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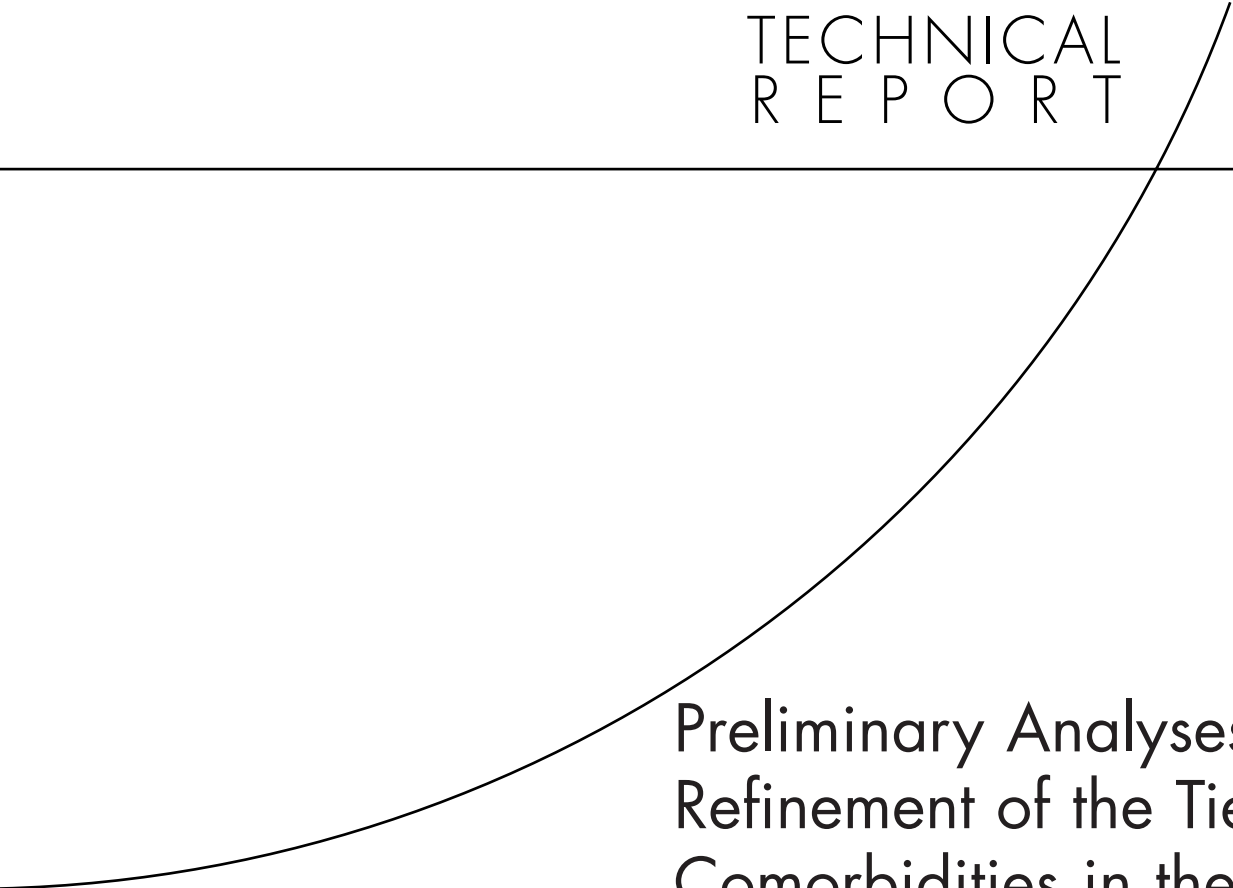
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TECHNICAL REPORT



Preliminary Analyses for Refinement of the Tier Comorbidities in the Inpatient Rehabilitation Facility Prospective Payment System

Grace M. Carter, Mark E. Totten

Supported by the Centers for Medicare and Medicaid Services

The research described in this report was supported by the Centers for Medicare and Medicaid Services.

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Published 2005 by the RAND Corporation
1776 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138
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Preface

This report covers the RAND Corporation's analyses concerning the possible refinement of the comorbidity parameters of the Inpatient Rehabilitation Facility Prospective Payment System (IRF PPS). This work was performed during phase II of our project to design, develop, implement, monitor, and refine the IRF PPS. Phase II began in October 2001. Implementation of the IRF PPS began January 1, 2002. This research was sponsored by the Centers for Medicare and Medicaid Services (CMS) under contract No. 500-95-0056 and is one part of the final report on that project. The research was conducted within RAND Health, a division of the RAND Corporation. A profile of RAND Health, abstracts of its publications, and ordering information can be found at www.rand.org/health.

The analyses in this report relate the cost of individual IRF discharges of Medicare beneficiaries during FY 2003 to the presence of comorbidities coded on the patient assessment instrument. We estimated the discharge costs using cost report information in the public use files that most closely matched the date of the beneficiary's discharge (e.g., for a beneficiary discharged October 30, 2002, we used the IRF's cost report that included October 30, 2002, assuming it was available on the file). After this report was completed, but during the public comment period on the proposed rule updating the IRF PPS effective October 1, 2005, HealthSouth, a large chain organization, notified CMS that its IRFs did not include any home office costs in their cost reports for cost reporting periods beginning on or after October 1, 2001 and before October 1, 2003. Home offices of chain organizations such as HealthSouth usually furnish central management and administrative services such as centralized accounting, purchasing, personnel services, management, and other services to support patient care services furnished by its member providers. The reasonable costs of these services are normally included in the provider's cost report and reimbursed as part of the provider's costs. The home office costs for HealthSouth are approximately 13 percent of total costs for its IRFs. These home office costs were omitted from their cost reports covering FY2003 discharges. The HealthSouth hospitals cared for about 19 percent of the cases in our sample hospitals and we estimate that analyses in this report are based on costs per case that were understated by approximately 1.6 percent on average. It is unlikely that this had a substantial effect on our findings since the missing costs affected HealthSouth cases with and without comorbidities proportionally. For further information on this issue, see the IRF PPS final rule (Department of Health and Human Services, Centers for Medicare and Medicaid Services, "Medicare Program; Inpatient Rehabilitation Facility Prospective Payment System for FY 2006; Final Rule," *Federal Register*, Vol. 70, No. 156, August 15, 2005, p. 47884).

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Summary

In 2002, Medicare phased in the implementation of a prospective payment system (PPS) for inpatient rehabilitation facilities (IRFs). This PPS included a way of addressing the added costs of treating patients with certain comorbidities. These comorbidity costs were included using a grouping, or tier, system that ranked comorbidities in three tiers—the first tier is the most expensive to treat and the third the least expensive—while a fourth grouping included conditions that did not affect cost.

These tiers and the conditions assigned to them were based on analyses conducted by RAND with clinical input from our Technical Expert Panel (TEP) and policy decisions by CMS. The tiers consist only of conditions that were correlated with higher costs in the 1998–1999 data used to design the IRF PPS and that our clinical consultants believed actually cause increased costs. The TEP is composed of medical practitioners and administrators

Along with our TEP, we have reviewed the tier conditions and the assignment of specific conditions to tiers. The purpose of the review is to develop refinements to better align payment schedules for comorbidities with treatment costs.

Our analysis had two specific objectives:

1. to determine what changes in the definitions of tiers and the conditions assigned to each would better predict treatment costs
2. to understand changes in the frequency of occurrence of coded conditions and assess how well the tier system functions as part of the PPS.

We examined the relationship between comorbidities and marginal cost and the frequency with which individual comorbidities were assigned to IRF patients. We used data from the first year when almost all hospitals were fully paid under the PPS (FY 2003). This data should be more representative of future IRF PPS cases than the 1998–1999 data.

Tier Refinement

With respect to the first study objective, the analysis found problems with some of the tier comorbidities. We found that five conditions containing a total of 11 diagnoses (miscellaneous throat conditions, esophageal conditions, ventilator status, cachexia, and amputation) and seven individual codes within other conditions (including two of the four malnutrition codes) were no longer positively related to treatment cost after controlling for Case Mix Group (CMG). Altogether, 1.6 percent of FY 2003 cases received a tier payment that was not justified by a higher cost for its diagnoses.

Another problem with the existing tiers is that costs for several conditions would be more accurately predicted if their tier assignments were changed. Dialysis patients cost substantially more than they are currently paid and should be moved into the highest paid tiers. A full 4 percent of FY 2003 cases should be moved down to tiers with lower payment.

We also explored the effect of frequently found diagnoses that are not currently part of the tiers but that might be suitable for a tier. We found three diagnoses that we believe should be added to the tier list.

In the body of the report we provide specific recommendations for each of these changes including diagnoses codes and tier assignments.

In addition to the changes to the tier that we are able to recommend, we found that a few other conditions are correlated with higher costs. One set of conditions contains depression and other affective disorders. We agree with our TEP that it would be inappropriate to include the ICD-9-CM codes for depression or other affective disorders in the tier system. We urge CMS to include a valid, reliable scale that identifies patients with depression and is suitable for use in an inpatient rehabilitation setting into the next revision of the IRF PAI and to provide additional payments for the care of depressed patients as soon as practical.

In developing the PPS, patients with osteomyelitis, thrombophlebitis, skin ulcers, and urinary tract infections were found to have higher costs. These were not added to the tier system because at least some of these cases might be preventable and CMS (and many of our TEP) did not want to reward bad care. We show here that cases with these conditions remain more costly in 2003. Further we were able to use the IRF PAI data to show that those patients who are said to have the condition at admission are also more costly. These differences are large enough to raise access concerns. Consequently, we urge CMS to consider providing additional payments for these patients. However, there are some problems with the current IRF PAI collection of this data. It would be best if the next revision of the IRF PAI simplified the collection of complication and comorbidity data in a way that improved the reliability of information on whether the conditions were present during the admission assessment.

Tier Assessment

There was a substantial increase (52 percent) in the frequency of tier comorbidity codes between the 1998–1999 data and the 2002 data. The increase was greatest in Tier 1.

The explanation for the changes in the estimated marginal effects of the tier conditions from 1999 to 2003 probably is a mixture of three factors: (1) problems with the data in 1999, (2) poor choices for some of the diagnosis codes included in the tiers, and (3) coding problems in FY 2003.

A few of the codes in the tier list describe conditions that turned out to be too nonspecific to be appropriate for a tier. The original tier diagnoses lists were examined carefully to eliminate such codes. Although many were deleted, a few managed to get through. A case in point may be nutritional marasmus, which we heard anecdotally was applied to any nonspecific indication of malnutrition in the medical record. Cachexia and some of the not otherwise specified codes are possibly other such codes (see Chapter Three).

The increase in the frequency of condition codes along with the decline in the marginal cost of some conditions causes concern that overcoding may be diminishing the effect of

these conditions in our analyses. We examined the extent of concentration of diagnoses and conditions that substantially decreased in marginal cost between 1999 and 2003. Only the malnutrition codes are highly concentrated within providers. These diagnoses may indeed have been affected by upcoding.

None of the other diagnoses were concentrated or occurred more than a handful of times at any individual provider. Thus, the decline in the marginal cost of these cases is not influenced by upcoding at a small number of hospitals and is not influenced by consistent upcoding anywhere.

Despite possible remaining and undetected problems with coding, the tier system remains an important means for matching payments to costs. The percent by which the cost of a case with a tier diagnosis exceeds the cost of a case in the same CMG with no tier condition is substantial. Tier 1 is typically 42 percent; Tier 2, 21 percent; and Tier 3, 9 percent. Because the tier system continues to play an important role in matching payments to costs, it helps insure access to IRF care and provide fair payments to hospitals.

The tier system requires a reasonable amount of revision in response to coding changes found during FY 2003. On balance, however, we judge the performance of the tier system to be acceptably stable, especially in the face of the large change in coding (or case mix). We expect that the rate of change in the coding of tiers will greatly decline over time. If not, it will require a reexamination of the costs and benefits of the tier system.

Acknowledgments

We thank the members of our TEP, whose names are listed on the following page, for their support and guidance throughout this phase of our project. A subcommittee of the TEP provided several very useful suggestions for the analysis and interpretation of our findings. Members of the TEP reviewed an earlier version of this report and pointed out the need for additional analyses, which have been added here.

We would also like to thank Guadalupe Billalobos and Melanie Frazey of Health South for their help with issues concerning ICD-9-CM. Melinda Beeukes Buntin and Barbara Wynn of RAND provided very helpful comments on a preliminary version of this report. The report benefited greatly from the work of David Adamson, a RAND communications analyst. Remaining problems of presentation and analysis are, of course, the responsibility of the authors.

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List of Abbreviations

AMI	Acute Myocardial Infarction
CHF	Congestive Heart Failure
CMG	Case Mix Group
CMS	Centers for Medicare and Medicaid Services
CY	Calendar Year
DX	Diagnosis
FY	Fiscal Year
IDC-9-CM	International Classification of Diseases, 9 th revision, Clinical Modification
IRF	Inpatient Rehabilitation Facility
IRVEN	Inpatient Rehabilitation Validation and Entry
LE	Lower Extremity
LOS	Length of Stay
NEC	Not Elsewhere Classified
NOS	Not Otherwise Specified
PAI	Patient Assessment Instrument
PPS	Prospective Payment System
RIC	Rehabilitation Impairment Category
SNF	Skilled Nursing Facility
TEP	Technical Expert Panel
UTI	Urinary Tract Infection

Introduction

In 2002, Medicare implemented a prospective payment system (PPS) for inpatient rehabilitation facilities (IRFs). This PPS addressed the added costs of treating patients with comorbidities by creating a series of three groupings or tiers—the first tier containing the most expensive comorbidities to treat and the third the least expensive. In addition, a fourth grouping included conditions that did not affect treatment cost.

These tiers and the conditions assigned to them were based on analyses conducted by the RAND Corporation with clinical input from our Technical Expert Panel (TEP). TEP members suggested a variety of hypotheses about comorbidities and complications that affect cost. We tested each hypothesis to determine whether the nominated conditions were in fact associated with increased cost after controlling for the function-related group to which each case belonged. The Centers for Medicare and Medicaid Services (CMS) and the TEP believed that diagnoses should not be used to lower payment. Even if average costs were lower than for cases without the comorbidity, the extra illness of the patient would be more costly under some circumstances and hospitals should not be discouraged from providing necessary care.

Our analyses resulted in a list of conditions that were correlated with higher costs and that our clinical consultants believed actually increase costs and that were used to define tiers (Carter, 2002a). The data on which these analyses were conducted, however, had some limitations. The comorbidity data had not been used routinely and, therefore, we expected that tier comorbidities were under coded. Further, the data were from a self-selected set of facilities, although the sample was very large.

Now data are available on discharges during fiscal year (FY) 2003, the first year during which almost all IRF were paid using the PPS. These data should reflect the coding practices that will prevail under the PPS. We believe that these data are much better suited to this analysis than the earlier data. They should enable us to refine the tiers in a way that better matches payments to the resource needs of IRF patients.

Purpose of This Analysis

The purpose of this analysis is to assist CMS in refining the definitions of the tiers. To do this, the analysis had two specific objectives:

- to determine what changes in the definitions of tiers and the conditions assigned to each would better predict treatment costs

- to evaluate how well the earlier assignment of comorbidities to tiers predicted treatment costs.

Our analysis examined the relationship between comorbidities and relative cost and the frequency with which individual comorbidities were assigned to IRF patients.

Background on the IRF PPS

To help explain our data, we first present a brief review of how payments work within the IRF PPS, beginning with a review of the overall payment system and then details about its use of comorbidities. Many readers may be familiar with this material, but we nonetheless provide it as convenient background.

IRF Prospective Payment System

The IRF PPS began to pay for some inpatient Medicare stays on January 1, 2002. IRFs are paid under the PPS beginning with the start of each IRF's own fiscal year, so initially the system was used only for hospitals whose fiscal year corresponded to the calendar year 2002. Almost all IRFs were being paid under the IRF PPS by October 2002, which is the beginning of FY 2003.

The IRF PPS payment system assigns cases to Case Mix Groups (CMGs) in order to establish payment amounts. The data used to assign a CMG to each IRF patient come from the IRF Patient Assessment Instrument (PAI). For most cases (all except very short stays and in-hospital deaths), CMG assignment depends on the type of impairment, functional independence, and age. All cases are first classified into 1 of 21 Rehabilitation Impairment Categories (RICs). Most RICs are based on particular body structures (e.g., brain, lower extremity) and/or types of loss (e.g., stroke, fracture).

Each RIC is subdivided into CMGs based on functional independence and age. Functional independence is determined by the response to 17 questions on the IRF PAI. The response to each question is a number between 1 (least independent) and 7 (most independent).¹ The sum of 12 items is used to create a motor score and the remaining 5 items are summed for a cognitive score. The values of motor and cognitive scores and patient age determine the patient's CMG assignment within RIC. The CMG assignment rules were created to maximize the ability to predict cost with the constraint that payment for care of a patient with a lower score (less independence) is never less than payment for care of an otherwise similar patient with a higher score (more independence).

¹ Unobserved items are recorded as zero, but used as one in creating the functional independence scores. These 17 questions cover the same domains of functioning as 17 of the 18 items in the Functional Independence Measure (UDSmr, 1997), although the meanings of some responses were changed.

Comorbidities

As previously mentioned, comorbidities can significantly increase the cost of IRF care for Medicare patients. The IRF PPS deals with comorbidity by splitting most CMGs² into four payment subgroups: three tiers ranked from highest cost to lowest and one subgroup with no costly comorbidities. One item in the IRF PAI (item 24) is used to record the comorbidities for each patient. Selected diagnostic codes and V-codes are assigned to one of the three tiers.³ Codes are excluded from tiers in a particular RIC when it is believed that this or a similar condition will afflict many patients in the RIC and thus the costs should be considered an integral part of the cost of rehabilitation of all patients in the RIC. Except for such RIC-specific exclusions, tiers are defined similarly across all CMGs.

Comorbidity tier affects the relative weight used for payment in the CMGs. Tier 1 comorbidities are the most costly and have the highest relative weight within the CMG followed in order by tiers 2 and 3. The least expensive subgroup, which is the one with the lowest weight within each CMG, consists of patients with no relevant comorbidity. Patients that have comorbidities in more than one tier are assigned to the most expensive of those tiers. Multiple comorbidities in the same or lower tiers do not affect payment.

The effect of each tier on relative weight (and cost) is modeled as a percent increase in payment relative to a case in the same CMG with no comorbidities. The percent increase varies across RIC and tier but is the same within each CMG in the same RIC.

Outline of Report

Chapter Two describes our data and methods. Chapter Three describes the analyses of the existing tier comorbidities and concludes with the implications of these analyses (including interpretive comments received from our TEP) and presents preliminary recommendations to CMS for diagnoses to be dropped from the current tier list.

Because the 2003 data set should have more accurate coding of comorbidities and is more representative of the universe of IRFs, it allows us to examine more individual codes and more subsets of codes than was possible in the implementation analyses. Thus, Chapter Four presents analyses of conditions that are not currently in the comorbidity tiers but might be considered for inclusion in the future. The chapter concludes with recommendations for a small number of codes to be added to the tier lists.

Chapter Five provides preliminary recommendations for tier assignment and an evaluation of the ability of the tier system to predict cost in the implementation data set.

² All except for atypically short stays and in-hospital deaths.

³ The comorbidity lists (including exclusions) are found in both the Federal Register (CMS, 2001) and in Carter et al. (2002).

Data and Methods

Our data describe Medicare discharges from IRFs from January 1, 2002 to September 30, 2003. We matched IRF PAI records and hospital bills to get a description of the clinical characteristics of the patient and the resources used during the rehabilitation stay. The first subsection below describes the source data and the major derived variables. The selection of cases for analysis is discussed along with other methodological issues in the second subsection. We end by reporting the size of the analysis sample. The 1998–1999 findings used for comparison are almost all from tables found in Carter et al. (2002). The 1999 frequencies of individual diagnoses, which were not previously reported, were calculated from the analysis sample described in Chapter Four of that report.

Data

Source Data

Our first source of data is the IRF PAI. IRFs submit each patient's IRF PAI record electronically to the national database using the Inpatient Rehabilitation Validation and Entry System (IRVEN) or vendor purchased software. The receiving system validates the provider's identity and checks certain items on the record for valid codes. In particular, it checks that the submitted CMG and tier are consistent with information on impairment, age, functional status, and comorbidities found on the IRF PAI.¹

In this analysis we use the IRF PAI CMG variable and the list of up to 10 codes for comorbid conditions in item 24. We also used the demographic information, provider number, and admission, discharge, transfer, and return dates to link the IRF PAIs to bills.

Our second source of data is the inpatient bills submitted to the Fiscal Intermediaries by the IRFs. We use the bills after standard analytic file processing. These bills contain the provider number, beneficiary number, admission date, and discharge date, which allow us to match most bills to an IRF PAI record. The bills also provide departmental charges and information on length of stay (LOS), which we use to estimate the cost of resources used during the stay. Discharge destination from the bill is used to determine whether the stay ended with a transfer or an in-hospital death. A flag on the bill is used to determine whether the hospital was paid under the PPS at the time of the discharge. For cases paid under the PPS, the CMG and comorbidity tier are found on the bill. For cases paid under the PPS, we use

¹ We have independently verified that, with only very rare exceptions, the CMGs on the IRF PAI are consistent with the underlying data and that, when the bill contains a CMG, the CMG on the IRF PAI is consistent with the CMG on the bill.

only records where the bill CMG is consistent with the IRF PAI CMG. The bills and IRF PAI records were received in the spring of 2004.

The third source of data is CMS' hospital cost report files. We drew hospital cost reports from the public use files dated March 2004.

Derived Variables

Conditions are defined as lists of ICD-9-CM² diagnostic codes that describe clinically related diseases or health states (e.g., pneumonia, amputated lower extremity). The patient is assigned to the condition if any diagnostic code in the list appears in any of the 10 items 24a through 24j. Most conditions used in this report are defined as shown in Table 4.10 of our implementation report (Carter et al., 2002). In Chapters Three and Four of this report, however, we will provide diagnoses lists for a few additional conditions that we studied here.

Accounting cost is defined for each bill in our file using the departmental algorithm described more fully in Carter et al. (2002). Cost-to-charge ratios were calculated using the cost report covering the time of the discharge, if available. If that cost report was not available, we used the latest available cost report. After calculating accounting cost, we used the wage index found on the pricer to adjust for area variation in wages.

The IRF PPS contains an interrupted stay rule. If a patient is discharged from an IRF and then returns to the same IRF in three days (the day of discharge or either of the following two calendar days), only a single payment will be made for both parts of the stay. Separate bills for each part of interrupted stays were appropriate during the pre-PPS portion of 2002 and earlier. We bundled multiple bills for interrupted stays into a single simulated stay described by admission date from the earliest bill, IRF PAI data from the earliest matched record, and discharge date and discharge destination from the last discharge. We calculated LOS and cost for the bundle as the sum of the LOS and costs for all discharges in the bundle.

Transfers are defined as cases with discharge destination on the bill in any of 02 (acute hospital), 03 (Skilled Nursing Facility [SNF]), 61 (a swing bed), 62 (an IRF), 63 (a long term-care hospital), or 64 (a nursing facility certified under Medicaid but not Medicare). In-hospital deaths are defined as those with a bill discharge destination of 20.

Methods

In this report, we address how the definition of tier comorbidities should be refined. One of the reasons for refinement might be that particular codes were applied sparingly and only to expensive cases in our implementation data, but are now applied to a wider range of cases that do not cost more than other cases in their CMG. Thus we are interested in the frequency with which codes are assigned to IRF patients as well as changes in the relationship of diagnoses to relative cost.

We compare the frequency of diagnosis codes and conditions in the years for which data are available—1996 through 1999, 2002, and FY 2003—with special attention to changes between 1999, the data year used to determine the tiers, and FY 2003, when the PPS was almost fully implemented.

² ICD-9-CM stands for: International Classification of Diseases, 9th revision, Clinical Modification.

The 1996 through 1999 findings are almost all from tables found in Carter et al. (2002). The 1999 frequencies of individual diagnoses, which were not previously reported, were calculated from the analysis sample described in Chapter Four of that report.

As was the case when the tiers were originally analyzed, analyses in this paper are restricted to cases discharged to the community because the cost of transfer cases may not be representative of the cost of a full in-patient stay. In order to be consistent with the payment system, we perform our analyses on bundled data. Although the 1998–1999 data used for comparison are not bundled,³ this has very little effect on the comparison. Because interrupted stays are less than one percent of all cases, bundling has no important effect on the results. Further, because transfer cases are not included in the analysis, and because most interrupted stays contain at most one nontransfer discharge, the 1998–1999 data also typically include at most one discharge per interrupted stay.

Cost Regressions

We use two types of regression models to analyze the relationship between comorbidities and cost of an IRF case. In both models the dependent variable is the natural logarithm of wage-adjusted cost. The independent variables in the first model type are dummy variables for each CMG and for a set of specified ICD-9-CM codes—for example, for all the conditions in the existing tiers. As another example, we fit models that included both conditions and selected diagnosis codes within the condition in order to determine whether the selected codes within a condition were associated with similar costs as the other codes in the condition. In the second type of model the dependent variables also control for each CMG, but the condition variables are replaced by dummies for each combination of RIC and tier.

The specification of the models means that the coefficient on each condition can be used to estimate the fraction by which the cost of a typical case with that comorbidity exceeds the cost of a typical case in the same CMG with similar other comorbidities in the regression.

Sample Selection and Sample Size

Our bill records show that 473,645 bills for care of Medicare patients were submitted from IRFs during calendar year (CY) 2002.⁴ As shown in Table 2.1, we eliminated 1,661 records that would not be paid under the PPS because they were part of interrupted stays. Despite the fact that almost all the 2003 discharges are on PPS, there were still 979 discharges that were for only part of an interrupted stay.

We matched the remaining bills to an IRF PAI where the IRF PAI data was self-consistent and the bill data was consistent with the IRF PAI (92.5 percent of bills in CY 2002 and 94.3 percent in FY 2003).

We restrict the analyses in this report to cases discharged to the community and cases that stayed in the IRF more than three days. This sample definition eliminates 22 percent of matched bills.

We also eliminate records with missing data or with data that is so unusual it might distort our analyses. Many of the cases without cost reports come from all-inclusive providers

³ The relative weights that determine payment were calculated on bundled data.

⁴ This number excludes two duplicate bills and 49 bills that overlapped another bill. The FY 2003 total bill count excludes three duplicates and 15 overlapping bills.

for whom we cannot reliably estimate case cost. We also eliminate the few cases (less than one-half of one percent of remaining cases) with log costs outside of three standard deviations of mean log cost for their RIC.

Table 2.1
Counts of IRF PPS Discharges Excluded from Sample and Remaining Sample,
by Reason for Exclusion, for CY 2002 and FY 2003

Reason for Exclusion	CY 2002		FY 2003	
	Excluded Records	Remaining Sample	Excluded Records	Remaining Sample
Total bills	0	473,645	0	491,862
Bundling interrupted stays	1,661	471,984	979	490,883
No good match to IRF PAI	35,299	436,685	28,222	462,661
Transfers	85,200	351,485	92,113	370,548
In-hospital death	1,245	350,240	1079	369,469
LOS ≤ 3	9,398	340,842	9,933	359,536
LOS > 365	1	340,841	0	359,536
Cost report not available	8,015	332,826	8,671	350,865
Wage index not available	8,822	324,004	9,981	340,884
Outside 3 std dev of log (cost)	1,507	322,497	1,156	339,728

NOTE: Discharges in the last quarter of CY 2002 are counted for both CY 2002 and FY 2003.

Current Tier Conditions and Diagnoses

The analyses in this chapter address changes in the frequency and cost of Medicare IRF cases assigned to tiers. We compare 1998–1999 IRF discharges, which were used to develop the PPS parameters, with FY 2003 IRF discharges, the first year of the PPS and the latest data now available. We use these analyses to lay out a set of preliminary recommendations that would better align comorbidity payments with treatment costs.

We present empirical analyses of the following questions:

1. How did the proportion of cases with tier diagnoses and conditions change over time?
2. How did the relationship of the tier comorbidities to cost change between 1998–1999 and 2003?

The last subsection of this chapter discusses the implications of these analyses for the list of tier diagnoses.

Frequency of Comorbidities

We begin our analysis with changes in the frequency with which tier codes are assigned to IRF patients. These changes may help us understand changes in the relationship between comorbidities and relative cost. We expected to see an increase in the frequency of comorbidity coding in cases that would be paid by the PPS because (1) the comorbidity data used for implementation had not been used routinely and were therefore likely under coded and (2) the incentives of the PPS. One of the reasons for refinement might be that some of the current tier codes apply to too wide a range of severity. It is possible they had been applied sparingly and only to expensive cases in our implementation data, but are now being applied to a wider range of cases that do not cost more than other cases in their CMG.

Table 3.1 shows that the percentage of cases with at least one tier comorbidity increased from 16.79 percent in the data on which tiers were defined (1998–1999) to 23.40 percent in CY 2002 and to 25.51 percent in FY 2003. This is an increase of 52 percent in tier incidence ($52 = 100 \times (25.51 - 16.79) / 16.79$). The presence of a Tier 1 comorbidity, the highest paid of the tiers, almost quadrupled (283 percent increase) from 1998–1999 to FY 2003. Tiers 2 and 3 also increased noticeably, though at a much smaller rate than Tier 1.

The three tiers used for IRF PPS payment were defined from a set of 23 conditions that were judged by our clinical consultants to cause higher costs and that were found to

Table 3.1
Percent of Cases with Each Tier in Implementation Data and in 2002 and 2003 Data

CY 1998–1999		CY 2002		FY 2003	
Tier	Percent of Cases	Percent of Cases	Percent Increase from 1998–1999	Percent of Cases	Percent Increase from 1998–1999
Tier 1	0.56	1.51	170	2.15	283
Tier 2	5.51	8.02	45	8.86	61
Tier 3	10.72	13.87	29	14.50	35
Any tier	16.79	23.40	39	25.51	52
N cases	361,659	322,497		339,728	

NOTE: 2002 and 2003 data based on comorbidity analysis sample. (See Chapter Two.)

SOURCE: 1998–99 data is from Table 4.7 of Carter et al., 2002.

predict higher cost in our 1998 and 1999 data. Table 3.2 shows the percent of cases with each of the 23 conditions that make up the tiers in each of the years from 1996 to 1999 and in 2002 and FY 2003. All columns are percents, not fractions. So the 0.015 percent of 1996 patients coded with ventilator support means 15 out of each 100,000 sample IRF cases had a ventilator code. The next two columns show the percentage increase in the percent of cases with the condition over the two three-year periods from 1996 to 1999 and 1999 to 2002 and from 1999 to FY 2003.

The penultimate row in the table summarizes the frequency of condition coding in each year by giving the average number of conditions per case. These numbers are larger than the fraction of cases in a tier for the same year because some cases have multiple conditions, although they can have only one tier. There was only a small increase in the coding of conditions from 1996 to 1999 (a total of 2.5 percent), a substantial increase from 1999 to 2002 (64.5 percent), and a further increase to 81.5 percent in FY 2003. The increase in the coding of conditions was higher than the increase in the cases with tiers because more cases in 2002 and 2003 had more than one of the tier conditions.

As shown in Table 3.2, there was an enormous variation in the rate of increase from 1999 to 2002 across the 23 conditions that make up the tiers. The greatest increases were for miscellaneous throat conditions and malnutrition, each of which were more than ten times as frequent in 2003 as in 1999. The growth in these two conditions was far larger than for any other condition. Many conditions, however, more than doubled in frequency, including dialysis, cachexia, obesity, and the non-renal complications of diabetes. The condition with the least growth, renal complications of diabetes, may have been affected by improved coding of dialysis. (It is set to zero whenever dialysis is coded in order to remove co-linearity in subsequent regressions.)

In addition to the changes in conditions, we are also interested in the growth rates of the individual ICD-9-CM codes that make up the conditions. Many individual codes are used very little and thus their growth rate has a large random component. In order to reduce the random component, we restrict our presentation of growth in individual codes in Table 3.3 to diagnoses that appeared at least 120 times in our 2003 sample and that at least dou-

Table 3.2
Percent of Cases with Each Condition in a Tier, in Each Year From q99 to q999 and in 2002

Condition	Percent of Cases with Condition						Percent Increase		
	q99	q99	q998	q999	2002	FY 2003	q99 –q999	q999–2002	q999–FY 2003
entilator	0.015	0.025	0.027	0.047	0.069	0.060	213.3	45.8	27.8
Miscellaneous throat problems	0.017	0.022	0.022	0.011	0.106	0.163	–35.3	866.9	1379.8
Candidiasis (selected)	0.065	0.073	0.070	0.055	0.079	0.087	–15.4	43.2	58.4
Tracheostomy	0.183	0.192	0.238	0.218	0.390	0.380	19.1	78.9	74.3
ocal cord paralysis	0.135	0.121	0.110	0.121	0.130	0.130	–10.4	7.6	7.3
Malnutrition	0.136	0.148	0.123	0.117	0.803	1.394	–14.0	586.7	1091.2
Intestinal infection Clostridium	0.414	0.511	0.550	0.652	1.004	1.196	57.5	54.0	83.4
Dialysis	0.402	0.449	0.527	0.567	1.398	1.535	41.0	146.6	170.7
Pseudomonas	0.600	0.603	0.526	0.498	0.549	0.686	–17.0	10.1	37.8
Other infections	2.005	2.173	2.273	2.382	3.101	3.420	18.8	30.2	43.6
Cachexia	0.069	0.100	0.095	0.086	0.330	0.402	24.6	284.0	367.5
Dysphagia	1.254	1.484	1.516	1.607	2.377	2.661	28.1	47.9	65.6
angrene	0.110	0.132	0.106	0.115	0.116	0.110	4.5	0.8	–4.8
Meningitis and encephalitis	0.127	0.136	0.130	0.141	0.174	0.166	11.0	23.2	17.7
Renal complications of diabetes	0.755	0.858	1.009	1.048	0.829	0.823	38.8	–20.8	–21.4
Hemiplegia	2.748	2.436	1.086	0.948	0.910	0.855	–65.5	–4.0	–9.8
Selected anemias	0.210	0.247	0.225	0.236	0.240	0.258	12.4	1.6	9.4
Ma or comorbidities	5.049	4.689	4.690	4.812	5.729	5.657	–4.7	19.1	17.6
Morbid obesity	0.410	0.515	0.587	0.626	3.060	4.008	52.7	388.9	540.2
Esophageal conditions	0.203	0.190	0.206	0.221	0.299	0.288	8.9	35.4	30.1
Pneumonia	1.525	1.663	1.832	2.123	2.650	2.792	39.2	24.8	31.5
Non-renal complications of diabetes	0.941	1.060	1.070	1.073	5.214	5.586	14.0	386.0	420.6
Amputation of LE	0.462	0.572	0.564	0.577	0.508	0.530	24.9	–12.0	–8.2
Average number of conditions per case	0.178	0.184	0.176	0.183	0.301	0.332	2.5	64.5	81.5
Number of cases	128,591	153,317	172,136	189,523	322,497	339,728			

NOTE: Based on cases discharged to the community. Cases with renal complications of diabetes exclude cases on dialysis.

SOURCE: Data for 1996 through 1999 from Table 4.3 of Carter et al., 2002.

Table 3.3
Number of Cases and Percent of Cases with ICD 9 CM Codes That Are Part of Tier Conditions and That Doubled in Incidence Between q999 and 2003, by ICD 9 CM Code

Code	Diagnosis	Exclusions	Condition	Cases with Code		Percent of Cases		Percent Increase
				q999	FY 2003	q999	FY 2003	
356.4	Idiopathic progressive polyneuropathy	3,6,19	Meningitis and encephalitis	8	289	0.004	0.085	1914
250.60	Diabetes II, w neurological manifestations, not stated as uncontrolled	6	Non-renal complications of diabetes	2,625	10,054	1.385	2.959	114
250.90	Diabetes II, w unspecified complications, not stated as uncontrolled	None	Non-renal complications of diabetes	32	345	0.017	0.102	501
250.92	Diabetes II, w unspecified complications, uncontrolled	None	Non-renal complications of diabetes	32	399	0.017	0.117	595
250.93	Diabetes I, w unspecified complications, uncontrolled	None	Non-renal complications of diabetes	20	140	0.011	0.041	289
260	Kwashiorkor	None	Malnutrition	53	1,710	0.028	0.503	1698
261	Nutritional marasmus	None	Malnutrition	75	1,541	0.040	0.454	1045
262	Other severe protein calorie deficiency	None	Malnutrition	34	1,469	0.018	0.432	2316
410.91	AMI, NOS, initial	14	Major comorbidities	171	649	0.090	0.191	112
415.11	Iatrogenic pulmonary embolism infarct	15	Major comorbidities	95	423	0.050	0.125	149
514	Pulmonary hypostasis	15	Major comorbidities	129	566	0.068	0.167	145
518.3	Pulmonary eosinophilia	15	Major comorbidities	107	568	0.057	0.167	196
584.9	Acute renal failure, unspecified	15	Major comorbidities	1,135	4,202	0.599	1.237	107
682.2	Other cellulitis and abscess, trunk	None	Other infections	120	454	0.063	0.134	111
682.8	Other cellulitis and abscess, unspecified sites	None	Other infections	34	129	0.018	0.038	112

NOTES: Restricted to diagnoses that occurred at least 120 times in 2003. Excludes single DX conditions (cachexia, dialysis, obesity) and miscellaneous throat problems where 97 percent of the cases are the same code.

bled between 1999 and 2003. Some of the conditions in Table 3.2 are formed by a single code (including dialysis, cachexia, and obesity, which were among the conditions that doubled), and we will not repeat that data. Further, all but 8 of the 553 cases with miscellaneous throat conditions have the same diagnosis (933.1), so growth in the condition is the same as growth in the diagnosis (DX); therefore we also will not include it in Table 3.3.

Table 3.3 shows the 15 remaining ICD-9-CM codes with at least 120 cases in 2003 and that doubled between 1999 and 2003. Although the set of all meningitis and encephalitis codes increased by less than 25 percent between 1999 and 2003, the one code for idiopathic progressive polyneuropathy increased 20-fold: from 4 per 100,000 to 85 per 100,000.

There are many codes for non-renal complications of diabetes and many of them grew substantially. However, only four of the most frequent codes made the cut for Table 3.3 and of these only two (250.90 and 250.92) grew faster than average for this condition. There are four codes for malnutrition and only 579.3—intestinal postoperative nonabsorption—did not double; its incidence actually declined slightly. The remaining lines in Table 3.3 are two infection codes and five codes from the condition for major comorbidities in acute care; each of these codes increased in incidence more than the average code and much more than the typical diagnosis in their condition.

We had expected some increase in the coding of comorbidities because the comorbidity lists on the bills and on the assessment forms had not been routinely used by hospitals or Medicare. Thus, before making any decisions on the need for refinement, we need to examine the relationship of these conditions and diagnoses to the cost of a case. In the following subsections we examine whether changes in the marginal cost of comorbidities are related to whether the rate of coding of the condition or diagnoses grew much more than average.

Changes in the Marginal Cost of Tier Comorbidities

We next examine changes in the marginal cost of tier comorbidities between the 1998–1999 data and the 2003 data. We begin with an examination of our conditions and then examine frequently occurring individual diagnoses, the exclusion of pulmonary cases from the tracheostomy condition, and other subgroups of tier diagnoses. After presenting our empirical findings, we discuss the comments we received from our TEP on analogous results from CY 2002.

Conditions

Table 3.4 compares condition coefficients from a regression of the log of cost in 2003 with those from a similar regression for 1998–1999. The coefficients and t-statistics in the table are only for each tier condition, although the regressions also controlled for CMG. Each coefficient in the table estimates (approximately) the fraction by which the condition increases cost, that is, it gives the expected fraction by which the cost of a case with that condition exceeds the cost of a case in the same CMG and with the same set of other conditions. For example, ventilator cases were 25 percent more costly than otherwise similar cases in 1998–1999, but only 6 percent more costly in 2003.

Cases with the miscellaneous throat condition actually cost less than otherwise similar cases in FY 2003. Further, the marginal cost of five of the conditions—ventilator, cachexia, meningitis and encephalitis, esophageal conditions, and amputations—are not sta-

Table 3.4
Comparison of the Effect of Conditions on Log Cost Between 1998–1999 Data and FY 2003 Data

Condition	1998–1999		2003		Percent Change in Coef.
	Coef.	t-stat	Coef.	t-stat	
Ventilator	0.2516	6.07	0.0610	1.93 ^a	–76
Miscellaneous throat problems	0.2371	3.78	–0.0904	–4.72	–138
Candidiasis (selected)	0.2219	6.91	0.0993	3.81	–55
Tracheostomy	0.1935	11.40	0.2462	19.29	27
Vocal cord paralysis	0.1808	7.66	0.1392	6.50	–23
Malnutrition	0.1660	7.18	0.0190	2.88	–89
Intestinal infection Clostridium	0.1497	14.43	0.1198	16.83	–20
Dialysis	0.1400	12.82	0.2697	42.32	93
Pseudomonas	0.1294	11.52	0.1209	12.95	–7
Other infections	0.1225	22.90	0.0946	22.16	–23
Cachexia	0.1228	4.60	0.0164	1.34 ^a	–87
Dysphagia	0.1214	18.37	0.1336	26.92	10
Gangrene	0.1109	4.60	0.0608	2.61	–45
Meningitis and encephalitis	0.1069	4.91	0.0234	1.24 ^a	–78
Renal complications of diabetes	0.1010	11.81	0.0844	9.70	–16
Hemiplegia	0.0933	11.27	0.0828	9.61	–11
Selected anemias	0.0896	5.37	0.0790	5.21	–12
Major comorbidities	0.0881	22.91	0.0702	20.63	–20
Morbid obesity	0.0794	7.70	0.0239	6.04	–70
Esophageal conditions	0.0687	3.96	0.0101	0.70 ^a	–85
Pneumonia	0.0607	10.48	0.0727	15.39	20
Non-renal comps of diabetes	0.0545	12.12	0.0332	9.44	–39
Amputation of LE	0.0453	4.19	0.0138	1.30 ^a	–70

NOTES: All coefficients are statistically different than zero ($p < 0.01$) unless otherwise noted.

Regression controls for CMG; R^2 for 2003 is 0.3216; R^2 for 1998–1999 is 0.3386; $N = 339,728$ bundles in 2002; $N = 361,659$ in 1998–1999; See Table 2.1 for definitions of sample.

^a Coefficient is not statistically different from zero ($0.05 < p$).

SOURCE: 1998–1999 regression is from Table 4.2 of Carter et al. (2002).

tistically different from zero in the 2003 data. Of these six problem conditions, only miscellaneous throat problems and cachexia increased in frequency more than average, although there was a single code in meningitis and encephalitis that did increase markedly (data on frequency were presented in the previous subsection, Frequencies of Comorbidity).

The coefficients on some other conditions declined markedly, although they remain significantly related to cost. The largest percentage declines for coefficients that remain significant are for malnutrition and obesity, with candidiasis, gangrene, and non-renal complications of diabetes also declining by 39 percent or more. The obesity code, three of the four malnutrition codes, and four of the non-renal complications greatly increased in frequency. None of the three candidiasis codes increased more than the average code and gangrene actually declined in incidence.

Overall, the largest increase in the cost of a condition is for dialysis, where the coefficient increased by 93 percent, from 0.1400 to 0.2697. Part of the explanation for the increased coefficient could be that some IRFs had not borne all dialysis costs for their patients in the pre-PPS period, for example, by allowing separate billing for dialysis. Because the fraction of cases coded with dialysis increased by 170 percent, it is also possible that improved coding was part of the explanation for the increased coefficient.

Other conditions where larger coefficients were found in 2003 than in 1998–1999 are tracheostomy (up 27 percent), dysphagia (up 10 percent), and pneumonia (up 20 percent). The remaining eight conditions (Intestinal infection *Clostridium*, *psuedonomas*, renal complications of diabetes, hemiplegia, the selected anemias, major comorbidities, vocal cord paralysis, and other infections) had changes of 23 percent or less and maintain very strong cost effects. Thus 12 of the 23 conditions that accounted for 83 percent of the tier cases in 1999 remain important predictors of cost with reasonably stable effects. Despite the changes in the other 11 coefficients, the regression as a whole performed just about as well on the 2003 data as on the 1998–1999 data.

Codes with Large Increases in Incidence

This brings us to possible modifications in the way some conditions are defined. We begin with the individual diagnoses singled out in Table 3.3. The frequency with which these codes occurred more than doubled between 1999 and 2002, and each occurred in more than 120 cases in 2003. These diagnoses are frequent enough that we should be able to measure their marginal effect on cost with reasonable precision. We begin with the model shown in Table 3.4, which controls for CMG and all of the tier conditions. Then we add variables for individual ICD-9-CM codes that are part of the condition. Because both the condition and the code are in the regression, the code coefficient tests whether the code has a different marginal cost than the other codes in the condition rather than whether the code has any marginal effect on cost. The net effect of individual codes is the sum of the coefficient on the code and that on the condition.

The results are shown in Table 3.5. The first row of the table concerns the meningitis and encephalitis code 356.4. When this code is added to the earlier model, its coefficient of -0.109 says that cases with this code, on average, cost about 11 percent less than similar cases with the other meningitis and encephalitis condition codes.¹ Further, the coefficient on the meningitis and encephalitis condition, which was negative and not significant in Table 3.4, is now positive and significant. Thus, if we redefine the meningitis and encephalitis condition to drop code 356.4, we will improve our ability to predict cost and account for the higher costs of cases with meningitis and encephalitis.

The next four lines in Table 3.5 examine the individually large- and fast-growing codes within the condition of non-renal complications of diabetes. Two of these codes, 250.90 and 250.93, both of which note unspecified complications, have marginal costs lower than other codes for non-renal complications ($p < 0.01$), and indeed have negative marginal costs. So if we drop these two diagnoses from the tier list, we will improve our ability to predict cost and account for the higher costs of cases with meningitis and encephalitis.

The next three lines in the table deal with the rapidly increasing malnutrition codes. Of these, only kwashiorkor is positively related to cost, and the amount of the marginal cost is much less than the increase in payment associated with assignment to tier 1.

Table 3.
Tests for Whether Each Diagnosis Code That Was Reported Much More in 2003 Than in 1999 Had the Same Cost Effect in 2003 as Other Diagnoses in the Same Condition

Code	Diagnosis	Condition	D Coef.	D t-stat	Condition Coef.	Condition t-stat	Net Effect of D
356.4	Idiopathic progressive polyneuropathy	Meningitis and encephalitis	-0.1090	2.88W	0.075	2.88W	-0.034
250.60	Diabetes II, w neurological manifestations, not stated as uncontrolled	Non-renal complications of diabetes	-0.0136	2.08 ^b	0.041	8.15W	0.027
250.90	Diabetes II, w unspecified complications, not stated as uncontrolled	Non-renal complications of diabetes	-0.0710	2.89W	0.035	9.75W	-0.036
250.92	Diabetes II, w unspecified complications, uncontrolled	Non-renal complications of diabetes	0.0344	1.51 ^a	0.032	9.13W	0.067
250.93	Diabetes I, w unspecified complications, uncontrolled	Non-renal complications of diabetes	-0.1733	4.56W	0.035	9.80W	-0.139
260	Kwashiorkor	Malnutrition	0.0792	5.84W	-0.010	1.18 ^a	0.070
261	Nutritional marasmus	Malnutrition	-0.0515	3.7W	0.036	4.47W	-0.016
262	Other severe protein calorie deficiency	Malnutrition	-0.0287	2.04 ^b	0.028	3.53W	-0.001
410.91	AMI, NOS, initial	Major comorbidities	-0.1317	7.35W	0.075	21.61W	-0.057
415.11	Iatrogenic pulmonary embolism infarct	Major comorbidities	-0.0305	1.38 ^a	0.071	20.60W	0.040
514	Pulmonary hypostasis	Major comorbidities	-0.0476	2.48 ^b	0.072	20.76W	0.024
518.3	Pulmonary eosinophilia	Major comorbidities	-0.0330	1.73 ^a	0.071	20.63W	0.038
584.9	Acute renal failure, unspecified	Major comorbidities	0.0206	2.63W	0.066	17.27W	0.086
682.2	Other cellulitis and abscess, trunk	Other infections	-0.0164	0.76 ^a	0.095	21.90	0.079
682.8	Other cellulitis and abscess, unspecified sites	Other infections	0.0695	1.75 ^a	0.094	21.86	0.163

NOTES: Restricted to diagnoses that occurred at least 120 times in 2003 and that doubled between 1999 and 2003.

Excludes single DX conditions (cachexia, dialysis, obesity) and miscellaneous throat problems where 97 percent of the cases are the same code.

^a Coefficient is not statistically different from zero (0.05 < p).

^b Coefficient is marginally different from zero (0.01 < p < 0.05).

Wp < 0.01.

The next set of five rows in Table 3.5 examines the marginal cost of five of the codes within the major comorbidities. Only one of them (410.91, AMI, Not Otherwise Specified [NOS]) has a statistically lower marginal effect on cost ($p < 0.01$) than the other major comorbidities. The last code in this section of the table, 584.9, has costs slightly higher than the other major comorbidity codes, but not enough higher to warrant consideration of a higher tier and thus it can remain in the major comorbidity variable.

The last two lines in the table are for the two rapidly growing infection codes. Neither of them is significantly different than the other cases in the infection condition. Altogether we find that 6 of the 15 conditions that we singled out as being potentially problematic because of their rapid growth, are actually a problem.

Other Potential Refinements to Existing Tier Conditions

Changes in Tracheostomy Condition

The tracheostomy condition was excluded from tiers in RIC 15 in the implementation of the IRF PPS. However, in earlier unpublished work on 1999 discharges, we found that cases with tracheostomy in RIC 15 (pulmonary impairments) were significantly more costly than otherwise similar cases.

We now show that this result also holds true in the 2003 data. We begin with the model shown in Table 3.4, which controls for CMG and all of the tier conditions. The tracheostomy condition now is a single ICD-9-CM code, V44.0. In order to examine whether tracheostomy cases in RIC 15 have similar marginal costs as other tracheostomy cases, we add a variable for tracheostomy that does not exclude RIC 15. Because both the original condition variable and the one with no exclusions are in the regression, the coefficient on the variable with exclusions tests whether the subset of all cases with a tracheostomy diagnosis that are not in RIC 15 has a different marginal cost than the larger group of all cases with a tracheostomy diagnosis. The model is thus analogous to those reported in Table 3.5.

The results are shown in the first row of Table 3.6. The cost of the subset of cases with exclusion is not significantly different than the cost of the larger group of all cases with tracheostomy. Thus, we may be able to improve the tiers by removing the RIC 15 exclusions for tracheostomy cases.

In reviewing these results with persons familiar with IRF coding, we received the suggestion that the code “V55.0 Attention to Tracheostomy” should be included in the tracheostomy condition. We were told that this code reflects tracheostomy care. In the 2003 data there are only 108 cases that have this code and do not have the V-code included in the tiers. But as shown in the second row of Table 3.6, cases with these codes have costs statistically indistinguishable from that of other tracheostomy cases. Thus, we can further improve the tiers by adding this code to the tracheostomy condition.

Subdivision of Vocal Cord Paralysis

The codes for not otherwise specified or NOS allow coding cases where details of the medical condition are not available. We saw previously that the rapidly increasing unspecified complications of diabetes code cost substantially less than specified complications of diabetes. Similarly, the last row of Table 3.6 shows that cases with the NOS code for vocal cord pa-

Table 3.6
Marginal Cost of Tracheostomy and Vocal Cord Paralysis Under Alternative Definitions of Conditions

Condition	Alternative Definitions		Effect of Large Group		Effect of Subset		Net Effect of Subset
	Large Group	Subset	Coef.	t-stat	Coef.	t-stat	
Tracheostomy	V44.0, no exclusions	Exclude RIC 15	0.214	5.45	0.032	0.79	0.246
Tracheostomy	V44.0 and V55.0 no exclusions	V44.0 no exclusions	0.199	4.62	0.044	0.99	0.243
Vocal cord paralysis	All diagnoses	478.30	0.187	6.34	-0.098	2.36	0.089

NOTE: From regression of log (cost) that control for CMG and for other conditions in Table 3.4.

ralysis (478.3) cost less than the cases where the condition is specified as to total or partial and as to unilateral or bilateral.²

Although the marginal cost of cases with this diagnosis is less than the cost of other diagnoses currently in the vocal cord paralysis condition, it is still significantly greater than zero ($p < 0.01$) and as large as many Tier 3 conditions. When this diagnosis is removed from the condition, the remainder of cases in the condition have marginal costs slightly higher than they had in 1999.

Exploration of Other Subgroups within Existing Conditions

In the preceding section we noted that cases with six of the tier conditions were not significantly more costly than other similar cases (Table 3.4). We have seen that if we drop idiopathic progressive polyneuropathy from the definition of meningitis and encephalitis, cases with the condition again become significantly more costly than similar cases without the condition. What of the other five insignificant conditions? Ventilator dependence and cachexia are single diagnosis codes and therefore must be dropped in their entirety. All but 7 of the 318 cases with the miscellaneous throat conditions have the same diagnosis (933.1), so we must drop this entire condition too.

There are three codes in the esophageal condition. As shown in Table 3.7 we calculated the marginal cost of each of these three codes, but none of them is significantly more costly than similar cases with no comorbidity code. Because we were not interested in whether the codes differ from each other, only whether they differ from zero, we dropped the esophageal condition from this model. Although not shown in detail, we combined the two less frequent codes into a single variable, and it too was not significantly greater than zero. So, we recommend dropping this entire condition from the tier definition.

There are three diagnoses in the lower extremity amputation condition that correspond to amputations below the knee, above the knee, and of the hip. The fourth row in Table 3.7 shows that the amputations above the knee and hip are also not significantly more costly. We note that the number of cases with a lower extremity (LE) amputation but not a primary impairment of a LE amputation actually declined from 1999. It is possible that some of the cases with the condition in our 1999 data set were actually bad data—either they were not amputated or they were given the wrong primary impairment.

Table 3.7
Cost Effects of Diagnoses and Groups of Diagnoses Within Tier Conditions That Do Not Increase Cost in FY 2003

Tested DX		Condition	DX Coef.	DX t-stat
530.0	Achalasia and cardiospasm	Esophageal	0.047	1.00
530.3	Esophageal stricture	Esophageal	0.007	0.45
530.6	Acquired esophageal diverticulum	Esophageal	0.002	0.04
V49.76, V49.77	Amputation above the knee or LE amputation hip		0.013	0.70

Discussion and Recommendations

The explanation for the changes in the estimated marginal effects of the tier conditions from 1999 to 2003 probably is a mixture of three factors: (1) problems with the data in 1999, (2) poor choices for some of the diagnosis codes included in the tiers, and (3) coding problems in FY 2003.

Members of our TEP informed us that, in almost all cases, patients on a ventilator in rehabilitation facilities also have a tracheostomy. Part of the explanation for the finding of a ventilator effect in 1999 may be the under coding of tracheostomy condition in 1999. The coding of tracheostomy status increased much more than ventilator status, and the percentage of cases with both tracheostomy and ventilator status went up even more than tracheostomy cases without ventilator. However, the 140 cases in 2003 with ventilator status and no tracheostomy are likely affected by poor coding. We heard anecdotally that some IRFs may be applying the ventilator code as a history code or to patients who require positive pressure during sleep rather than according to the coding clinic guidelines, which require that the patient be on the respirator in the facility in order to use the code.

A few of the codes in the tier list describe conditions that turned out to be too non-specific to be appropriate for a tier. The original tier diagnoses lists were examined carefully to eliminate such codes. Although many were deleted, a few managed to get through. A case in point is the “unspecified complications of diabetes” codes. Another is nutritional marasmus, which we heard anecdotally was applied to any nonspecific indication of malnutrition in the medical record. Cachexia is possibly another such code.

The large number of cases with the very rare disease of kwashiorkor was troubling to our TEP who believed that this could not be accurate and that it should be removed from the condition list. Indeed more than half of the cases with this condition are found in only five IRFs suggesting a serious, if limited, coding problem.

The increase in the frequency of condition codes along with the decline in the marginal cost of some conditions causes concern that poor coding may be more widespread. The TEP was concerned that some IRFs may be upcoding and that this could be diminishing the effect of these conditions in our analyses. Consequently we examined the extent of concentration of diagnoses and conditions that substantially decreased in marginal cost between 1999 and 2003.

The results are mixed. Only the malnutrition codes and, to a lesser extent, obesity are concentrated within providers. As previously mentioned, kwashiorkor was highly concentrated in five facilities that provided half the cases and with the top four facilities having used this code for between 39 and 85 percent of their cases. The other severe protein deficiency code and nutritional marasmus codes were also concentrated with 14 hospitals providing half of each code and having incidence rates of 7 to 28 percent.

No IRF provided more than three codes for vocal cord paralysis, NOS or more than a very small numbers of codes for candidiasis, gangrene, or cachexia. Thus, the decline in the marginal cost of these cases is not influenced by upcoding at a small number of hospitals and is not influenced by consistent upcoding anywhere.

Morbid obesity is also widespread—the top 100 IRFs account for less than half the cases with the disease. There are 64 IRFs with this code in 10 percent or more of their patients. However, within this set of IRFs the morbid obese patients cost slightly more than the average marginal cost of patients with this code (not statistically different). So again it seems that the declining marginal cost of these cases is not influenced by upcoding at a small number of hospitals and is not influenced by consistent upcoding anywhere.

Our recommendations, which were generally endorsed by the TEP, are to:

- Drop conditions that are not costly in the 2003 data and have no costly frequent codes. These are: ventilator, miscellaneous throat problems, Cachexia, amputation, and esophageal conditions.
- Drop frequently occurring individual diagnoses that do not affect cost from the tier list. In particular, drop the following six codes: 356.4, 250.90, 250.93, 261, 262, and 410.91.
- Drop code 260, kwashiorkor, as coding does not appear to have face validity.
- Redefine the tracheostomy condition to include diagnosis V55.0 and remove the RIC 15 exclusions for tracheostomy.

Further, when we assign tiers we will consider the code 428.30 (vocal cord paralysis, NOS) separately from the remaining diagnoses in the vocal cord paralysis condition. Table 3.8 shows the marginal cost of the conditions that result from this recommendation. We will make a final decision about postoperative malnutrition after examining possible additions to the tier list.

Table 3.8
Regression of Log Cost on Tier Comorbidities After Preliminary
Recommendations

Condition	Coef.	t-stat	Pr > t
Dialysis	0.269	42.30	< 0.0001
Tracheostomy (M)	0.242	20.80	< 0.0001
Vocal cord paralysis (M)	0.194	6.51	< 0.0001
Dysphagia	0.132	26.61	< 0.0001
Pseudomonas	0.121	12.90	< 0.0001
Intestinal infection Clostridium	0.120	16.88	< 0.0001
Postsurgical non-absorption	0.113	2.37	0.0176
Candidiasis (selected)	0.098	3.77	0.0002
Other infections	0.094	22.09	< 0.0001
Meningitis and encephalitis (M)	0.086	3.19	0.0014
Renal complications of diabetes	0.083	9.54	< 0.0001
Hemiplegia	0.082	9.57	< 0.0001
Selected anemias	0.079	5.20	< 0.0001
Vocal cord paralysis, NOS	0.076	2.48	0.0115
Major comorbidities (M)	0.074	21.54	< 0.0001
Pneumonia	0.073	15.46	< 0.0001
Gangrene	0.062	2.63	0.0085
Non-renal complications of diabetes	0.036	10.21	< 0.0001
Obesity	0.023	5.94	< 0.0001

NOTE: $R^2 = 0.3218$; N = 339728 cases from FY 2003.

Exploration of Possible Additions to Tier Conditions

Affective Disorders

In the work leading up to the implementation of the IRF PPS we evaluated whether various psychiatric conditions would also significantly predict higher costs. In the 1998–1999 database, affective disorders (including separate depression variables) did not pass our test for statistical significance and had only a tiny effect on cost—much less than any of the tier comorbidities.¹ Thus, they were not included in the tier definition. However the issue of care for depressed patients remains of great importance to the field and to researchers concerned with quality of care.² Therefore, we wanted to determine whether these conditions are more costly in the 2003 data.

We defined two affective disorder variables as shown in Table 4.1. The severe affective disorder variable is restricted to psychiatric diagnoses of severe affective disorders. The any affective disorder variable is intended to include all codes used for depression. It uses the severe affective disorder codes plus codes noting mild or moderate levels of the same affective disorders, manic disorders, and code 311, which is depressive disorder not elsewhere classified (NEC).

A priori both of the affective disorder variables have problems as payment variables. The problem with the any affective disorder variable is that a situational depression may be a perfectly rational response to many impairments (e.g., stroke or hip fracture). So, if we started to pay on the any affective disorder condition, it might mean that almost all cases would qualify for the tier so that the condition should really be considered as part of the usual treatment. Indeed, this category is the largest of any condition considered for a tier: 10.4 percent of IRF patients received one of these codes; 8.9 percent had the single code 311, which as a NEC code, appears to be nonspecific. The condition is a significant part of all RICs, with the percentage of cases with the condition ranging from 7.8 for LE joint replacement to 16.3 for neurological impairments.

The problem with the second variable, severe affective disorder, is that few IRFs have psychiatric personnel and rehabilitation doctors rarely have the time required to observe the patient in order to make a complete psychiatric evaluation. Thus, these diagnoses may fre-

¹ Schizophrenia was also marginally significant in the 1998–1999 data but had no effect in the 2003 data, so we will not present any details here.

² CMS is sponsoring work on IRF quality indicators at the Research Triangle Institute.

Table 4.1
Definitions of Condition Variables for Affective Disorders

Variable: Severe affective disorder	
296.2	Major depressive disorder, single episode*
296.23	Severe, without mention of psychotic behavior
296.24	Severe, specified as with psychotic behavior
296.3	Major depressive disorder, recurrent episode*
296.33	Severe, without mention of psychotic behavior
296.34	Severe, specified as with psychotic behavior
296.4	Bipolar affective disorder, manic*
296.43	Severe, without mention of psychotic behavior
296.44	Severe, specified as with psychotic behavior
296.5	Bipolar affective disorder, depressed*
296.53	Severe, without mention of psychotic behavior
296.54	Severe, specified as with psychotic behavior
296.6	Bipolar affective disorder, mixed*
296.63	Severe, without mention of psychotic behavior
296.64	Severe, specified as with psychotic behavior
296.8	Manic-depressive psychosis, other and unspecified*
296.80	Manic-depressive psychosis, unspecified
296.81	Atypical manic disorder
296.82	Atypical depressive disorder
Variable: Any affective disorder	
311	Depressive disorder, NEC
296.xx	All valid codes under the heading Affective Disorders

NOTE: The asterisk denotes a label describing the following sets of codes. A code with an asterisk is not a valid code without further specificity.

quently be assigned incorrectly and patients with these conditions may not be assigned these diagnosis.

We examined regressions that add each one of the variables defined in Table 4.1 to the regression in Table 3.8. Separate regressions were used for each variable and the results are reported in Table 4.2. The severe depression variable does appear to predict about a 6-percent increase in cost. This is large enough to qualify easily for a Tier 3 condition. On the other hand, the any affective disorder variable is highly significant and at 0.03 also meets the Tier 3 threshold. Given these findings with what is probably quite dirty data (though better than the 1998–1999 data), it is possible that patients with affective disorders have costs that are higher than the regression coefficients shown here.

Table 4.2
Effect of Affective Conditions on Log (Cost) in FY 2003

Variable	Coef.	t-stat	p-value
Severe depression	0.063	3.79	0.0002
Any affective disorder	0.034	13.46	< 0.0001

NOTE: Regression also controls for CMG and all conditions in Table 3.8.

Before we could recommend that either of these variables be used to assign a tier, we would have to demonstrate high reliability of the coding of these diagnoses within rehabilitation facilities. Given the circumstances of IRFs we expect that high reliability would be very difficult to achieve and that other alternative scales designed to be used by general practitioners or nurses might be more effective. Thus, we would urge CMS to incorporate such measures in the next revision of the IRF PAI. Our TEP agreed that it would be inappropriate to use ICD-9-CM diagnoses to identify patients with affective disorders and that it is important to add a valid, reliable scale to the IRF PAI.

Possibly Preventable Conditions

There were conditions that met statistical criteria for increasing cost that were not included in the IRF PPS as warranting extra payment. They fall into a group that we called possibly preventable conditions to indicate that some clinicians believe that they are preventable in at least some cases. These include urinary tract infections (UTIs), chronic skin ulcers, selected thrombophlebitis codes, and osteomyelitis.

In the combined 1998–1999 data, cases with one of these conditions cost from 10 percent to 16 percent more than otherwise similar cases without the condition.

There was substantial disagreement among members of the TEP subcommittee on comorbidities about whether cases with possibly preventable complications should be paid an extra amount because of such conditions. There was even disagreement about whether one could be sure that these conditions were sometimes actually preventable. For possibly preventable conditions, there is a tension between being fair to hospitals that get more patients who are prone to these diseases and rewarding hospitals that provide poor care. Because of budget neutrality, an explicit payment for these conditions would penalize hospitals that invest in effective preventive activities at a greater than average rate.

The disagreement in the TEP concerned only conditions that arose (or were identified) following the assessment period. There was unanimity that the IRF should pay for conditions present at admission to the rehabilitation hospital if they required treatment or affected treatment in such a way as to increase cost.

In the 1999 data there was no way to determine (or estimate effectively) whether a condition was present at admission. Our TEP strongly advised that we examine the 2003 data with the intent of measuring the current marginal cost of these four conditions, determining how often they are present at admission and how costs differ between conditions present and not present at admission.

The IRF PAI provides two fields in which comorbidities and complications are to be recorded and that, at least theoretically, should allow determining whether a condition was found during the admission assessment.³ However, the structure of these items is not straightforward and invites error. IRFs are to record in item 24 conditions “diagnosed during the admission assessment or anytime during the stay” except for the day of discharge and the preceding day. Item 47 is to record complications that began after the rehabilitation stay began and is also to exclude conditions recognized on the day of discharge or the previous day. Thus items listed in item 24 and not item 47 should be present at admission, although the need to double-enter complications might easily lead to omissions.

One problem with the instructions is visible in the data: for each of the four conditions of interest, about half of the cases found in item 47 are not recorded in item 24 as they should be.

Table 4.3 compares the incidence of each of these four conditions between the 1998–1999 data set and 2003. For the 2003 data, we count all cases where the condition appears in either item 24 or 47. The overall incidence is similar in the two years. The last column shows the percent of cases where the condition is not noted in item 47. Conditions present at admission will be overestimated if hospitals did not doubly record some conditions, but it suggests that the majority of the cases were recognized at admission. However, only 61 percent of the UTI cases were recognized at admission. Some of the other patients may have been on catheters, which hid the symptoms of the infection, but we do not know how often this is the explanation.

Table 4.4 compares the marginal cost of each of these four conditions between 1998–1999 and 2003. The average costs are quite comparable, suggesting that the 2003 data is no worse than the 1999 data. The effects are large enough to raise access issues. Some hospitals might discriminate against patients with these conditions forcing them into nursing homes where they will not receive a coordinated program of rehabilitation.

Table 4.3
Incidence of Possibly Preventable Conditions and Percent Present at Admissions

Condition	Percent of 1998–1999 Cases	Percent of 2003 Cases with Code in Item 24 or 47	Percent of Cases with Condition Recognized at Admission
Chronic osteomyelitis	0.4	0.2	95.2
Selected thrombophlebitis codes	1.8	1.7	78.1
Chronic skin ulcer	4.1	2.7	82.6
Urinary tract infection	13.5	13.0	61.1

³ A condition could of course be present at admission but overlooked during the assessment or masked by other problems.

Table 4.4
Estimated Marginal Cost of Possibly Preventable Conditions for All Cases and Those with
Condition at Admission

Condition	FY 2003 Data					
	1998–1999 Data		All Cases		Present at Admission	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Chronic osteomyelitis	0.113	8.14	0.156	9.44	0.147	8.68
Selected thrombophlebitis codes	0.148	22.71	0.135	22.46	0.100	14.64
Chronic skin ulcer	0.131	29.12	0.138	28.73	0.135	25.66
Urinary tract infection	0.098	38.97	0.087	37.19	0.050	17.22

The last two columns of Table 4.4 show that cases with these conditions at admission have a lower marginal cost than the complete set of cases with the condition. The differences are particularly pronounced for UTI and thrombophlebitis.

Other Frequently Used Diagnosis Codes

Members of our TEP wanted us to explore whether we had missed any important conditions that increase cost but are not currently tier conditions. Although our analyses leading up to the design of the tier system were quite exhaustive, it remains possible that the improvement in the 2003 data set might allow us to find additional codes that were insignificant in 1999 but now predict cost.

We examined the 200 most frequent ICD-9-CM comorbidities in the CY 2002 data set that had not been assigned to a tier in the IRF PPS implementation. Many of them were immediately dismissed from further inquiry as:

1. diagnoses within the four conditions that we analyzed as possibly preventable conditions
2. describing a state that can be said to be found in almost all inpatient rehabilitation patients, such as difficulty walking or a V-code for rehabilitation procedures or aftercare
3. describing a state that is so nonspecific that it covers a wide range of illness from a little to a lot such as hypertension, hyperlipidemia, osteoporosis with site unspecified, or anemia NOS
4. a code that CMS had initially rejected as either too vague or too nonspecific such as hypertensive renal disease unspecified, with renal failure.

After examination we were left with 29 codes that we tested for their effect on cost. These included a variety of psychiatric conditions including Alzheimer's disease (331.0), chronic other specific organic brain syndrome (294.8), and organic personality syndrome

(310.1). The named conditions were statistically significant but decreased cost. Other psychiatric conditions were insignificant. This is consistent with our previous attempts to model psychiatric conditions in rehabilitation and probably reflects the limited ability of some patients with these conditions to participate in or tolerate intensive rehabilitation for a long period of time, thus lowering average costs.

Most of the frequent medical diagnoses that we found here were also either negative or nonsignificant, probably reflecting inconsistent costs. For example V58.61, long term use of anticoagulants, was slightly negative but highly significant. Some of the nonsignificant conditions probably have only a minor relationship to rehabilitation, such as valve disorders (424.0 and 424.1) and eye problems (glaucoma, NOS, and macular degeneration).

Twelve of the tested coefficients were positive and significant. They are all listed in Table 4.5. All the coefficients are relatively small.

The first three diagnoses in Table 4.5 are: congestive heart failure (CHF); insulin dependent diabetes without mention of complications, not stated as uncontrolled; and heart valve replacement. All three seem well defined and have marginal costs within the Tier 3 range. We excluded cases in the cardiac RIC from the CHF and heart valve conditions.

Table 4.5
Positive, Significant Coefficients from Search of all Frequent Diagnoses not in Tiers—Regression of Log Cost, 2003 Data

Code	Diagnosis	Exclusions	Coefficient	t-stat	p-value
428.0	Congestive heart failure	14	0.061	22.35	< 0.0001
250.01	Insulin dependent diabetes, without mention of complications, not stated as uncontrolled	None	0.059	9.27	< 0.0001
V43.3	Heart valve replacement	14	0.040	4.69	< 0.0001
721.3	Lumbar sacral spondylosis w/o myelopathy	16	0.046	6.14	< 0.0001
425.4	Other primary cardiomyopathies	14	0.033	4.76	< 0.0001
274.0	Gouty arthropathy	None	0.029	2.79	0.0052
274.9	Gout, NOS	None	0.019	3.42	0.0006
332.0	Parkinson's	6	0.035	5.87	< 0.0001
041.4	<i>E. coli</i> infection, NOS	None	0.053	8.30	< 0.0001
276.5	(Fluid) volume depletion	None	0.057	8.87	< 0.0001
276.1	Hyposmolality and/or hyponatraemia	None	0.049	10.50	< 0.0001
276.8	Hypopotassemia	None	0.025	5.16	< 0.0001
274.x	Gout	None	0.021	4.36	< 0.0001
721.x	Spondylosis	Mixed	0.033	6.26	< 0.0001
425.x	Cardiomyopathy	14	0.034	5.08	< 0.0001

NOTE: Regressions also control for CMG and the conditions listed in Table 3.8.

Cases with complications of diabetes are already in tiers.⁴ It may be that just the need for the patient to manage his insulin in the community leads to extra rehabilitation costs. In any case, insulin dependence is a well-defined state and is easily auditable.

The next four entries in Table 4.5 share the property that they are all parts of three larger groups of similar conditions that would probably have similar effects: spondylosis, cardiomyopathies, and gout. Consequently, we also ran regressions for each of these three conditions with the results shown in the last three rows of the table. The size of the coefficient for gout is smaller than for any existing Tier 3 condition and we believe that it should not be considered further.

Spondylosis, any of several degenerative diseases of the spine, shares with many of the other conditions in Table 4.5 the property that it exists in various degrees, which may have differential effects on rehabilitation costs. Consequently, we cannot now recommend that CMS include this, or any of the other conditions in Table 4.5 beyond the first three listed, as tier conditions. This exploration was done in response to a request from the TEP. Because of time limitations, the TEP as a whole has not had a chance to review these findings before we issued this report. If CMS is interested in pursuing this further, we could obtain clinical input on each of the conditions listed in Table 4.5 as to their suitability for inclusion in the tier in time for CMS to make final decisions on tier diagnoses for FY 2006.

Preliminary Recommendations

We agree with our TEP that it would be inappropriate to include the ICD-9-CM codes for depression or other affective disorders in the tier system. We urge CMS to include, in the next revision of the IRF PAI, a valid, reliable scale that identifies patients with depression and is suitable for use in an inpatient rehabilitation setting and to provide additional payments for care of depressed patients as soon as practical.

Patients admitted with osteomyelitis, thrombophlebitis, and skin ulcers cost from 10 to 15 percent more than other similar patients; those admitted with urinary tract infections cost 5 percent more. These differences are large enough to raise access concerns. Consequently, we urge CMS to consider providing additional payments for these patients. It would be best if the next revision of the IRF PAI simplified the collection of complication and comorbidity data in a way that improved the reliability of information on whether the conditions were present during the admission assessment.

We recommend that codes for congestive heart failure (428.0); insulin dependent diabetes without mention of complications, not stated as uncontrolled (250.01); and heart valve replacement (V43.3) be added to the tier system. Further, we urge CMS to consider the clinical and coding implications of including each of the other very frequent conditions found to increase cost before deciding on inclusion or exclusion from the tiers.

⁴ Except for ketoacidosis, hyperosmolarity, and coma, which were viewed as being possible problems with care or patients not suitable for inpatient rehabilitation.

Implications of Suggested Changes in Diagnoses Lists

In Chapter Three we recommended dropping various diagnoses and conditions from the current list of diagnoses that are paid a tier supplement. In Chapter Four we recommended adding three additional diagnoses to that list. In this chapter, in the first subsection, we develop a tier assignment for each of the diagnoses that would be in a tier if the above recommendations were carried out. We do not include the possibly preventable conditions in this chapter because this requires a change in policy rather than just a refinement of existing tier policy. In the second subsection we count the number of cases that would be paid differently under this modified tier list. We conclude with a brief assessment of the tier system.

Tier Assignment

As previously mentioned, we used the 1998–1999 regression shown in Table 3.4 to define the tiers for the initial IRF PPS. We used the coefficients on this regression to assign tiers. We show in the first column of Table 5.1 a similar regression using the conditions defined under the recommendations just discussed. The conditions are ordered by decreasing marginal effect on cost. Dialysis is the most expensive condition, followed by tracheostomy. Insulin dependent diabetes, without mention of complications, is included in the non-renal complications of diabetes condition.

We propose to assign all conditions with coefficients above 0.15 to Tier 1, those between 0.10 and 0.15 to Tier 2, and the remaining coefficients to Tier 3. These are the same rules used to create the existing tiers.

The last columns in Table 5.1 compare the tier definitions in the implementation (old tier) with the recommendation from this analysis (new tier). Thirteen of the tier conditions remain in the tier that they are currently in. Dialysis moves from Tier 2 to Tier 1; the other changes all moved down a tier.

Magnitude of Changes to Tiers and Conditions

Table 5.2 shows the number of cases with diagnoses that would be treated differently if the recommendations found in this report were implemented; 3.2 percent of the cases have a diagnosis that is no longer in a tier. Many of these have other tier comorbidities, so 1.6 percent of cases that would be in a tier under the current payment system would not be in a tier if our recommendations were accepted.

Table 5.1
Regression of Log (Cost) on All Conditions Recommended for New Tiers and Tier Assignment

Condition	Estimate	t-value	Pr > t	Old Tier	New Tier
Dialysis	0.266	41.84	< 0.0001	2	1
Tracheostomy (M)	0.249	19.66	< 0.0001	1	1
Vocal cord paralysis (M)	0.198	6.63	< 0.0001	1	1
Dysphagia	0.134	27.04	< 0.0001	2	2
Pseudomonas	0.122	13.12	< 0.0001	2	2
Intestinal infection Clostridium	0.119	16.81	< 0.0001	2	2
Postsurgical non-absorption	0.116	2.44	0.0146	1	2
Candidiasis (selected)	0.101	3.86	0.0001	1	2
Other infections	0.094	22.08	< 0.0001	2	3
Meningitis and encephalitis (M)	0.090	3.35	0.0008	2	3
Renal complications of diabetes	0.079	9.07	< 0.0001	3	3
Hemiplegia	0.086	9.95	< 0.0001	3	3
Aplastic anemia and anemias	0.078	5.17	< 0.0001	3	3
Vocal cord paralysis, NOS	0.075	2.44	0.0148	1	3
Major comorbidities (M)	0.072	20.78	< 0.0001	3	3
Pneumonia	0.069	14.67	< 0.0001	3	3
Gangrene	0.060	2.59	0.0097	3	3
Congestive heart failure	0.060	21.96	< 0.0001	None	3
Non-renal complications of diabetes	0.041	12.83	< 0.0001	3	3
Heart valve	0.034	3.91	< 0.0001	None	3
Morbid obesity	0.020	5.18	< 0.0001	3	3

NOTES: Based on 339,728 discharges from FY 2003. Regression also controls for FRG. $R^2 = 0.3229$.

More than half of the cases with a dropped condition come from one of the three malnutrition diagnoses: kwashiorkor, nutritional marasmus, and other severe protein-calorie malnutrition. Cachexia was responsible for an additional 15 percent of these cases. We saw previously that these diagnoses are coded much more frequently now and that cases with the malnutrition codes, but not those with cachexia, are concentrated in a small number of IRFs.

We also added cases—the pulmonary RIC cases with tracheostomy and three additional diagnoses, which are quite frequent. (See the second section of Table 5.2.) Again,

Table 5.2
Number of 2003 Cases That Would be Affected by Change in Preliminary Recommendation

Change	Cases with Relevant Diagnoses	Percent of Sample
Drop miscellaneous throat problems	553	0.2
Drop esophageal conditions	977	0.3
Drop ventilator status	204	0.1
Drop cachexia	1,366	0.4
Drop LE amputation	1,843	0.5
Drop 356.4 from meningitis and encephalitis	286	0.1
Drop most malnutrition codes	4,646	1.4
Drop 2 codes from non-renal complications of diabetes	633	0.2
Drop 1 code from major comorbidities	532	0.2
SUBTOTAL	11,040	3.2
Remove RIC 15 exclusion for tracheostomy and add code	242	0.1
Add congestive heart failure	30,557	9.0
Add uncomplicated insulin dependent diabetes	4,968	1.5
Add heart valve replacement	2,722	0.8
SUBTOTAL	38,489	11.3
Cases no longer in tiers	5,455	1.6
Cases entering tiers	23,875	7.0
Cases moving into Tier 1 from a lower tier	5,054	1.5
Cases moving down to Tier 3 from a higher tier	13,717	4.0
Cases with some change	48,101	14.2

some of these are also in a tier in the current payment system, so we are adding 7.0 percent of cases to the tier system.

There are also a large number of cases that change tiers. More than 5,000 cases with dialysis moved up to Tier 1 while many more moved down to Tier 3. Altogether, 48,101 cases would be affected by these preliminary recommendations.

Tier Effects

Table 5.3 provides a regression of log cost on each tier within each RIC, using our preliminary recommendation to define tier and 2003 data. For comparison, the table provides the similar regression using 1998–1999 data from Table 4.8 in the implementation report (Carter et al., 2002). The tiers in the 1998–1999 regression are those used in the IRF PPS.

Table 5.3
Regression of Log Cost on Tier in Each RIC

RIC	Tier q				Tier 2				Tier 3			
	FY 2003 Data		q998–q999 Data		FY 2003 Data		q998–q999 Data		FY 2003 Data		q998–q999 Data	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
1	0.1796	11.24	0.1867	7.83	0.0598	3.29	0.076	6.56	0.0046	0.98 ^a	0.0342	5.78
2	0.4596	11.08	0.1975	3.6	0.2282	10.52	0.192	7.97	0.0548	3.27	0.1006	4.86
3	0.3639	10.90	0.2297	4.63	0.2091	11.85	0.1418	8.07	0.0835	6.61	0.0854	6.22
4	0.3592	5.24	0.3594	4.69	0.1865	4.79	0.1603	3.89	0.1118	3.84	0.1251	3.45
5	0.4390	11.53	0.3631	6.09	0.2159	11.17	0.2543	13.68	0.1028	10.25	0.1399	8.89
6	0.3515	16.74	0.3281	6.76	0.1067	8.05	0.1094	8.63	0.0740	8.84	0.0889	8.07
7	0.3092	14.75	0.0726	1.50 ^a	0.1219	10.12	0.1531	12.01	0.0923	16.12	0.1158	12.18
8	0.3763	11.83	0.3123	6.59	0.1737	14.24	0.191	20.1	0.1051	26.38	0.1523	18.86
9	0.3268	9.69	0.3216	4.58	0.1923	9.68	0.1906	10.32	0.1048	12.79	0.1431	10.87
10	0.2535	15.31	0.1853	2.94	0.1462	5.70	0.1535	9.52	0.0593	5.38	0.082	8.5
11	0.3641	5.92	0.6138	2.20 ^b	0.1730	2.23 ^b	0.157	3.64	0.0985	2.80	0.0938	3.17
12	0.3220	6.01	0.5994	5.56	0.1822	6.26	0.1974	7.58	0.0923	8.34	0.1288	6.98
13	0.2929	4.29	0.3653	2.62	0.1790	4.63	0.1658	4.95	0.0657	4.08	0.1353	5.24
14	0.3280	17.31	0.3194	8.38	0.2079	15.91	0.2052	14.97	0.0783	10.72	0.0799	7.16
15	0.3002	4.47	0.2302	2.86	0.1917	9.83	0.1466	7.91	0.0369	3.13	0.0201	1.02 ^a
16	0.3719	6.40	0.2575	1.93 ^a	0.2356	7.21	0.2075	6.54	0.1054	8.60	0.1727	7.37

Table 5.3—continued

	Tier 1				Tier 2				Tier 3			
	FY 2003 Data		q998–q999 Data		FY 2003 Data		q998–q999 Data		FY 2003 Data		q998–q999 Data	
RIC	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
17	0.3523	7.64	0.2628	3.59	0.2129	5.55	0.2119	5.26	0.1282	7.00	0.0779	2.58
18	0.4057	5.43	0.1458	1.21 ^a	0.2650	4.69	0.2209	2.94	0.0439	1.00 ^a	–0.029	0.39 ^a
19	0.3465	2.84	0.0811	0.66 ^a	0.1417	2.08 ^b	0.1462	2.47 ^b	0.0467	0.86 ^a	0.0555	0.92 ^a
20	0.3665	34.99	0.3016	15.01	0.1586	18.93	0.1572	20.66	0.0825	16.95	0.0909	14.93
21	0.5946	3.58	0.0308	0.13 ^a	0.2014	1.45 ^a	0.026	0.23 ^a	0.0298	0.36 ^a	–0.099	–1.12 ^a
Median increase	42%		30%		21%		17%		9%		10%	

NOTES: 2003 regression based on 339,728 cases discharged to the community: $R^2 = 0.3223$. 1998–1999 regression based on 361,659 cases; $R^2 = 0.3388$. Regression also controls for CMG. All coefficients significantly different from zero ($p < 0.01$) unless otherwise noted.

^a Coefficient is not statistically different from zero ($0.05 < p$).

^b Coefficient is marginally different from zero ($0.01 < p < 0.05$).

Overall, the fit of the new tiers is as good in 2003 as in 1999; the R-Square for the regression is similar, although slightly smaller. The t-statistics for Tier 1 are uniformly and substantially higher, which reflects the importance of the high costs of dialysis patients. The t-statistics for the other two tiers are comparable—24 higher in 2003 and 18 lower. Although a few coefficients in 2003 are not statistically significant, or are only marginally significant, there are fewer than in the earlier data. Further, in all RICs, the coefficient on Tier 1 is greater than the coefficient on Tier 2, which in turn is greater than the coefficient on Tier 3 and all coefficients are positive.

One change may be worth noting. The Tier 2 and Tier 3 coefficients in stroke are now extremely small and only marginally significant. We have not been able to determine why this is so.

The last row in Table 5.3 summarizes the magnitude of the marginal cost of a tier condition. It gives the percent by which the cost of a case with that tier exceeds the cost of a case in the same CMG with no tier condition in the RIC that has the median cost effect. In each tier these are very substantial effects—42 percent in Tier 1, 21 percent in Tier 2, and 9 percent in Tier 3. These percents were calculated by exponentiation the coefficient in the median RIC.

Assessment of Tier Effects

The tier system requires a reasonable amount of revision in response to coding changes found during FY 2003. Of cases that were paid as tier cases, 1.6 percent would no longer be in a tier if our recommendations are implemented. In addition, 4 percent of cases would be placed in a lower tier.

Some of the changes in the tier system may be due to upcoding. More than half of the cases with a condition being dropped have one of the three malnutrition diagnoses: kwashiorkor, nutritional marasmus, and other severe protein-calorie malnutrition. Each of these diagnoses was coded much more frequently in 2003 than in 1999. Further, each diagnosis is highly concentrated in a small number of hospitals and these hospitals might be upcoding.

We found no other diagnoses that were highly concentrated in particular hospitals. Nevertheless we are concerned with the number of cases with diagnoses that are now less costly than they appeared in 1999 because coding problems might be more widespread than just the nutritional diagnoses. Morbid obesity in particular is subject to some judgment. CMS should consider adding height and weight to the next version of the IRF PAI and replacing the diagnosis with a more objective measure of obesity.

Despite possible remaining and undetected problems with coding, the tier system remains an important means of matching payments to costs. The percent by which the cost of a case with a tier diagnosis exceeds the cost of a case in the same CMG with no tier condition is substantial: Tier 1 is typically 42 percent; Tier 2, 21 percent; and Tier 3, 9 percent. Because the tier system continues to play an important role in matching payments to costs, it helps insure access to IRF care and provide fair payments to hospitals.

On balance, we judge the performance of the tier system to be acceptably stable, especially in the face of the large change in coding (or case mix). We expect that the rate of change in coding of tiers will greatly decline over time. If not, it will require reexamination of the costs and benefits of the tier system.

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