

---

---

# **DRG 87: PULMONARY EDEMA AND RESPIRATORY FAILURE**

---

---



**OFFICE OF INSPECTOR GENERAL**  
**OFFICE OF ANALYSIS AND INSPECTIONS**

---

---

AUGUST 1989

---

---

# **DRG 87: PULMONARY EDEMA AND RESPIRATORY FAILURE**

---

---

**RICHARD P. KUSSEROW  
INSPECTOR GENERAL**

## **Contract Information**

### **Contractor**

BOTEC Analysis Corporation  
36 JFK Street  
Cambridge, MA 02138

### **Project Officer**

David Hsia, J.D., M.D., M.P.H.  
Health Care Branch  
Office of Inspector General  
330 Independence Ave., SW  
Washington, D.C. 20201

### **Contract**

HHS-100-88-0019

---

---

## EXECUTIVE SUMMARY

---

---

### BACKGROUND

Diagnosis related group (DRG) 87 pays for pulmonary edema and respiratory failure. Only five, very specific, ICD-9-CM codes group to DRG 87 as principal diagnoses. Disorders such as congestive heart failure, chronic obstructive pulmonary disease, asthma, bronchitis, and pneumonia also involve lung pathology, but should group to other DRGs with lower relative weights.

### FINDINGS

- Overall, 56.0 percent of the discharges billed as DRG 87 should have been assigned to a different DRG. This error rate significantly exceeds the 18.6 percent for all DRGs from the National DRG Validation Study.
- Hospitals overpaid themselves in 96.4 percent of the incorrect DRG assignments. This ratio significantly exceeds the National DRG Validation Study's 59.7 percent of overpayments.
- The coding errors principally derived from physician mis-specification of the principal diagnosis or hospital resequencing of the diagnoses to substitute respiratory failure for the correct principal diagnosis.

### RECOMMENDATIONS

- The Health Care Financing Administration (HCFA) should direct the peer review organizations (PROs) to review prospectively DRG 87 bills for coding accuracy.
- The HCFA should direct the PROs to educate physicians and hospitals about the proper coding of DRG 87.

The HCFA disagrees with the first recommendation and believes that it has implemented the second recommendation. The Office of Inspector General has altered this report to accommodate HCFA's comments and continues to believe that adopting these recommendations could recover a projected \$35.5 million annually. The HCFA has already implemented a third recommendation made in the draft of this inspection.

---

---

## TABLE OF CONTENTS

---

---

### EXECUTIVE SUMMARY

<b>INTRODUCTION</b> .....	1
Background .....	1
PPS vulnerabilities .....	1
Claims processing .....	2
DRG 87 .....	2
Methodology .....	4

<b>FINDINGS</b> .....	5
Sample characteristics .....	5
Assignment errors .....	6
Direction of errors .....	7
Source of errors .....	7
Reasons for assignment errors .....	8
Financial effects .....	8
Correct DRG assignments .....	9
Clinical review results .....	10

<b>RECOMMENDATIONS</b> .....	11
------------------------------	----

<b>Appendix A-1: DRG 87 discharges from all PPS hospitals</b> .....	A-1
---	-----

<b>Appendix A-2: DRG 87 sampling frame</b> .....	A-1
--	-----

<b>Appendix A-3: DRG 87 hospital demography</b> .....	A-1
---	-----

<b>Appendix A-4: DRG 87 hospital demography comparison</b> .....	A-2
--	-----

<b>Appendix A-5: DRG 87 patient demography</b> .....	A-2
--	-----

<b>Appendix A-6: DRG 87 patient demography comparison</b> .....	A-3
---	-----

<b>Appendix B-1: DRG 87 assignment errors</b> .....	B-1
---	-----

<b>Appendix B-2: DRG 87 assignment errors comparison</b> .....	B-1
--	-----

<b>Appendix B-3: DRG 87 assignment errors by patient demography</b> .....	B-2
---	-----

<b>Appendix C-1: DRG 87 direction of error</b> .....	C-1
--	-----

<b>Appendix C-2: DRG 87 direction of error comparison</b> .....	C-1
---	-----

<b>Appendix C-3: DRG 87 direction of error by patient demography</b> .....	C-2
<b>Appendix D-1: DRG 87 hospital department making error</b> .....	D-1
<b>Appendix D-2: DRG 87 hospital department making error comparison</b> .....	D-1
<b>Appendix D-3: DRG 87 hospital department making error by patient demography</b> .....	D-2
<b>Appendix E-1: DRG 87 reasons for errors</b> .....	E-1
<b>Appendix E-2: DRG 87 reasons for errors by hospital demography</b> .....	E-1
<b>Appendix E-3: DRG 87 reasons for errors comparison</b> .....	E-2
<b>Appendix E-4: DRG 87 reasons for errors by patient demography</b> .....	E-2
<b>Appendix F-1: DRG 87 corrected relative weights</b> .....	F-1
<b>Appendix F-2: DRG 87 corrected reimbursement</b> .....	F-1
<b>Appendix F-3: DRG 87 projected cost of errors</b> .....	F-2
<b>Appendix G-1: Correct MDC for discharges miscoded to DRG 87</b> .....	G-1
<b>Appendix G-2: Correct DRG for discharges miscoded to DRG 87</b> .....	G-1
<b>Appendix G-3: Correct ICD-9-CM principal diagnoses for discharges miscoded to DRG 87</b> .....	G-2
<b>Appendix G-4: Original ICD-9-CM principal diagnosis for discharges incorrectly coded to DRG 87</b> .....	G-2
<b>Appendix G-5: ICD-9-CM codes for discharges correctly coded to DRG 87</b> .....	G-2
<b>Appendix H-1: DRG 87 clinical review</b> .....	H-1
<b>Appendix H-2: DRG 87 clinical review comparison</b> .....	H-1

---

---

## INTRODUCTION

---

---

### **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 new prospective payment system (PPS) replaced the cost-based reimbursement system. Congress mandated this change because of rapid growth in health care costs, particularly 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. 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 hospital care provided to patients with diagnoses grouping to that DRG as a proportion of the cost of the average patient. 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 payments to the hospitals provided the same financial resources for patient care. In effect, PPS reversed the financial incentives for hospitals. Where the cost-reimbursement system rewarded longer hospital stays and more costly treatments, PPS rewarded earlier discharges and less costly procedures. One of the first consequences of the new payment system was a drop in average length of hospital stay for Medicare patients.

### **PPS vulnerabilities**

The advent of PPS created new opportunities for manipulation or "gaming" to increase hospital revenues from Medicare patients. To protect the integrity of PPS and maintain quality of care Congress established the peer review organizations (PROs) to monitor hospital activities.

The Office of the Inspector General (OIG) conducted The National DRG Validation Study (NDRGVS) to survey the general accuracy of DRG assignment and quality of care performed by hospitals under PPS. Its examination of 7000 medical records established that assignment errors resulted in \$300 million in overpayments to hospitals, and that the majority of overpayments could be traced to assignment errors affecting a small number of DRGs. This report is one in a series examining assignment accuracy of one of the DRGs identified as having the highest impact on overpayments under PPS and the greatest potential for cost recovery.

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. PPS permits optimization, which flows from the basic incentive structure of the PPS system.

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

- **Misspecification:** The attending physician writes an incorrect principal diagnosis (defined by the Uniform Hospital Discharge Data Set (UHDDS) as "that condition established after study to be chiefly responsible for occasioning the admission of the patient to the hospital for care"), secondary diagnoses, or procedures on the attestation sheet.
- **Miscoding:** The hospital assigns incorrect numeric codes to diseases or procedures correctly attested to by the attending physician.
- **Resequencing:** The hospital substitutes a secondary diagnosis for the correct principal diagnosis.

Auditing and review practices seek to curtail illegal creep by identifying discharges in which coding rules are misapplied or ignored.

## Claims processing

Under PPS, the hospital files a claim for Medicare reimbursement upon discharging the beneficiary. At the time of discharge, the attending physician attests to the principal diagnosis which caused the patient's admission to the hospital, 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 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 thus have significant financial implications.

## DRG 87

This study examines erroneous assignment in a single DRG: 87, pulmonary edema and respiratory failure. At the time covered by this inspection, only five ICD-9-CM codes group to DRG 87: three types of pulmonary edema and two forms of pulmonary insufficiency.

Physiologically, the former condition consists of fluid filling the lungs, usually secondary to cardiac (e.g., advanced left heart failure, mitral stenosis) or occasionally to non-cardiac (e.g., narcotic overdose, high altitude sickness, neurogenic) causes. The latter adds severe arterial hypoxemia to the liquid in the lungs and has equally diverse causes (e.g., infection, aspiration, toxin inhalation, immunological response, trauma).

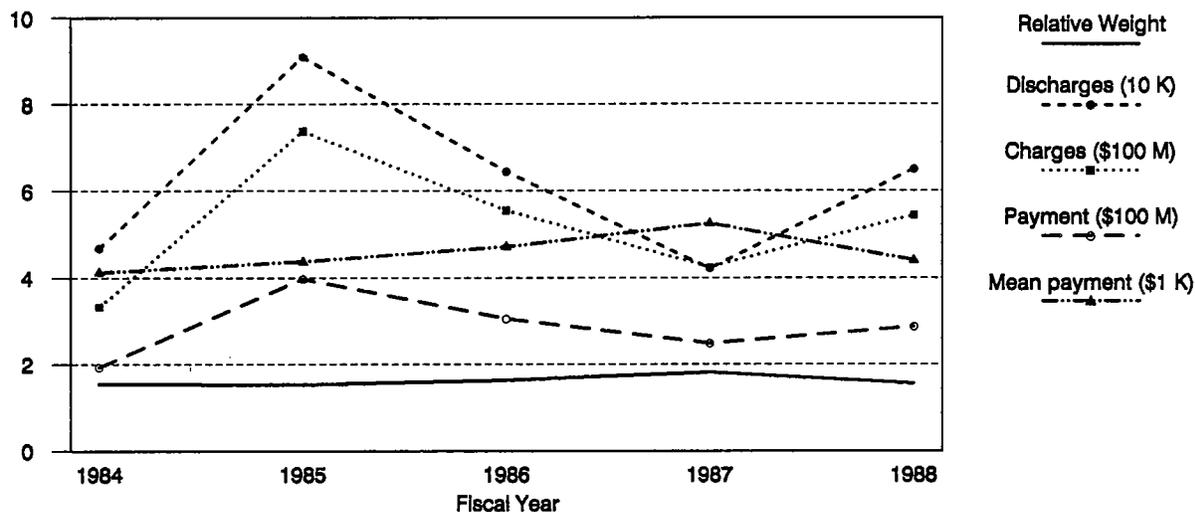


Figure 1: DRG 87

Each of these conditions represents an end stage (and often terminal) complication of diseases grouping to other DRGs. Disorders such as congestive heart failure, chronic obstructive pulmonary disease, asthma, bronchitis, and pneumonia also involve lung pathology, but should group to other DRGs with lower relative weights. A chest X-ray should distinguish between the mild stage of the underlying cause and the fluid buildup required for DRG 87. Arterial blood gases and invasive procedures may serve to further define the pulmonary edema and its etiologies. [Appendix A-1]

## Methodology

This study 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 bed size strata: 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 at least 25 DRG 87 bills from each strata for Medicare discharges between October 1, 1984 and March 31, 1985.

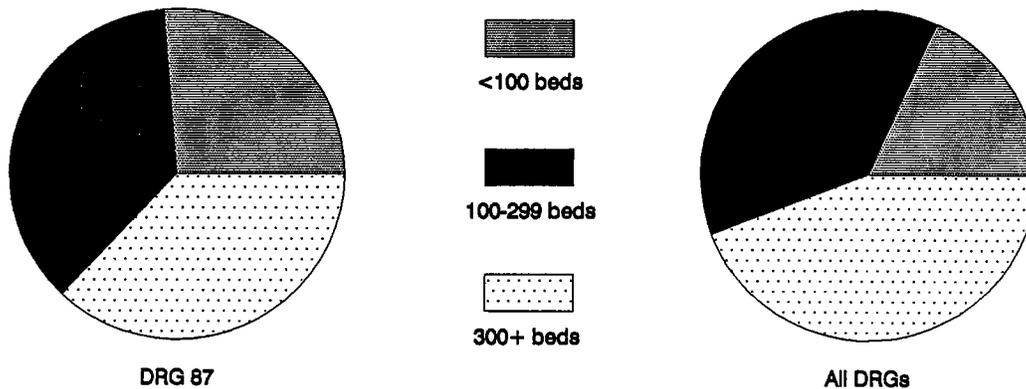


Figure 2: Sampling frame

The OIG contracted with the Health Data Institute (HDI) of Lexington, Massachusetts to reabstract the medical records. Upon receipt, the contractor "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 substantiate 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 principal diagnosis, and additional diagnoses and/or procedures which were 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 contractor record review is available in the final report of the National DRG Validation Study (available from OIG Public Affairs).

DRG 87 was chosen for this inspection because of its high relative weight (1.5368) and its high rate of errors. The OIG contracted with BOTEC Analysis of Cambridge, MA to examine data for DRG 87 in greater detail, to identify sources of assignment errors, and to make recommendations for recovery of overpayments.

---

---

## FINDINGS

---

---

### Sample characteristics

In FY 1985, 90,917 of the 8.3 million PPS discharges (1.1 percent) grouped to DRG 87. The National DRG Validation Study estimated that approximately equal proportions came from each bed size strata. Small hospitals therefore billed for DRG 87 at a higher rate than large and medium sized institutions as a proportion of all PPS bills (Chi-square 4.09, df 2,  $P < 0.25$ ). 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 2,417 came from DRG 87 (1.1 percent). The sampling frame reflects their higher frequency of discharges from larger hospitals, while the sampling fraction captures the significantly higher rate in smaller hospitals (Chi-square 3.54, df 1,  $P < 0.1$ ). [Appendix A-2]

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.

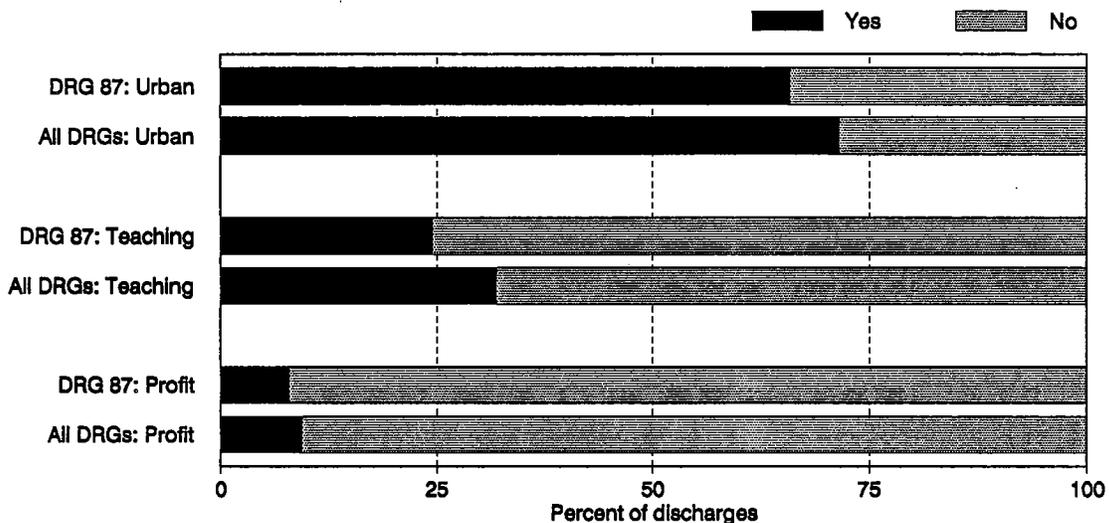


Figure 3: Hospital demography

Like all Medicare discharges as measured by the National DRG Validation Study, the majority of DRG 87 discharges came from urban (Mantel-Haenszel chi-square 0.16, df 1,  $P < 0.75$ ), nonteaching (Mantel-Haenszel chi-square 0.59, df 1,  $P < 0.5$ ), and nonprofit (Mantel-Haenszel chi-square 0.05, df 1,  $P < 0.9$ ) hospitals; but not a significant rates when controlling for hospital size. [Appendix A-3] In comparison to all PPS discharges, a slightly larger proportion of DRG 87 discharges came from rural and nonteaching hospitals. [Appendix A-4]

DRG 87 National DRG Medicare Validation Study			
Age (years)	71.5	73.6	not available
Sex (% male)	57.1	46.2	42.2
LOS (days)	8.3	7.5	7.8
Payment (\$)	41.87	3150	2985 urban 2381 rural
Mortality (%)	20.3	6.3	not available

Table I: Patient demography

Comparing personal characteristics, DRG 87 patients proved to be slightly younger (t-test = -3.30, df 91,  $P < 0.005$ ), to be more male (Mantel-Haenszel chi-square 7.37, df 1,  $P < 0.01$ ), and to have over three times the mortality of all Medicare beneficiaries. [Appendix A-5]. The average hospital stay ran a day longer, and the average reimbursement went over \$1000 higher for discharges paid as DRG 87. [Appendix A-6]

### Assignment errors

Weighted to represent discharges, 56.0 percent of this sample's bills should have grouped to another DRG. This error rate significantly exceeded the 18.6 percent for all DRGs (Mantel-Haenszel chi-square 84.29, df 1,  $P < 0.001$ ). Assignment errors occurred most frequently in discharges from small hospitals (Chi-square 3.60, df 2,  $P < 0.25$ ). [Appendix B-1]

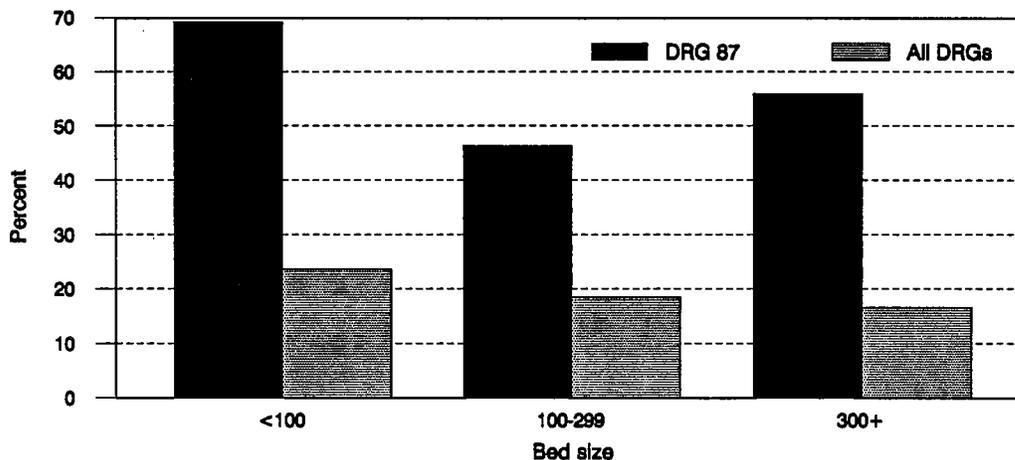


Figure 4: Coding errors

Rural and for-profit facilities had the highest rate of coding errors, with over three-quarters of discharges grouping to other DRGs. Teaching and urban hospitals had the lowest frequency of errors, mis-assigning 36.6 and 45.6 percent of their discharges respectively. [Appendix B-2]

Patient demographics differ between the correct and incorrect subsamples of discharges. In discharges assigned incorrectly, patients were on average slightly older, more frequently female, and had higher mortality. The length of hospital stay averaged slightly longer, but reimbursements lower, in discharges incorrectly assigned to DRG 87. [Appendix B-3]

### Direction of errors

The overwhelming majority of errors in assignment for DRG 87 resulted in overpayments to hospitals. Weighted by discharges, hospitals overpaid themselves in 96.4 percent of coding mis-assignments. In other words, hospitals billed discharges with lower weighted diagnoses as DRG 87 which, in 1985, had a relative weight of 1.5368. This rate significantly exceeds the 59.6 percent overpayments rate for all discharges (Mantel-Haenszel chi-square 1.05, df 1,  $P < 0.5$ ). Combining the 56.0 percent error rate with this 96.4 percent overpayment rate gives an effective overpayment rate of 54.0 percent. This rate is nearly five times the 11.1 percent for the National DRG Validation Study. [Appendix C-1]

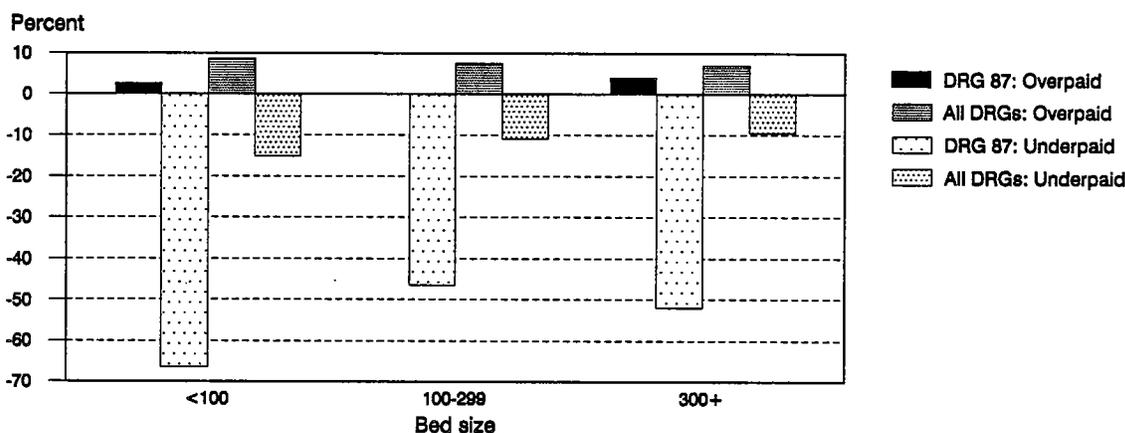


Figure 5: Direction of errors

Hospitals of all types overpaid themselves on DRG 87 errors. However, except for nonteaching status (Mantel-Haenszel chi-square 3.9, df 1,  $P < 0.05$ ), these demographic trends did not significantly exceed those in the National DRG Validation Study when controlling for hospital size. [Appendix C-2] While there were some differences in patient demographics among over- and under-paid discharges, the number of underpayments was too small to allow meaningful analysis of these differences. [Appendix C-3]

### Source of errors

Almost all the errors in this sample can be traced to the hospitals' medical records practices. Fifty-three cases were miscoded as DRG 87 and billed accordingly. Only one case was coded correctly to a DRG other than 87 but billed incorrectly as DRG 87 by the hospital. [Appendix D-1]

## Reasons for assignment errors

Physicians made the majority of errors by incorrectly specifying the diagnoses or procedures on patient attestation sheets. This mis-specification caused 48.2 percent of the mis-assignments. Most of these errors concerned the narrative principal diagnosis. In one case, the physician mis-specified a procedure. 29.6 percent of errors occurred when the hospital resequenced the narrative to substitute a secondary diagnosis for the correct principal diagnosis. A smaller number of errors resulted when the medical records department selected incorrect numeric codes for correct narrative diagnoses. The distribution of errors in this sample between physicians and other hospital departments approximated the trends in the entire National DRG Validation Study. [Appendix E-1]

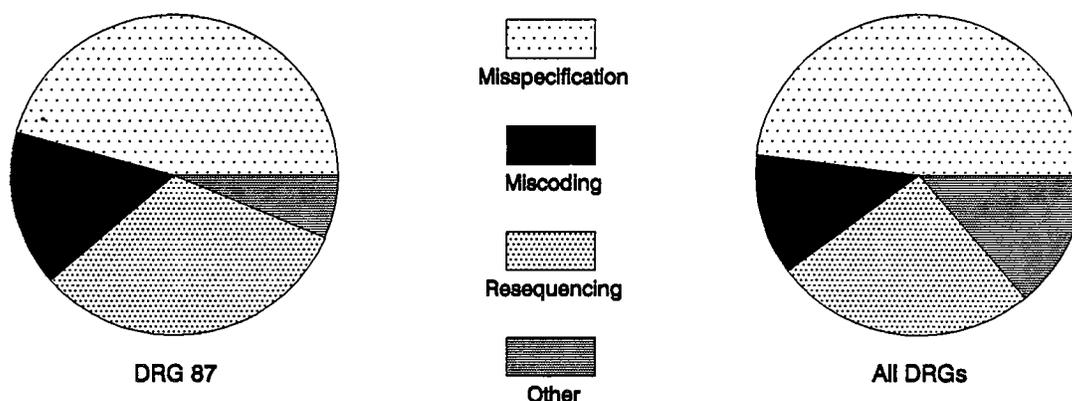


Figure 6: Reasons for errors

The reasons for errors in billing discharges to DRG 87 varied slightly by hospital demographics. [Appendix E-2] Narrative (physician) errors occurred particularly frequent in discharges from small hospitals and mid-sized facilities. Large hospitals, in contrast, had higher rates of miscoding and resequencing errors. Teaching hospitals miscoded records at over twice the rate of non-teaching hospitals, but non-teaching facilities resequenced diagnoses nearly twice as often as their non-teaching counterparts. In discharges from for-profit hospitals, narrative errors appeared frequently, but no resequencing errors. Patient age, sex, length of stay, and mortality were roughly similar across error types. [Appendix E-4]

## Financial effects

After reabstraction, the average relative weight for DRG 87 discharges in this sample dropped from 1.5368 to 1.2277. Discharge weighted, the decrease amounted to a net overpayment of 19.3 percent and applies to FY 1984-87 without modification. [Appendix F-1]

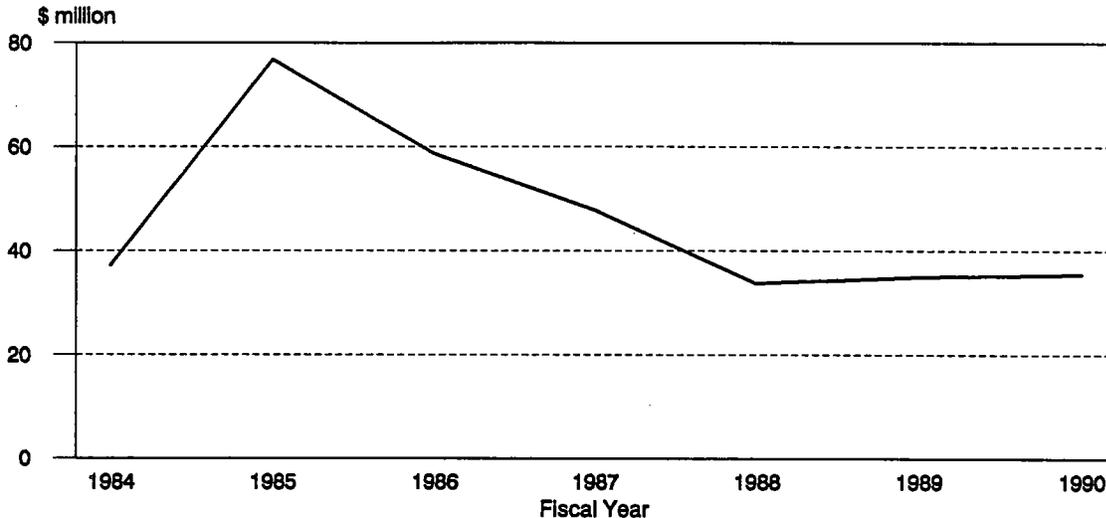


Figure 7: Overpayments

Effective October 1987 and subsequent to the period sampled for this inspection, the HCFA altered the grouper to drop one of DRG 87's more common principal diagnoses: 799.1 -- respiratory failure). This change would affect 61.1 percent of the discharges erroneously billed as DRG 87. Accordingly, this inspection decreases its estimated overpayment rate to 11.8 percent for FY 1988 and ensuing years. At this time, the HCFA also added DRGs for ventilator patients, a much rarer occurrence. [Appendix F-3]

DRG 87 total reimbursement peaked in FY 1985 and has subsequently averaged around \$300 million annually. Despite the grouper changes and a decrease in the relative weight, the total number of discharges and dollar reimbursement increased in FY 1988. Simple regression from the 1984-88 data projects that total reimbursement will continue to increase.

### Correct DRG assignments

Following reabstraction, the incorrectly billed discharges in this sample principally clustered in Major Diagnostic Categories (MDCs) 04 (respiratory system) -- 53.7 percent and 05 (circulatory system) -- 40.7 percent. [Appendix G-1] Within these two MDCs, five specific DRGs had 3 or more discharges and accounted for 81.5 percent of the erroneously billed cases: DRG 88 (chronic obstructive pulmonary disease), DRG 89 (pneumonia and pleurisy), DRG 96 (bronchitis and asthma), DRG 99 (respiratory signs and symptoms), and DRG 127 (heart failure and shock). Each of these DRGs has a lower relative weight than DRG 87. [Appendix G-2]

Analyzed at the level of ICD-9-CM codes, a variety of erroneous principal diagnoses appear, including congestive heart failure, acute bronchitis, nonspecific pneumonia, and chronic airway obstruction. [Appendix G-3] Examining the codes on erroneous DRG 87 bills, respiratory failure (no longer an acceptable principal diagnosis) constitutes 61.1 percent of this subsample. As noted above, this grouping change reduced the rate of overpayments. [Appendix G-4]

The majority of cases correctly assigned to DRG 87 also involved patients with respiratory failure. The balance of correctly billed discharges have acute lung edema -- not otherwise specified, as their principal diagnosis. [Appendix G-5]

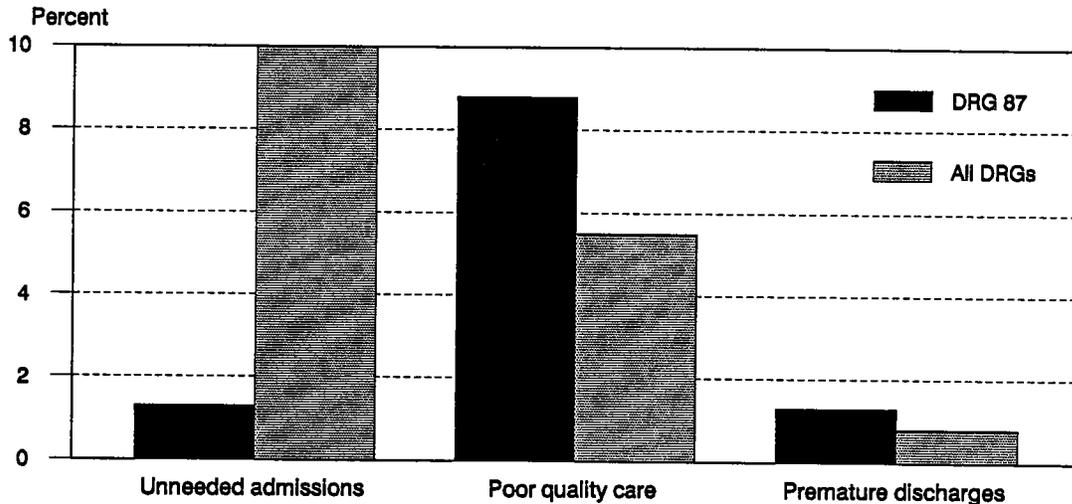


Figure 8: Clinical incidents

### Clinical review results

Reviewers concluded that only 1.3 percent of discharges in this sample constituted unnecessary admissions ("an admission in which the care received by the patient was either not needed or did not require the use of the inpatient setting.") [Appendix H-1] However, this rate did not differ significantly from the 10.0 percent for all DRGs (Chi-square 3.2, df 2,  $P < 0.25$ ). Two discharges were judged to have been premature, a rate also not significantly different from the National DRG Validation Study (Chi-square 1.66, df 2,  $P < 0.50$ ). [Appendix H-2]

Overall, 8.8 percent of discharges in this sample (discharge-weighted) evidenced "quality of care not meeting professionally recognized standards." Quality of care problems concentrated in discharges from small hospitals, which had over twice the rate of poor quality compared to other hospitals in this sample, and substantially more problems than discharges from small hospitals in the full National DRG Validation Study.

---

---

## RECOMMENDATIONS

---

---

- The Health Care Financing Administration should direct the peer review organizations to review prospectively DRG 87 bills for coding accuracy.
- The HCFA should direct the PROs to educate physicians and hospitals about the proper coding of DRG 87.

The HCFA disagrees with the first recommendation and believes that it has implemented the second recommendation. The OIG has considered the HCFA's comments on the draft of this report and continues to believe that adopting these recommendations could recover a projected \$35.5 million annually. The HCFA has already implemented a third recommendation made in the draft of this inspection.

### Appendix A-1: DRG 87 discharges from all PPS hospitals

Fiscal Year	1984	1985	1986	1987	1988
Relative weight	1.5529	1.5368	1.6316	1.8076	1.5691
Number of discharges	46,832	90,917	64,498	42,224	65,053
Total charges (\$ million)	332.4	737.6	555.7	424.3	544.0
Total reimbursement (\$ million)	193.2	397.5	304.6	248.0	286.4
Average reimbursement (\$)	4,126	4,372	4,723	5,251	4,402

### Appendix A-2: DRG 87 sampling frame

Number	Bed size			Total
	<100	100-299	300+	
Medicare population	23,911	33,367	33,639	90,917
Sample hospitals	214	742	1461	2417
Sampling frame	39	28	25	92
Sampling fraction (%)	18.2	3.8	1.7	3.8

### Appendix A-3: DRG 87 hospital demography

Number [Percent distribution]	Bed size			Total	Weighted percentage		
	<100	100-299	300+		Sample	Discharge	Hospital
Urban	4 [10.3]	20 [71.4]	25 [100]	49	[53.3]	[65.9]	[44.4]
Rural	35 [89.7]	8 [28.6]	0 [0.0]	43	[46.7]	[34.1]	[55.6]
Teaching	0 [0.0]	4 [14.3]	13 [52.0]	17	[18.5]	[24.5]	[12.9]
Nonteaching	39 [100]	24 [85.7]	12 [48.0]	75	[81.5]	[75.5]	[87.1]
Profit	4 [10.3]	4 [14.3]	0 [0.0]	8	[8.7]	[7.9]	[10.0]
Nonprofit	35 [89.7]	24 [85.7]	25 [100]	84	[91.3]	[92.1]	[90.1]
Total	39 [100]	28 [100]	25 [100]	92	[100]	[100]	[100]

## Appendix A-4: DRG 87 hospital demography comparison

Percent distribution		Bed size			Weighted percentage		
		<100	100-299	300+	Sample	Discharge	Hospital
Urban	DRG 87	10.3	71.4	100	53.3	65.9	44.4
	NDRGVS	19.9	70.2	94.0	62.0	71.5	48.0
Rural	DRG 87	89.7	28.6	0.0	46.7	34.1	55.6
	NDRGVS	80.1	29.8	6.0	38.0	28.5	52.0
Teaching	DRG 87	0.0	14.3	52.0	18.5	24.5	12.9
	NDRGVS	2.6	18.8	55.2	25.9	31.9	16.2
Non-teaching	DRG 87	100	85.7	48.0	81.5	75.5	87.1
	NDRGVS	97.4	81.2	44.8	74.1	68.2	83.8
Profit	DRG 87	10.3	14.3	0.0	8.7	7.9	10.0
	NDRGVS	9.2	17.5	2.5	9.8	9.4	10.9
Non-profit	DRG 87	89.7	85.7	100	91.3	92.1	90.1
	NDRGVS	90.8	82.5	97.5	90.2	90.6	89.2

## Appendix A-5: DRG 87 patient demography

	Bed size			Weighted average		
	<100	100-299	300+	Sample	Discharge	Hospital
Age (years)	74.2	72.4	67.9	72.0	71.2	72.6
Sex (% male)	69.2	50.0	52.0	58.7	55.8	60.2
LOS (days)	6.9	6.7	11.2	8.0	8.4	7.5
Payment (\$)	2868	4217	5476	3987	4328	3720
Mortality (%)	12.8	32.1	16.0	19.6	21.1	19.6

## Appendix A-6: DRG 87 patient demography comparison

		Bed size			Weighted average		
		<100	100-299	300+	Sample	Discharge	Hospital
Age (years)	DRG 87	74.2	72.4	67.9	72.0	71.2	72.6
	NDRGVS	76.2	74.0	72.2	74.1	73.6	74.9
Sex (% male)	DRG 87	69.2	50.0	52.0	58.7	55.8	60.2
	NDRGVS	43.3	45.4	48.1	45.7	46.2	44.8
LOS (days)	DRG 87	6.9	6.7	11.2	8.0	8.4	7.5
	NDRGVS	5.9	7.4	8.3	7.2	7.5	6.8
Payment (\$)	DRG 87	2868	4217	5476	3987	4328	3720
	NDRGVS	1849	2923	3807	2860	3074	2508
Mortality (%)	DRG 87	12.8	32.1	16.0	19.6	21.1	19.6
	NDRGVS	5.6	6.2	7.0	6.3	6.4	6.0

## Appendix B-1: DRG 87 assignment errors

Number [Percent]	Bed size			Total	Weighted percentage		
	<100	100-299	300+		Sample	Discharge	Hospital
Urban	2 [50.0]	6 [30.0]	14 [50.0]	22	[44.9]	[42.6]	[43.5]
Rural	25 [71.4]	7 [87.5]	---	32	[74.4]	[50.9]	[65.4]
Teaching	---	0 [0.0]	6 [46.1]	6	[35.3]	[17.1]	[7.3]
Nonteaching	27 [9.2]	13 [54.2]	8 [66.7]	48	[64.0]	[62.8]	[63.9]
Profit	3 [75.0]	3 [75.0]	---	6	[75.0]	[47.3]	[63.2]
Nonprofit	24 [68.6]	10 [41.7]	14 [56.0]	48	[57.1]	[54.1]	[57.8]
Total	27 [69.2]	13 [46.4]	14 [56.0]	54	[58.7]	[56.0]	[59.7]

## Appendix B-2: DRG 87 assignment errors comparison

Percent		Bed size			Weighted percentage		
		<100	100-299	300+	Sample	Discharge	Hospital
Urban	DRG 87	50.0	30.0	50.0	44.9	42.7	43.5
	NDRGVS	22.5	19.3	16.2	18.0	17.6	20.4
Rural	DRG 87	71.4	87.5	---	35.3	50.9	65.4
	NDRGVS	23.9	16.6	22.5	21.9	20.9	21.3
Teaching	DRG 87	---	0.0	46.1	35.3	17.1	7.3
	NDRGVS	20.0	20.9	15.8	17.4	17.2	19.6
Non-teaching	DRG 87	69.2	54.2	66.7	64.0	62.8	63.9
	NDRGVS	23.7	17.9	17.6	20.2	19.2	20.9
Profit	DRG 87	75.0	75.0	---	75.0	47.3	63.2
	NDRGVS	23.8	18.9	18.3	20.3	19.7	21.3
Non-profit	DRG 87	68.6	41.7	56.0	57.1	54.1	57.8
	NDRGVS	23.6	18.4	16.5	19.4	18.5	20.8
Total	DRG 87	69.2	46.4	56.0	58.7	56.0	59.7
	NDRGVS	23.6	18.5	16.6	19.5	18.6	20.8

## Appendix B-3: DRG 87 assignment errors by patient demography

		Bed size			Weighted average		
		<100	100-299	300+	Sample	Discharge	Hospital
Age (years)	Correct	68.1	70.5	68.3	69.1	69.1	68.9
	Incorrect	76.9	74.6	67.7	74.0	72.7	74.7
Sex (% male)	Correct	75.0	46.7	63.6	60.5	60.4	64.0
	Incorrect	66.7	53.9	42.9	57.4	53.2	58.8
LOS (days)	Correct	6.8	7.6	8.4	7.6	7.7	7.3
	Incorrect	6.5	5.7	13.3	8.1	8.7	7.3
Payment (\$)	Correct	2959	4658	5278	4301	4441	3879
	Incorrect	2829	3708	5632	3767	4189	3558
Mortality (%)	Correct	8.3	3.3	9.1	18.4	17.8	16.6
	Incorrect	14.8	30.8	21.4	22.6	23.1	21.1

### Appendix C-1: DRG 87 direction of error

Number [Percent of errors]	Bed size			Total	Weighted percentage		
	<100	100-299	300+		Sample	Discharge	Hospital
Urban	2 [100]	6 [100]	13 [92.9]	21	[95.5]	[97.4]	[98.9]
Rural	24 [96.0]	7 [100]	- ---	31	[96.9]	[61.9]	[82.1]
Teaching	- ---	- ---	5 [83.3]	5	[83.3]	[30.8]	[13.2]
Nonteaching	26 [96.3]	13 [100]	8 [100]	47	[98.0]	[99.0]	[98.1]
Profit	3 [100]	0 [0.0]	- ---	3	[50.0]	[54.2]	[67.0]
Nonprofit	24 [100]	10 [100]	13 [92.9]	47	[98.0]	[97.4]	[98.9]
Total	26 [96.3]	13 [100]	13 [92.9]	52	[96.3]	[96.4]	[97.0]

### Appendix C-2: DRG 87 direction of error comparison

Percent overpayments		Bed size			Weighted percentage		
		<100	100-299	300+	Sample	Discharge	Hospital
Urban	DRG 87	100.0	100.0	92.9	95.5	97.4	98.9
	NDRGVS	53.9	60.4	57.0	58.0	57.6	56.5
Rural	DRG 87	96.0	100.0	---	96.9	62.0	82.1
	NDRGVS	66.5	57.6	65.6	64.7	62.9	63.4
Teaching	DRG 87	---	---	83.3	83.3	30.8	13.2
	NDRGVS	66.7	59.6	56.6	57.9	59.8	62.8
Non-teaching	DRG 87	96.3	100.0	100.0	98.0	99.0	98.1
	NDRGVS	64.1	59.7	59.0	61.7	60.3	61.9
Profit	DRG 87	100.0	0.0	---	50.0	54.2	67.0
	NDRGVS	68.0	55.7	63.6	60.7	61.7	63.3
Non-profit	DRG 87	100.0	100.0	92.9	98.0	97.4	98.9
	NDRGVS	63.7	60.5	57.6	60.9	59.9	61.7
Total	DRG 87	96.3	100.0	92.9	96.3	96.4	97.0
	NDRGVS	64.1	59.6	57.7	60.8	59.7	61.6

## Appendix C-3: DRG 87 direction of error by patient demography

		Bed size			Weighted average		
		<100	100-299	300+	Sample	Discharge	Hospital
Age (years)	Overpaid	77.2	74.6	67.8	74.2	72.8	74.9
	Underpaid	69.0	---	67.0	68.0	42.9	46.2
Sex (% male)	Overpaid	69.2	53.9	38.5	57.7	52.2	59.4
	Underpaid	0.0	---	100.0	50.0	37.0	15.8
LOS (days)	Overpaid	3.0	---	79.0	41.0	30.0	14.0
	Underpaid	7.1	5.7	8.2	7.0	7.0	6.8
Payment (\$)	Overpaid	3000	---	14449	8725	6135	3831
	Underpaid	2822	3708	4954	3576	3936	3448
Mortality (%)	Overpaid	0.0	---	0.0	0.0	0.0	0.0
	Underpaid	15.4	30.8	23.1	22.0	23.9	21.6

## Appendix D-1: DRG 87 hospital department making error

Number by coding department [Percent]*	Bed size			Total	Weighted percentage		
	100	100-299	300+		Sample	Discharge	Hospital
Urban	2 [100]	6 [100]	14 [100]	22	[100]	[100]	[100]
Rural	25 [100]	6 [85.7]	- ---	31	[96.9]	[57.8]	[79.5]
Teaching	- ---	- ---	6 [100]	6	[100]	[62.7]	[40.6]
Nonteaching	27 [100]	12 [92.3]	8 [100]	47	[97.9]	[97.2]	[97.5]
Profit	3 [100]	3 [100]	- ---	6	[100]	[63.0]	[84.2]
Nonprofit	24 [100]	9 [90.0]	14 [100]	47	[97.9]	[96.3]	[96.7]
Total	27 [100]	12 [92.3]	14 [100]	53	[98.1]	[97.5]	[97.5]

\* Balance of errors by billing department.

## Appendix D-2: DRG 87 hospital department making error comparison

Percent by coding department		Bed size			Weighted percentage		
		<100	100-299	300+	Sample	Discharge	Hospital
Urban	DRG 87	100.0	100.0	100.0	100	100	100
	NDRGVS	89.2	88.8	89.7	89.7	89.3	
Rural	DRG 87	100.0	85.7	---	96.9	57.8	79.5
	NDRGVS	94.5	95.8	90.6	94.5	93.3	94.3
Teaching	DRG 87	---	---	100.0	100	62.7	40.6
	NDRGVS	91.7	92.6	89.2	90.3	91.0	91.6
Non-teaching	DRG 87	---	92.3	100.0	97.9	97.2	97.5
	NDRGVS	93.5	90.2	92.3	92.2	91.8	92.2
Profit	DRG 87	100.0	100.0	---	100	63.0	84.2
	NDRGVS	86.0	92.4	81.8	89.3	86.5	87.4
Non-profit	DRG 87	100.0	90.0	100.0	97.9	96.3	96.7
	NDRGVS	94.3	90.3	90.9	92.1	91.4	92.5
Total	DRG 87	100.0	92.3	100.0	93.3	97.5	97.5
	NDRGVS	93.5	90.7	90.6	91.7	91.2	92.1

---



---

**Appendix D-3: DRG 87 hospital department making error by patient demography**

---



---

		Bed size			Weighted average		
		<100	100-299	300+	Sample	Discharge	Hospital
Age (years)	Billing	---	74.0	---	74.0	27.2	24.1
	Coding	77.0	74.7	67.7	74.0	72.5	74.6
Sex (% male)	Billing	---	0.0	---	0.0	0.0	0.0
	Coding	66.7	58.3	42.9	58.5	54.8	60.2
LOS (days)	Billing	---	7.0	---	7.0	2.6	2.3
	Coding	7.0	5.6	13.3	8.3	8.8	7.5
Payment (\$)	Billing	---	3986	0	3986	1463	1299
	Coding	2828	3685	5632	3763	4180	3550
Mortality (%)	Billing	---	0.0	---	0.0	0.0	0.0
	Coding	14.8	33.3	21.4	20.8	24.0	21.9

---



---

### Appendix E-1: DRG 87 reasons for errors

---



---

	Bed size			Total	[Percent]
	<100	100-299	300+		
Narrative change	14	7	5	26	[48.1]
Miscoding	5	1	3	9	[16.7]
Resequencing	7	3	6	16	[29.6]
Other	1	2	0	3	[5.6]
<b>Total</b>	<b>27</b>	<b>13</b>	<b>14</b>	<b>54</b>	<b>[100.0]</b>

---



---

### Appendix E-2: DRG 87 reasons for errors by hospital demography

---



---

Number [Percent]	Narrative	Miscoding	Resequencing	Other
<100 beds	14 [51.8]	5 [18.5]	7 [26.0]	1 [3.7]
100-299 beds	7 [53.8]	1 [7.7]	3 [23.1]	2 [15.4]
300+ beds	5 [35.7]	3 [21.4]	6 [42.9]	0 [0.0]
Urban	10 [45.4]	3 [13.6]	8 [36.4]	1 [4.5]
Rural	16 [50.0]	6 [18.8]	8 [25.0]	2 [6.3]
Teaching	3 [50.0]	2 [33.3]	1 [16.7]	0 [0.0]
Nonteaching	23 [47.9]	7 [14.6]	15 [31.3]	3 [6.3]
Profit	5 [83.3]	1 [16.7]	0 [0.0]	0 [0.0]
Nonprofit	21 [43.8]	8 [16.6]	16 [33.3]	3 [6.3]
<b>Total</b>	<b>26 [48.2]</b>	<b>9 [16.7]</b>	<b>16 [29.6]</b>	<b>3 [5.6]</b>

### Appendix E-3: DRG 87 reasons for errors comparison

Percent		Bed size			Weighted percentage		
		<100	100-299	300+	Sample	Discharge	Hospital
Narrative	DRG 87	51.8	53.8	35.7	48.2	45.7	49.9
	NDRGVS	49.8	44.9	49.4	48.1	47.9	48.1
Miscoding	DRG 87	18.5	7.7	21.4	16.7	15.8	15.4
	NDRGVS	10.4	14.3	11.4	11.9	12.2	11.8
Resequencing	DRG 87	26.0	23.1	42.9	0.0	32.2	27.7
	NDRGVS	31.0	24.9	24.3	27.1	25.9	28.0
Other	DRG 87	3.7	15.4	0.0	5.6	6.4	6.9
	NDRGVS	6.7	15.9	14.9	12.8	13.5	11.0

### Appendix E-4: DRG 87 reasons for errors by patient demography

	Narrative	Miscoding	Resequencing	Other
Age (years)	75.0	70.3	73.9	76.3
Sex (% male)	50.0	66.7	68.8	33.3
LOS (days)	6.6	13.6	8.4	6.3
Payment (\$)	3387	4735	3934	3261
Mortality (%)	19.2	22.2	25.0	0.0

## Appendix F-1: DRG 87 corrected relative weights

Relative weight	Bed size			Average- Total
	<100	100-299	300+	
<u>Average</u>				
Paid	1.5368	1.5368	1.5368	1.5368
Correct	1.1830	1.2619	1.2589	1.2277
Difference	0.3538	0.2749	0.2779	0.3091
<u>Total</u>				
Paid	59.9352	43.0304	38.4200	141.3856
Correct	46.1370	35.3332	31.4725	112.9427
Difference	13.7982	7.6972	6.9475	28.4429
Overpayment rate [%]	[23.0]	[17.9]	[18.1]	[19.3]*

\* Discharge weighted

## Appendix F-2: DRG 87 corrected reimbursement

\$	Bed size			Average- Total
	<100	100-299	300+	
<u>Average</u>				
Paid	3755	4322	4587	4154
Correct	2890	3549	3758	3318
Difference	864	773	830	835
<u>Total</u>				
Paid	146,419	121,020	114,684	382,122
Correct	110,525	83,737	74,625	271,961
Difference	35,893	37,283	40,059	110,162

---

---

### Appendix F-3: DRG 87 projected cost of errors

---

---

Fiscal Year	Reimbursement (\$ million)	Overpayment (\$ million)
1984	193.2	37.3
1985	397.5	76.7
1986	304.6	58.8
1987	248.0	47.9
1988	286.4	58.6
1989 est.	297.0	60.0
1990 est.	300.7	61.4

Reimbursement estimates based on linear regression.

Overpayment calculated as 19.3 percent of reimbursement for 1984-87 and 11.8 percent for 1988-90.

## Appendix G-1: Correct MDC for discharges miscoded to DRG 87

#	MDC	Bed size			Total	[Percent]
		<100	100-299	300+		
04	Respiratory	12	8	9	29	[53.7]
05	Circulatory	12	5	5	22	[40.7]
11	Kidney & urinary tract	1	0	0	1	[1.9]
18	Infectious diseases	1	0	0	1	[1.9]
20	Addiction	1	0	0	1	[1.9]
	<b>Total</b>	<b>27</b>	<b>13</b>	<b>14</b>	<b>54</b>	<b>[100.0]</b>

## Appendix G-2: Correct DRG for discharges miscoded to DRG 87

#	DRG	Bed size			Total	[Percent]
		<100	100-299	300+		
88	Chronic obstructive pulmonary disease	1	3	1	5	[9.3]
89	Pneumonia & pleurisy	4	0	3	7	[13.0]
96	Bronchitis & asthma	4	3	4	11	[20.4]
99	Respiratory signs	3	0	0	3	[5.6]
127	Heart failure & shock	10	4	4	18	[33.3]
	<b>Subtotal</b>	<b>22</b>	<b>10</b>	<b>12</b>	<b>44</b>	<b>[81.5]</b>
	<b>Other</b>	<b>5</b>	<b>3</b>	<b>2</b>	<b>10</b>	<b>[18.5]</b>
	<b>Total</b>	<b>27</b>	<b>13</b>	<b>14</b>	<b>54</b>	<b>[100.0]</b>

---



---

**Appendix G-3: Correct ICD-9-CM principal diagnoses for discharges miscoded to DRG 87**

---



---

Code	Diagnosis	Number	[Percent]
038.9	Septicemia, unspecified	1	[1.9]
197.0	Lung metastases	1	[1.9]
303.01	Alcohol dependence	1	[1.9]
427.31	Atrial fibrillation	1	[1.9]
428.0	Congestive heart failure	16	[29.6]
428.1	Left heart failure	3	[5.6]
466.0	Acute bronchitis	9	[16.7]
482.2	Hemophilus influenzae pneumonia	1	[1.9]
482.3	Streptococcus pneumonia	1	[1.9]
486	Pneumonia, unspecified	5	[9.3]
493.90	Asthma, unspecified	2	[3.7]
496	Chronic airway obstruction	5	[9.3]
584.9	Acute renal insufficiency, unspecified	1	[1.9]
785.59	Shock	1	[1.9]
786.09	Respiratory symptoms	3	[5.6]
786.50	Chest pain, unspecified	1	[1.9]
799.1	Respiratory failure	1	[1.9]
934.1	Foreign body in main stem bronchus	1	[1.9]
	<b>Total</b>	<b>54</b>	<b>[100.0]</b>

---



---

**Appendix G-4: Original ICD-9-CM principal diagnosis for discharges incorrectly coded to DRG 87**

---



---

Code	Diagnosis	Number	[Percent]
514	Pulmonary congestion	7	[13.0]
518.4	Acute lung edema, unspecified	11	[20.4]
518.5	Pulmonary insufficiency	3	[5.6]
799.1	Respiratory failure	33	[61.1]

---



---

**Appendix G-5: ICD-9-CM codes for discharges correctly coded to DRG 87**

---



---

Code	Diagnosis	Number	[Percent]
518.4	Acute lung edema, unspecified	8	[21.1]
799.1	Respiratory failure	30	[78.9]

## Appendix H-1: DRG 87 clinical review

Number [Percent]	Bed size			Total	Weighted percentage		
	<100	100-299	300+		Sample	Discharge	Hospital
Unnecessary admissions	2 [5.1]	0 [0.0]	0 [0.0]	2	[2.2]	[1.3]	[2.6]
Poor quality of care	7 [17.9]	2 [7.1]	1 [4.0]	10	[10.9]	[8.8]	[12.2]
Premature discharges	2 [5.1]	0 [0.0]	0 [0.0]	2	[2.2]	[1.3]	[2.6]

## Appendix H-2: DRG 87 clinical review comparison

Percent		Bed size			Weighted percentage		
		<100	100-299	300+	Sample	Discharge	Hospital
Unnecessary admissions	DRG 87	5.0	0.0	0.0	2.2	1.3	2.6
	NDRGVS	12.6	10.1	8.9	10.5	10.0	11.3
Poor quality of care	DRG 87	17.9	7.1	4.0	10.9	8.8	12.2
	NDRGVS	11.4	5.1	3.5	6.6	5.5	8.1
Premature discharge	DRG 87	5.1	0.0	0.0	2.2	1.3	2.6
	NDRGVS	2.1	0.8	0.4	1.1	0.8	1.4