The Office of Inspector General (OIG) conducted the National DRG Validation Study to survey the general accuracy of DRG assignment and quality of care performed by hospitals under PPS. It examined assignment accuracy in over 7000 medical records and established that PPS assignment errors resulted in \$300 million in overpayments to hospitals. The majority of overpayments derive from assignment errors affecting a small number of DRGs. This inspection examines assignment accuracy in one of the DRGs identified as having the greatest impact on overpayments.

The PPS may create financial incentives for hospitals to manipulate or “game” the payment system in order to receive maximum Medicare reimbursement. The PPS gaming takes two principal forms: optimization and creep. “Optimization” strategies adhere to coding rules, but maximize hospital reimbursements by selecting the most expensive among viable alternative principal diagnoses or adding more secondary diagnoses. The PPS permits optimization.

“Creep” results from coding practices which do not conform to coding rules. Sources of DRG creep include:

- Mis-specification of the narrative diagnoses and procedures.
- Miscoding when assigning ICD-9-CM codes to the narrative diseases or procedures.
- Resequencing of the order of the narrative diagnoses to substitute a secondary diagnosis for the correct principal diagnosis.

Auditing and review practices which identify cases in which coding rules are misapplied or ignored address the problem of illegal DRG creep. Optimization, on the other hand, flows from the basic incentive structure of the PPS system. To protect the integrity of PPS and maintain quality of care, Congress established peer review organizations (PROs) to monitor hospital activities.

### ***PPS Claims Processing***

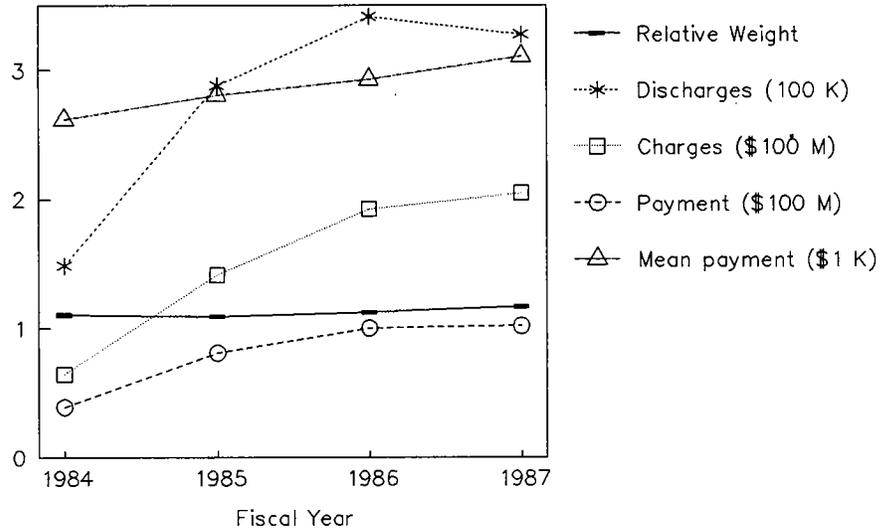
Under PPS, the hospital files a claim for Medicare reimbursement upon discharge of a covered patient. At the time of discharge, the attending physician attests to the principal diagnosis (defined by the Uniform Hospital Discharge Data Set as “that condition established after study to be chiefly responsible for occasioning the admission of the patient to the hospital for care”), secondary diagnoses, and procedures (diagnostic and therapeutic) provided. The hospital translates the narrative diagnoses of the physician’s attestation statement into numeric codes based on the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM), and prepares a claim. Fiscal intermediary (FI) organizations, working under contract with HCFA, enter the hospital’s codes into the GROUPER computer program which assigns the appropriate DRG for reimbursement.

Hospital reimbursement is calculated by multiplying the “relative weight” of each DRG category by a standardized amount, as modified by certain hospital-specific factors. The relative weight for all DRGs theoretically averages 1.0000. In Fiscal Year (FY) 1985, the standardized amount for a relative weight of 1.0000 was \$2985 for urban hospitals and \$2381 for rural hospitals. The relative weight of each DRG varies above or below 1.0000 according to the average amount of hospital resources used by patients in that diagnostic group. The higher the relative weight, the greater the reimbursement. Mis-assignment of the ICD-9-CM categories, or erroneous assignment or sequencing of patient diagnoses, can have significant financial implications.

## DRG 89

This study examines erroneous assignment in DRG 89: Simple Pneumonia and Pleurisy. DRG 89 appears particularly vulnerable to mis-assignment due to superficial symptomatological similarities with other pulmonary disorders and its high number of yearly discharges. In FY 1985, DRG 89 had a relative weight of 1.0914, compared to the average for all medical (non-surgical) DRGs of 0.9404. Discharges, mean payment, and reimbursement have all increased over time.

### DRG 089: ALL PPS discharges



Except for one case of pleurisy, all sample discharges listed an ICD-9-CM code for pneumonia as the principal diagnosis. Medical textbooks describe pneumonia as an inflammation deep in the lungs (i.e., in the bronchioles and alveoli), almost always due to an acute infection. The pathogen usually causes the patient to have a fever. Gram stain of sputum, white blood cell count, and chest X-ray should identify pneumonias suspected from medical history or physical examination. Treatment varies considerably depending upon the causal organism.

In some ways, DRG 89 is symptomatically similar to DRG 96 (bronchitis and asthma), which had a relatively low relative weight (0.7913). Bronchitis describes excessive mucus production, usually secondary to cigarette smoking; while asthma describes narrowing of the upper airways due to increased sensitivity to allergens. In either case, the patient need not have an infection and therefore no fever, although infection may co-exist with bronchitis or asthma. The findings from physical examination and chest X-ray differ from those of pneumonia. Treatment of these conditions differs from pneumonia therapy. A physician should have no difficulty distinguishing pneumonia from other diseases and instituting an appropriate remedy.

## **METHODOLOGY**

This inspection examined DRG 89 discharges drawn from the National DRG Validation Study. It used a stratified two-stage sampling design based on hospitals to select medical records for review. The first stage used simple random sampling without replacement to select up to 80 hospitals in each of three stratum based on bed size: less than 100 beds (small), 100 to 299 beds (medium) and 300 or more beds (large). The second stage of the design employed systematic random sampling to select up to 30 Medicare cases from each of the hospitals for Medicare discharges between October 1, 1984 and March 31, 1985.

The OIG contracted with the Health Data Institute (HDI) of Lexington, Massachusetts to reabstract the entire sample of records. Upon receipt, HDI "blinded" the ICD-9-CM codes by covering them, and assigned an identification number to each record. An Accredited Record Technician or Registered Record Administrator proficient in ICD-9-CM coding reviewed the entire record to identify the principal diagnosis, other diagnoses, and procedures indicated by the attending physician in the narrative attestation form.

Any records which did not support the assigned DRG classification were referred to physician reviewers. The physician reviewers designated the correct Uniform Hospital Discharge Data Set (UHDDS) principal diagnosis, and additional diagnoses and/or procedures as substantiated by the patient records. The GROUPER computer program processed the reabstracted ICD-9-CM codes to determine correct DRGs. A full discussion of the methodology and findings of the record review appears in the final report on the National DRG Validation Study.

The OIG contracted with BOTEC Analysis of Cambridge, Massachusetts to examine data for DRG 89 in greater detail, to identify sources of assignment errors, and to make recommendations for recovery of overpayments. On November 7, 1988, the OIG transmitted a draft version of this inspection to HCFA. The HCFA returned comments about it on December 15, 1988. The OIG has modified this final report to take the HCFA suggestions into account.

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## FINDINGS

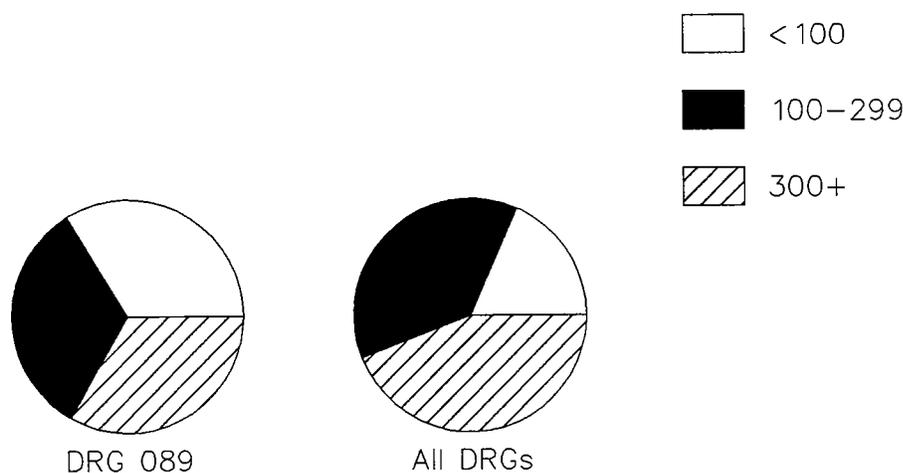
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### SAMPLE CHARACTERISTICS

In FY 1985, 288,067 of the 8.3 million prospective payment discharges (3.4 percent) grouped to DRG 89. According to estimates from the National DRG Validation Study, they came equally from all bed size strata, with the large hospitals' greater frequency of total discharges balancing the higher rate of DRG 89 discharges in small hospitals. In the first half of FY 1985, the 239 hospitals selected in stage one of the sample design (the sampling frame) billed for 222,396 discharges of which 8,250 came from DRG 89 (3.7 percent). The stratification into bed size classes reflected the larger discharge volume of large hospitals. Of the 7,050 medical records selected in stage two of the sample design, 351 came from DRG 89 (5.0 percent).

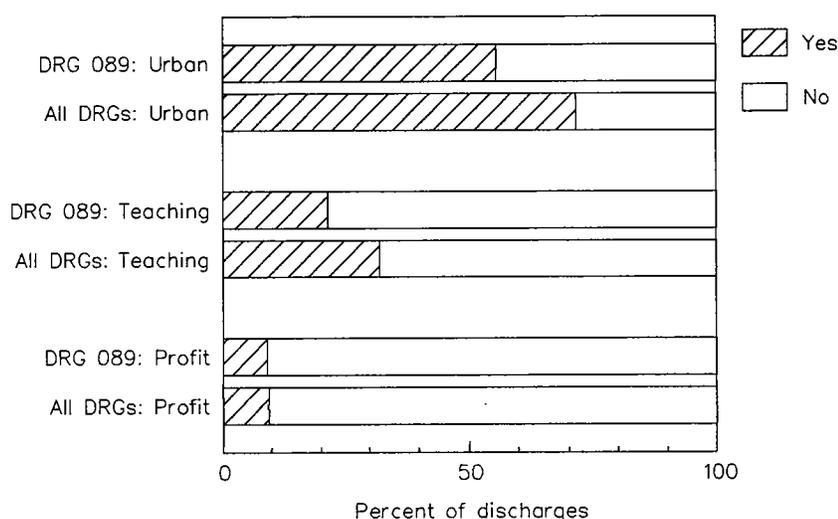
#### Discharges by hospital size



Additionally, the two-stage sample design permits calculation of separate results for Medicare beneficiaries (the probability of something happening to a person) and hospitals (the odds of an event at a particular hospital). The appendices, tables, and charts therefore report individual totals weighted by both discharges and hospitals.

Small hospitals have a significantly higher rate of DRG 89 bills (Chi-square 54.9, 1 df,  $p < 0.0001$ ). They contribute just over one-half of the DRG 89 discharges in this sample, while medium and large hospitals each contribute approximately one-quarter of the discharges. Weighted to reflect the underlying Medicare population, however, DRG 89 discharges come in approximately equal proportion from small, medium, and large hospitals. Comparison of DRG 89 discharges with all projected PPS discharges for FY 1985 reveals that small hospitals submitted an unusually high proportion of cases paid as DRG 89 (Chi-square 43.5, 2 df,  $p < 0.001$ ).

## Hospital demography



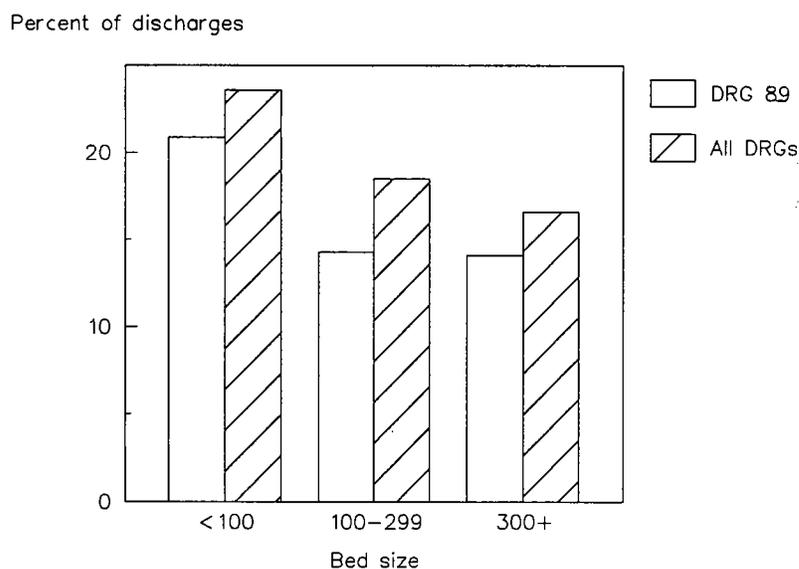
The majority of DRG 89 discharges, weighted to correspond to the Medicare population, come from rural (Mantel-Haenszel Chi-square 10.75, 1 df,  $p < 0.005$ ), nonteaching (Mantel-Haenszel Chi-square 3.6, 1 df,  $p = 0.06$ ) and nonprofit (Mantel-Haenszel Chi-square 0.6, 1 df,  $p = 0.4$ ) hospitals. However, only rural location attained significance when controlling for hospital size. DRG 89 discharges paralleled the general trends of the National DRG Validation Study. Rural and nonteaching hospitals accounted for a greater but non-significant share of discharges assigned to DRG 89.

Discharges in DRG 89 (discharge-weighted) averaged slightly older in age (T-test 7.50, 350 df,  $p < 0.001$ ) and had a higher proportion of males (Mantel-Haenszel Chi-square 4.81, 1 df,  $p < 0.05$ ) than discharges in the National DRG Validation Study. Discharges assigned to DRG 89 had a longer average length of hospital stay, but were paid less (T-test -3.34, 350 df,  $p < 0.001$ ) than the average reimbursement for all discharges included in the National DRG Validation Study. DRG 89 patients exhibited approximately the same rate of mortality. When adjusted by hospital weights, the relationships remain the same.

## DRG ASSIGNMENT ERRORS

Overall, 16.5 percent of discharges paid as DRG 89 changed to a different DRG after reabstraction. Assignment errors occurred less frequently in discharges paid as DRG 89 than the average for all DRGs in the National DRG Validation Study. However, this difference did not attain significance (Mantel-Haenszel Chi-square 2.3, 1 df,  $p < 0.25$ ). This finding applied across all hospital bed sizes. Within the DRG 89 sample, however, discharges from small hospitals made assignment errors most frequently, but not at a significantly higher rate (Chi-square 2.68, 2 df,  $p < 0.5$ ). This trend parallels the National DRG Validation Study, which found that small hospitals made more assignment errors and at a significant rate.

## Coding error rate



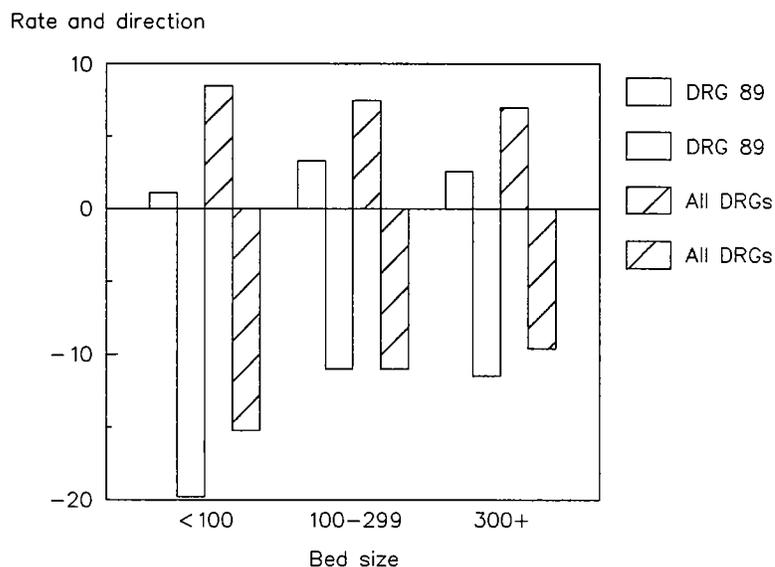
Appendix B-2 reveals no significant differences in hospital location (Chi-square 0.02, 1 df,  $p < 0.9$ ), teaching status (Chi-square 0.34, 1 df,  $p < 0.75$ ), or profit status (Chi-square 0.1, 1 df,  $p < 0.75$ ) associated with assignment accuracy for DRG 89 when controlling for bed size. The National DRG Validation Study also finds that for all DRGs, assignment accuracy has no significant association with hospital characteristics.

Patient demographics indicate that bills erroneously paid as DRG 89 covered a subsample of patients having a higher age, more males, and a substantially lower mortality rate than for those correctly assigned. Discharges assigned correctly and incorrectly had approximately the same length of hospital stay, but the incorrectly-assigned discharges were reimbursed at a higher average rate of payment.

### DIRECTION OF ERRORS

Weighted by discharges, fully 86.0 percent of errors in the DRG 89 sample resulted in overpayments to hospitals. This proportion significantly exceeds the 59.7 percent of National DRG Validation Study (Mantel-Haenszel Chi-square 18.62, 1 df,  $p < 0.005$ ). The majority of errors in all sampling strata resulted in overpayments to hospitals. Small hospitals had the highest proportion of overpayments for DRG 89, while mid-sized hospitals had the lowest (Chi-square 3.70, 2 df,  $p < 0.25$ ).

## Direction of coding errors



Examined by hospital location and type: rural, teaching, and for-profit hospitals all displayed rates of overpayment consistent with those in the National DRG Validation Study. Urban, non-teaching and nonprofit hospitals, however, each measured overpayment rates above 84.0 percent, approximately 30 percentage points higher than in the National DRG Validation Study. The proportion of overpayments (84.5 percent) combined with the 16.5 percent rate of error gives DRG 89 had an effective overpayment rate of 13.9 percent as compared to 11.1 percent in the National DRG Validation Study.

Patient characteristics differed substantially between discharges for which hospitals overpaid and underpaid themselves. As shown, discharges assigned to a higher relative weight (overpaid) by hospitals had a higher average age, proportion of males, and rate of mortality. Overpaid discharges from large hospitals had a lower average length of stay and payment. Among discharges from small and mid-sized hospitals, the reverse pattern prevailed: higher lengths of stays and payments.

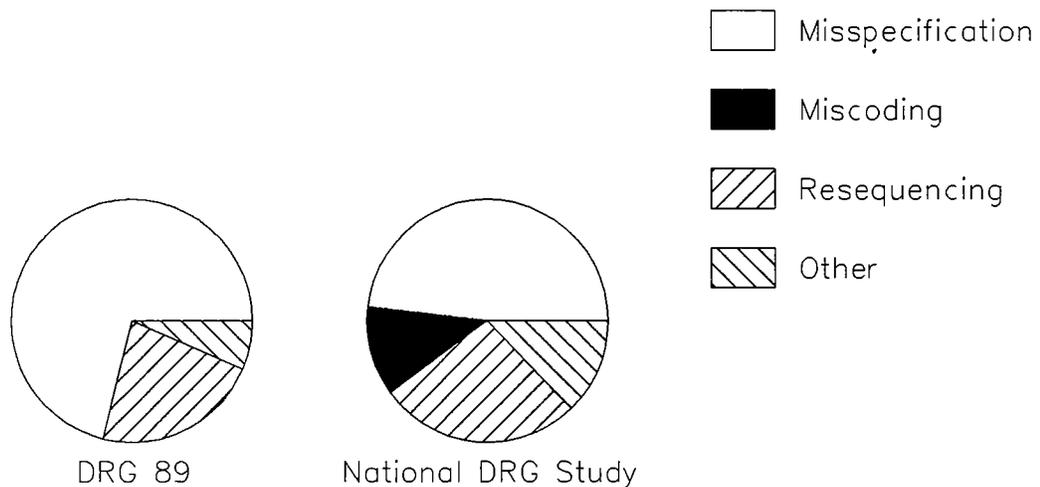
## SOURCE OF ERRORS

The majority of errors in DRG 89 discharges occurred when hospitals incorrectly coded the discharge as DRG 89 and billed it accordingly. Only three out of 62 errors resulted when the medical records department correctly indicated a different diagnosis, but the hospital billed it as DRG 89 anyway.

## REASONS FOR ASSIGNMENT ERRORS

Mis-specification errors by the attending physician (i.e., writing down the wrong diagnosis or procedure) caused the majority of errors in assignment to DRG 89. When examined using an exclusive analysis (identifying the first error to occur chronologically), physicians mis-specified the principal diagnoses or secondary diagnoses in 70.9 percent of discharges. Mis-specification also constituted the single largest source of error in the National DRG Validation Study.

### Reasons for coding errors



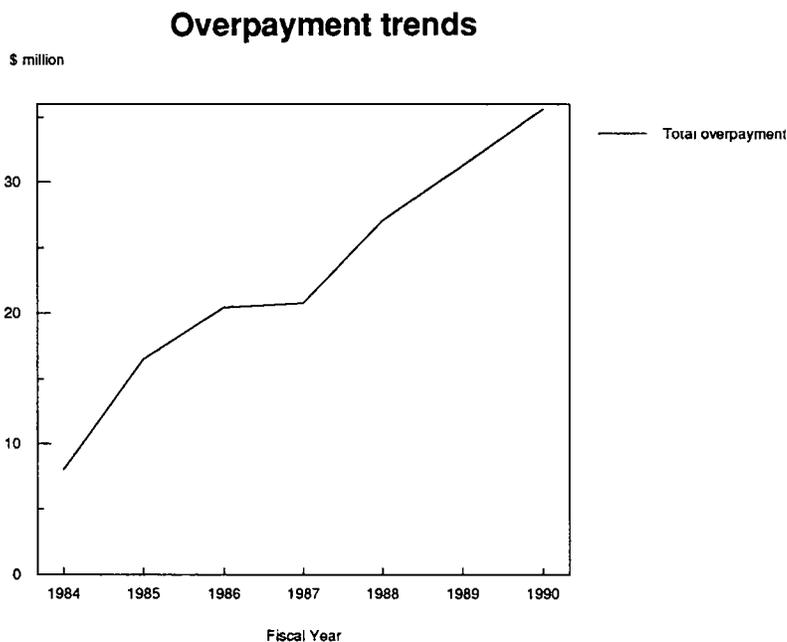
Resequencing of the principal and secondary diagnoses by the hospital accounted for nearly one-quarter of the errors in the DRG 89 sample, the second largest category of errors. In no cases did the medical records department enter the incorrect numeric code for a correct narrative diagnosis. Also, a small number of “other” errors occurred.

Appendix E-2 compares reasons for coding errors by hospital characteristics. Narrative errors by physicians caused the majority of errors in all strata. Resequencing errors occurred particularly frequently in small hospitals, and “other” errors occurred with greater frequency at mid-sized hospitals. Hospitals exhibited similar reasons for errors by location and type, with a few exceptions. Resequencing errors happened particularly frequently in discharges from for-profit hospitals and “other” errors occurred with greater frequency in discharges from urban hospitals and teaching facilities.

As shown in appendix E-4, the age and gender of the patients did not differ by type of error. Both the length of hospital stay and rate of mortality, however, increased in discharges incorrectly resequenced by the hospital.

## FINANCIAL EFFECTS

After reabstraction, the average relative weight for DRG 89 discharges in this sample dropped from 1.0914 to 1.0627. For the 351 discharges in this sample, this equalled an aggregate drop in relative weight of 10.0737. Based on standardized amounts for reimbursement in 1985 (\$2985 urban and \$2381 rural), the average change in relative weight for discharges assigned to DRG 89 resulted in average overpayments to hospitals of \$113 (small hospitals), \$26 (mid-sized) and \$31 (large) on each discharge paid as DRG 89.



When extrapolated to the entire Medicare population, assuming a constant rate of errors, miscoding of DRG 89 resulted in \$16.5 million of overpayments in FY 1985. Most of the overpayments went to small hospitals, which had both a higher rate of discharges to DRG 89 and a higher rate of coding errors. Estimates indicate that, without corrective action, overpayments will rise to \$35.6 million by FY 1990.

## CORRECT DRG ASSIGNMENTS

Of the discharges incorrectly assigned to DRG 89, 59.7 percent came from the same Major Diagnostic Category (MDC): 04 — diseases and disorders of the circulatory system. Indeed, 41.3 percent of the errors grouped to a single DRG: 96 — bronchitis and asthma. DRG 96 has a substantially lower relative weight for purposes of reimbursement (0.7913). As noted, simple diagnostic measures readily distinguish patients with pneumonia from cases of bronchitis, asthma, or combinations of these conditions. The remainder of correct DRG assignments spread among 21 alternative DRGs grouped in nine MDCs.

It appears that a substantial portion of the errors in assignment for “pneumonia and pleurisy” resulted when physicians identified a similar but incorrect respiratory or infectious disease as the principal diagnosis on the attestation sheet. Discharges from small hospitals, and from rural and nonteaching facilities, which may lack the knowledge or resources to perform complete diagnostic workups accounted for most of these errors and overpayments. In addition, physicians, as well as medical records personnel, in these smaller and less well-equipped hospitals may be less well-trained in the correct procedures for identifying the principal diagnosis.

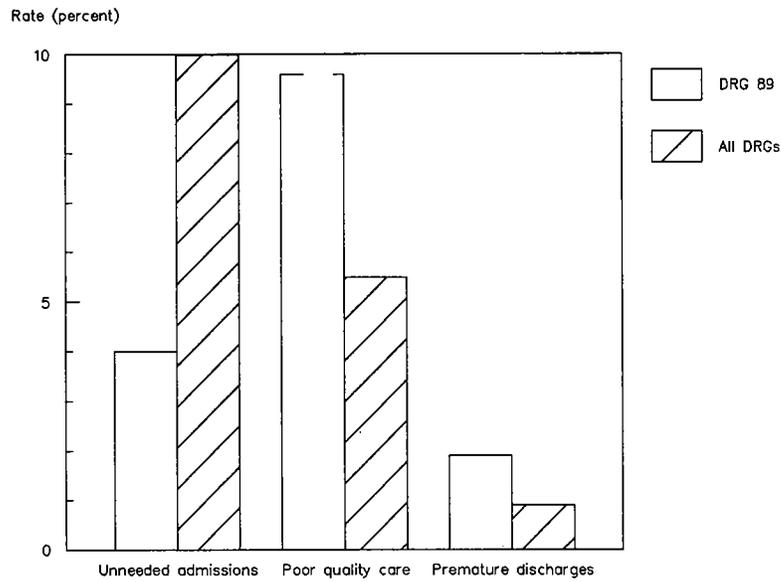
Only one-quarter of discharges correctly assigned to DRG 89 exhibited ICD-9-CM codes that specified the pathogen responsible for the infection (e.g., 481: pneumococcal pneumonia, 482.2: H. influenza pneumonia, streptococcal pneumonia). Two-thirds of discharges failed to specify the organism causing the pneumonia (e.g., 486: Pneumonia not otherwise specified, 54.9 percent. 485: Bronchopneumonia not otherwise specified, 11.6 percent) suggesting that the attending physician either did not write down adequate information or did not order tests which would identify the responsible organism.

This inadequate diagnosis of pneumonia implies in turn that the attending physician treated the patient with no notion of the causal organism. Different bacteria require contrasting therapy. The higher mortality rate among discharges correctly assigned to DRG 89 may reflect this diagnostic inadequacy. Both accurate payment and adequate clinical care therefore militate against accepting the non-specific diagnosis of pneumonia. Possibly, ICD-9-CM code 468: Pneumonia, organism not otherwise specified, should be removed from DRG 89 and placed in a DRG with a lower relative weight. For such a highly weighted DRG, hospitals should have to expend the resources necessary for proper diagnosis and treatment.

## **CLINICAL REVIEW RESULTS**

Only 4.0 percent of discharge weighted cases did not require hospital admission upon review by physicians (“an admission in which the care received by the patient was either not needed or did not require the use of the inpatient setting”). This rate of unnecessary admissions significantly improves upon the 10.0 percent for the National DRG Validation Study controlling for bed size (Mantel-Haenszel 17.5, 1 df,  $p < 0.0001$ ). Appendix H-1 shows the rate of inappropriate admissions to be similar across hospital bed size. Physician reviewers found 1.5 percent of discharges to be premature; more than twice the rate of the National DRG Validation Study, but nonsignificant (Mantel-Haenszel 1.07, 1 df,  $p = 0.30$ ).

## Clinical review



Physician reviewers judged 9.6 percent of DRG 89 discharges to evidence “quality of care not meeting professionally recognized standards.” Although almost twice the rate of poor quality care concerns identified in the entire National DRG Validation Study sample, this difference proved nonsignificant when controlling for bed size (Mantel-Haenszel 1.88, 1 df,  $p=0.17$ ). In both samples, quality of care problems occurred particularly often in discharges from small hospitals and the frequency of problems was approximately the same. The samples differed, however, in the extent of problems at mid-sized and large hospitals. Among these hospitals, poor quality of care occurred much more frequently in discharges assigned to DRG 89.

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## RECOMMENDATIONS

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- The Health Care Financing Administration should direct the PROs to educate hospitals and physicians about distinguishing between (1) pneumonia and (2) bronchitis-asthma as principal diagnoses.
  
- The HCFA should review the high rate of non-specific ICD-9-CM codes 485 and 486 in DRG 89 bills.

The HCFA concurs with these recommendations.

### Appendix A-1: DRG 89 discharges from PPS hospitals

Fiscal Year	1984	1985	1986	1987
Relative weight	1.1029	1.0914	1.1194	1.1657
Number of discharges	148,485	288,067	341,622	327,645
Total charges (\$ million)	643.8	1,412.4	1,922.9	2,047.2
Total reimbursement (\$ million)	388.6	807.9	1,005.4	1,017.4
Average reimbursement (\$)	2,617	2,805	2,929	3,105

### Appendix A-2: DRG 89 sampling frame

Number of discharges	Bed size			Total
	< 100	100-299	300+	
Medicare population	97,173	95,085	95,808	288,067
Sampling frame	1,176	2,481	4,593	8,250
Sample	182	91	78	351
Sampling fraction [%]	[15.5]	[3.7]	[1.7]	[4.3]

### Appendix A-3: DRG 89 hospital demography

	Bed size			Total	Weighted proportion		
	< 100	100-299	300+		Sample	Discharge	Hospital
Number of discharges							
Urban	19	59	72	150	[55.9]	[55.6]	[41.1]
Rural	163	32	6	201	[44.1]	[44.4]	[58.9]
Teaching	1	14	38	53	[21.6]	[21.5]	[13.0]
Nonteaching	181	77	40	298	[78.4]	[78.5]	[87.0]
Profit	11	18	1	30	[9.0]	[9.0]	[9.8]
Nonprofit	171	73	77	321	[91.0]	[91.0]	[90.2]
Total	182	91	78	351	[100.0]	[100.0]	[100.0]

## Appendix A-4: DRG 89 hospital demography comparison

Percent distribution		Bed size			Weighted proportion		
		<100	100-299	300+	Sample	Discharge	Hospital
Urban	DRG 89	10.4	64.8	92.3	55.9	55.6	41.1
	NDRGVS	19.9	70.2	94.0	62.0	71.5	48.0
Rural	DRG 89	89.6	35.2	7.7	44.1	44.4	58.9
	NDRGVS	80.1	29.8	6.0	38.0	28.5	52.0
Teaching	DRG 89	0.5	15.4	48.7	21.6	21.5	13.0
	NDRGVS	2.6	18.8	55.2	25.9	31.9	16.2
Nonteaching	DRG 89	99.5	84.6	51.3	78.4	78.5	87.0
	NDRGVS	97.4	81.2	44.8	74.1	68.2	83.8
Profit	DRG 89	6.0	19.8	1.3	9.0	9.0	9.8
	NDRGVS	9.2	17.5	2.5	9.8	9.4	10.9
Nonprofit	DRG 89	94.0	80.2	98.7	91.0	91.0	90.2
	NDRGVS	90.8	82.5	97.5	90.2	90.6	89.2

## Appendix A-5: DRG 89 patient demography

	Bed size			Weighted average		
	<100	100-299	300+	Sample	Discharge	Hospital
Age (years)	79.0	75.6	75.8	76.8	76.8	77.4
Sex (% male)	50.0	51.8	50.0	50.6	50.6	50.6
LOS (days)	6.7	8.8	9.5	8.3	8.3	7.8
Payment (\$)	1908	2828	3201	2646	2642	2412
Mortality (%)	9.3	5.5	5.1	6.6	6.6	7.4

## Appendix A-6: DRG 89 patient demography comparison

		Bed size			Weighted average		
		< 100	100-299	300+	Sample	Discharge	Hospital
Age (years)	DRG 89	79.0	75.6	75.8	76.8	76.8	77.4
	NDRGVS	76.2	74.0	72.2	74.1	73.6	74.9
Sex (% male)	DRG 89	50.0	51.8	50.0	50.6	50.6	50.6
	NDRGVS	43.3	45.4	48.1	45.7	46.2	44.8
LOS (days)	DRG 89	6.7	8.8	9.5	8.3	8.3	7.8
	NDRGVS	5.9	7.4	8.3	7.2	7.5	6.8
Payment (\$)	DRG 89	1908	2828	3201	2646	2642	2412
	NDRGVS	1849	2923	3807	2860	3115	2508
Mortality (%)	DRG 89	9.3	5.5	5.1	6.6	6.6	7.4
	NDRGVS	5.6	6.2	7.0	6.3	6.4	6.0

## Appendix B-1: DRG 89 errors

		Bed size			Total	Weighted average		
		<100	100-299	300+		Sample	Discharge	Hospital
Number of errors [Percent of discharges]								
Urban	5 [26.3]	10 [16.9]	11 [15.3]	26	[19.5]	[19.5]	[21.5]	
Rural	33 [20.2]	3 [9.4]	0 [0.0]	36	[9.9]	[9.9]	[13.5]	
Teaching	0 [0.0]	2 [14.3]	9 [23.7]	11	[12.7]	[12.6]	[8.4]	
Nonteaching	38 [21.0]	11 [14.3]	2 [5.3]	51	[13.5]	[13.6]	[16.3]	
Profit	4 [36.3]	2 [11.1]	0 [0.0]	6	[15.8]	[15.9]	[22.3]	
Nonprofit	34 [19.9]	11 [15.1]	11 [14.3]	56	[16.4]	[16.5]	[17.5]	
Total	38 [20.9]	13 [14.3]	11 [14.1]	62	[16.4]	[16.5]	[17.7]	

## Appendix B-2: DRG 89 error rate comparison

Error rate		Bed size			Weighted average		
		<100	100-299	300+	Sample	Discharge	Hospital
Urban	DRG 89	26.3	16.9	15.3	19.5	19.5	21.5
	NDRGVS	22.5	19.3	16.2	18.0	17.6	20.4
Rural	DRG 89	20.2	9.4	0.0	9.9	9.9	13.5
	NDRGVS	23.9	16.6	22.5	21.9	20.9	21.3
Teaching	DRG 89	0.0	14.3	23.7	12.7	12.6	8.4
	NDRGVS	20.0	20.9	15.8	17.4	17.2	19.6
Nonteaching	DRG 89	21.0	14.3	5.3	13.5	13.6	16.3
	NDRGVS	23.7	17.9	17.6	20.2	19.2	20.2
Profit	DRG 89	36.3	11.1	0.0	15.8	15.9	22.3
	NDRGVS	23.8	18.9	18.3	20.3	19.7	21.3
Nonprofit	DRG 89	19.9	15.1	14.3	16.4	16.5	17.5
	NDRGVS	23.6	18.4	16.5	19.4	18.5	20.8
Total	DRG 89	20.9	14.3	14.1	16.4	16.5	17.7
	NDRGVS	23.6	18.5	16.6	19.5	18.6	20.8

## Appendix B-3: DRG 89 errors by patient demography

		Bed size			Weighted average		
		<100	100-299	300+	Sample	Discharge	Hospital
Age (years)	Correct	79.3	74.7	75.8	76.6	76.6	77.2
	Incorrect	78.1	81.3	75.9	78.4	78.4	78.8
Sex (% male)	Correct	50.7	55.1	53.7	53.2	53.2	52.6
	Incorrect	47.4	38.5	27.3	37.7	37.8	41.3
LOS (days)	Correct	6.9	8.7	9.2	8.3	8.3	7.9
	Incorrect	5.9	9.4	10.8	8.7	8.7	7.8
Payment (\$)	Correct	1831	2791	3096	2573	2568	2344
	Incorrect	2200	3054	3838	3031	3027	2737
Mortality (%)	Correct	10.4	5.1	6.0	7.2	7.2	8.0
	Incorrect	5.3	7.7	0.0	4.3	4.3	5.2

## Appendix C-1: DRG 89 direction of error

	Bed size			Total	Weighted proportion		
	<100	100-299	300+		Sample	Discharge	Hospital
Number of overpayments [Proportion of errors]							
Urban	5 [100.0]	7 [70.0]	9 [81.8]	21	[83.9]	[84.0]	[87.3]
Rural	31 [93.9]	3 [100.0]	0 [0.0]	34	[64.6]	[64.7]	[81.1]
Teaching	0 [0.0]	2 [100.0]	7 [77.8]	9	[59.3]	[58.9]	[44.9]
Nonteaching	36 [94.7]	8 [72.7]	2 [100.0]	46	[89.1]	[89.2]	[88.3]
Profit	4 [100.0]	1 [50.0]	0 [0.0]	5	[50.0]	[50.2]	[67.9]
Nonprofit	32 [94.1]	9 [81.8]	9 [81.8]	50	[85.9]	[85.9]	[88.1]
Total	36 [94.7]	10 [76.9]	9 [81.8]	55	[84.5]	[84.5]	[86.9]

## Appendix C-2: DRG 89 direction of error comparison

		Bed size			Weighted proportion		
		<100	100-299	300+	Sample	Discharge	Hospital
Overpayments as a proportion of all errors							
Urban	DRG 89	100.0	70.0	81.8	83.9	84.0	87.3
	NDRGVS	53.9	60.4	57.0	58.0	57.6	56.5
Rural	DRG 89	93.9	100.0	0.0	64.6	64.7	81.1
	NDRGVS	66.5	57.6	65.6	64.7	62.9	63.4
Teaching	DRG 89	0.0	100.0	77.8	59.3	58.9	44.9
	NDRGVS	66.6	59.6	56.6	57.9	59.8	62.8
Nonteaching	DRG 89	94.7	72.7	100.0	89.1	89.2	88.4
	NDRGVS	64.1	59.7	59.0	61.7	60.3	61.9
Profit	DRG 89	100.0	50.0	0.0	50.0	50.2	67.9
	NDRGVS	68.0	55.7	63.6	60.7	61.7	63.3
Nonprofit	DRG 89	94.1	81.8	81.8	85.9	85.9	88.1
	NDRGVS	63.7	60.5	57.6	60.9	59.9	61.6
Total	DRG 89	94.7	76.9	81.8	84.5	84.5	86.9
	NDRGVS	64.1	59.6	57.7	60.8	59.7	61.6

### Appendix C-3: DRG 89 direction of error by patient demography

		Bed size			Weighted average		
		<100	100-299	300+	Sample	Discharge	Hospital
Age (years)	Overpaid	77.9	81.9	78.2	79.3	79.3	79.3
	Underpaid	82.0	79.3	65.5	75.6	75.6	78.5
Sex (% male)	Overpaid	47.2	40.0	33.3	40.2	40.2	42.7
	Underpaid	50.0	33.3	0.0	27.8	27.9	36.7
LOS (days)	Overpaid	5.8	10.4	7.2	7.8	7.8	7.5
	Underpaid	8.5	6.3	27.0	13.9	13.9	10.7
Payment (\$)	Overpaid	2232	3178	3709	3040	3036	2774
	Underpaid	1629	2640	4418	2896	2890	2399
Mortality (%)	Overpaid	5.6	10.0	0.0	5.2	5.2	6.1
	Underpaid	0.0	0.0	0.0	—	—	—

### Appendix D-1: DRG 89 hospital department making error

	Bed size			Total	Weighted proportion		
	<100	100-299	300+		Sample	Discharge	Hospital
Number of coding department errors* [Proportion of errors]							
Urban	5 [100.0]	8 [80.0]	10 [90.9]	23	[90.3]	[90.4]	[92.0]
Rural	33 [100.0]	3 [100.0]	0 [0.0]	36	[66.7]	[66.7]	[84.2]
Teaching	0 [0.0]	1 [50.0]	8 [88.9]	9	[46.3]	[46.1]	[30.3]
Nonteaching	38 [100.0]	10 [90.9]	2 [100.0]	50	[97.0]	[97.0]	[97.0]
Profit	4 [100.0]	2 [100.0]	0 [0.0]	6	[66.7]	[66.7]	[84.2]
Nonprofit	34 [100.0]	9 [81.8]	10 [90.9]	53	[90.9]	[91.0]	[92.6]
Total	38 [100.0]	11 [84.6]	10 [90.9]	59	[91.8]	[91.9]	[93.5]

\* Balance of errors made by billing department

## Appendix D-2: DRG 89 hospital department making error comparison

		Bed size			Weighted proportion		
		<100	100-299	300+	Sample	Discharge	Hospital
Coding department errors as proportion of all errors							
Urban	DRG 89	100.0	80.0	90.9	90.3	90.4	92.0
	NDRGVS	89.2	88.8	90.6	89.7	89.7	89.3
Rural	DRG 89	100.0	100.0	0.0	66.7	66.7	84.2
	NDRGVS	94.5	95.8	90.6	94.5	93.3	94.3
Teaching	DRG 89	0.0	50.0	88.9	46.3	46.1	30.3
	NDRGVS	91.7	92.6	89.2	90.3	91.0	91.6
Nonteaching	DRG 89	100.0	90.9	100.0	97.0	97.0	97.0
	NDRGVS	93.5	90.2	92.3	92.2	91.8	92.2
Profit	DRG 89	100.0	100.0	0.0	66.7	66.7	84.2
	NDRGVS	86.0	92.4	81.8	89.3	86.5	87.4
Nonprofit	DRG 89	100.0	81.8	90.9	90.9	91.0	92.6
	NDRGVS	94.3	90.3	90.9	92.1	91.4	92.5
Total	DRG 89	100.0	84.6	90.9	91.8	91.9	93.5
	NDRGVS	93.5	90.7	90.6	91.7	91.2	92.1

## Appendix D-3: DRG 89 hospital department making error by patient demography

		Bed size			Weighted average		
		< 100	100-299	300+	Sample	Discharge	Hospital
Age (years)	Coding	78.2	80.8	76.6	75.8	78.5	78.8
	Billing	0.0	84.0	69.0	51.0	50.7	38.3
Sex (% male)	Coding	47.4	36.4	30.0	37.9	38.0	41.1
	Billing	0.0	50.0	0.0	16.7	16.5	16.3
LOS (days)	Coding	5.9	9.7	10.6	8.7	8.7	7.9
	Billing	0.0	8.0	13.0	7.0	7.0	4.7
Payment (\$)	Coding	2200	2867	3993	3020	3017	2701
	Billing	0	4080	2284	2121	2106	1691
Mortality (%)	Coding	5.3	9.1	0.0	4.8	4.8	5.7
	Billing	0.0	0.0	0.0	—	—	—

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## Appendix E-1: DRG 89 reasons for errors

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	Bed size			Total	[Percent]
	< 100	100-299	300+		
Mis-specification					
Principal diagnosis	25	8	8	41	[66.1]
Secondary diagnosis	3	0	0	3	[4.8]
Miscoding	0	0	0	0	[0.0]
Resequencing	10	2	2	14	[22.6]
Other	0	3	1	4	[6.5]
Total	38	13	11	62	[100.0]

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## Appendix E-2: DRG 89 reasons for errors by hospital demography

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	Mis-specification		Miscoding		Resequencing		Other	
Number [Proportion of errors]								
< 100 beds	28	[73.7]	0	[0.0]	10	[26.3]	0	[0.0]
100-299 beds	8	[61.5]	0	[0.0]	2	[15.4]	3	[23.1]
300+ beds	8	[72.7]	0	[0.0]	2	[18.2]	1	[9.1]
Urban	17	[65.4]	0	[0.0]	5	[19.2]	4	[15.4]
Rural	27	[75.0]	0	[0.0]	9	[25.0]	0	[0.0]
Teaching	7	[63.6]	0	[0.0]	2	[18.2]	2	[18.2]
Nonteaching	37	[72.5]	0	[0.0]	12	[23.5]	2	[3.9]
Profit	4	[66.7]	0	[0.0]	2	[33.3]	0	[0.0]
Nonprofit	40	[71.4]	0	[0.0]	12	[21.4]	4	[7.1]
Total	44	[71.0]	0	[0.0]	14	[22.6]	4	[6.5]

### Appendix E-3: DRG 89 reasons for errors comparison

		Bed size			Weighted proportion		
		<100	100-299	300+	Sample	Discharge	Hospital
Misspecification	DRG 89	73.7	61.5	72.7	69.3	69.3	69.6
	NDRGVS	49.8	44.9	49.4	48.0	47.9	48.1
Miscoding	DRG 89	0.0	0.0	0.0	0.0	0.0	0.0
	NDRGVS	10.4	14.3	11.4	12.0	12.2	11.8
Resequencing	DRG 89	26.3	15.4	18.2	20.0	20.0	21.5
	NDRGVS	31.0	24.9	24.3	26.7	25.9	28.0
Other	DRG 89	0.0	23.1	9.1	10.7	10.7	9.0
	NDRGVS	6.7	15.9	14.9	12.5	13.5	11.0

### Appendix E-4: DRG 89 reasons for errors by patient demography

	Narrative	Miscoding	Resequencing	Other
Age (years)	79.2	0.0	76.4	76.8
Sex (% male)	40.9	0.0	42.9	50.0
LOS (days)	6.4	0.0	11.1	8.0
Payment (\$)	2602	0	2745	3152
Mortality (%)	2.3	0.0	14.3	0.0

### Appendix F-1: DRG 89 corrected relative weights

Average relative weight	Bed size			Average
	<100	100-299	300+	
Paid	1.0914	1.0914	1.0914	1.0914
Correct	1.0452	1.0819	1.0810	1.0627
Difference	0.0462	0.0095	0.0104	0.0287
<b>Total relative weight</b>				<b>Total</b>
Paid	198.6348	99.3174	85.1292	383.0814
Correct	190.2264	98.4529	84.3180	373.0077
Difference	8.4084	0.8645	0.8112	10.0737

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### Appendix F-2: DRG 89 corrected reimbursement

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Average \$	Bed size			Average
	<100	100-299	300+	
Paid	2,667	3,026	3,207	2,881
Correct	2,554	2,999	3,177	2,805
Difference	113	26	31	76
<b>Total \$</b>				<b>Total</b>
Paid	485,427	275,347	250,151	1,011,317
Correct	464,878	272,950	247,768	984,723
Difference	20,549	2,397	2,384	26,594
Overpayment rate (%)	4.2	0.9	1.0	2.0

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### Appendix F-3: DRG 89 projected cost of errors\*

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Fiscal Year	Reimbursement (\$ million)	Overpayment (\$ million)
1984	388.6	8.0
1985	807.9	16.5
1986	1,000.5	20.5
1987	1,017.4	20.8
1988 est.	1,323.3	27.1
1989 est.	1,531.2	31.3
1990 est.	1,739.0	35.6

\* Overpayment is calculated as 2.0 percent of reimbursement.  
 Estimates are based on linear regression.

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### Appendix G-1: Correct MDCs for DRG 89 errors

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		Bed size			Total	[Percent]
		< 100	100-299	300+		
03	Ear, Nose & Throat	2	1	1	4	[6.5]
04	Respiratory	21	8	8	37	[59.7]
05	Circulatory	3	1	0	4	[6.5]
06	Digestive	0	0	1	1	[1.6]
08	Musculoskeletal	3	0	0	3	[4.8]
09	Skin and Breast	0	1	0	1	[1.6]
10	Endocrine and Metabolic	2	1	0	3	[4.8]
11	Kidney and Urinary Tract	1	0	0	1	[1.6]
18	Infectious Diseases	6	0	1	7	[11.3]
21	Injury, Poisoning & Drugs	0	1	0	1	[1.6]
	Total	38	13	11	62	[100.0]

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### Appendix G-2: Correct DRGs for DRG 89 errors

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		Bed size			Total	[Percent]
		< 100	100-299	300+		
96	Bronchitis & asthma	15	4	6	25	[40.3]
68	Otitis media & upper respiratory infections	2	1	1	4	[6.5]
127	Heart failure & shock	3	1	0	4	[6.5]
421	Viral illness	4	0	0	4	[6.5]
79	Respiratory infections & inflammations	1	2	0	3	[4.8]
88	Chronic obstructive pulmonary disease	3	0	0	3	[4.8]
	Subtotal	28	8	7	43	[69.4]
	Other	10	5	4	19	[30.6]
	Total	38	13	11	62	[100.0]

### Appendix G-3: ICD-9-CM codes from correct DRG 89 bills

ICD-9	Disease	Number	Percent
480.9	Unspecified viral pneumonia	4	1.4
481	Pneumococcal pneumonia	26	9.0
482.2	Hemophilus influenza pneumonia	21	7.3
482.3	Streptococcal pneumonia	22	7.6
482.8	Other specified pneumonia	9	3.1
482.9	Unspecified bacterial pneumonia	2	0.7
483	Other specific pneumonia	1	0.3
485	Unspecified bronchopneumonia	34	11.8
486	Unspecified pneumonia	160	55.4
487.0	Influenza with pneumonia	9	3.1
511.0	Pleurisy	1	0.3

### Appendix H-1: DRG 89 clinical review

	Bed size			Total	Weighted average		
	<100	100-299	300+		Sample	Discharge	Hospital
Number [Rate]							
Unnecessary admissions	7 [3.8]	4 [4.4]	3 [3.8]	14	[4.0]	[4.0]	[4.0]
Poor quality of care	20 [11.0]	8 [8.8]	7 [9.0]	35	[9.6]	[9.6]	[10.0]
Premature discharge	4 [2.2]	2 [1.1]	1 [1.3]	7	[1.5]	[1.5]	[1.7]

### Appendix H-2: DRG 89 clinical review comparison

Rate		Bed size			Weighted average		
		< 100	100-299	300+	Sample	Discharge	Hospital
Unnecessary admissions	DRG 89	3.8	4.4	3.8	4.0	4.0	4.0
	NDRGVS	12.6	10.1	8.9	10.5	10.2	11.3
Poor quality of care	DRG 89	11.0	8.8	9.0	9.6	9.6	10.0
	NDRGVS	11.4	5.1	3.5	6.6	5.5	8.1
Premature discharge	DRG 89	2.2	1.1	1.3	1.5	1.5	1.7
	NDRGVS	2.1	0.8	0.4	1.1	0.8	1.4