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TECHNICAL REPORT

Changes in Patient Severity Following Implementation of the Inpatient Rehabilitation Facility Prospective Payment System

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Supported by the Centers for Medicare and Medicaid Services

RAND HEALTH

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Preface

Since the inception of the Inpatient Rehabilitation Facility Prospective Payment System (IRF PPS) in 2002, the RAND Corporation has been contracted by the Centers for Medicare and Medicaid Services (CMS) to support its efforts to monitor the effect of the IRF PPS. To date, RAND has provided a number of analyses and reports on patient access to and utilization of IRF services before and after the implementation of the IRF PPS. Our reports address the Congressional mandate for a study of IRF patient access to care. This report focuses specifically on whether the implementation of IRF PPS has affected patient access to care, especially for patients who are considered "severely ill" and in need of significant levels of care. This report was prepared for CMS, but should also be of interest to individuals in the health care and policy-making arenas who are concerned about Medicare beneficiaries' access to care.

This work was sponsored by CMS under contract 500-2004-00033C and was conducted within RAND Health, a division of the RAND Corporation. Comments or inquiries should be sent to the first author of this report, Susan Paddock (**Susan_Paddock@rand.org**). We would like to thank Donna Farley of RAND and Bowen Garrett of the Urban Institute for reviewing this document and providing helpful comments. We also thank Barbara Meade of RAND for editorial comments and Regina Hollins for administrative assistance. A profile of RAND Health, abstracts of its publications, and ordering information can be found at www.rand.org/health.

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Executive Summary

Background

In response to the Balanced Budget Act of 1997, the Centers for Medicare and Medicaid Services (CMS) implemented a prospective payment system for care provided by hospital inpatient rehabilitation facilities (IRFs) to Medicare beneficiaries beginning on January 1, 2002. The goals of the IRF prospective payment system (IRF PPS) include enhancing access to IRF care by more closely aligning Medicare payments with actual IRF costs (by compensating IRFs based on their case mix -- the mix of medically severe and less severe cases being treated in IRFs) and controlling Medicare's inpatient rehabilitation expenditures.

The IRF PPS was implemented in part as a response to concerns about access to care under the earlier payment system, which was based on historical costs rather than case mix. One implication of using historical costs was that rehabilitation facilities could not recover extra costs if their case mixes shifted to include more severe patients who are costlier to treat. IRFs therefore had an incentive to accept more patients with less severe conditions, whose care is less expensive, and to restrict the access of patients with more severe conditions. However, similar concerns are presented by the structure of IRF PPS, which also gives facilities a more subtle incentive to accept less severe patients (e.g., patients with higher functional status) within each case mix group and comorbidity tier.

Study Purpose and Approach

The purpose of this analysis is to examine the effects of the IRF PPS on patient access to care, and to determine if access for more severe patients cases is being restricted. To examine such effects, we first developed three hypotheses, based on prior

experience with the implementation of prospective payment systems. Our work was designed to test the hypotheses. The three hypotheses are:

1) Following the IRF PPS implementation, fewer patients with particularly costly conditions will be admitted from acute care.
2) Cases having higher resource use requirements (i.e., more severe cases) will have reduced admission rates under the IRF PPS. Specifically, relatively severe cases within case mix and comorbidity groups may experience reduced access to IRF care.
3) Patients will receive a lower intensity of care under the IRF PPS.

We compared indicators of patient access measured before and after the IRF PPS implementation. We focused primarily on measures of the amount of care delivered, such as length of stay and average cost per case, and patient characteristics, such as functional status, mortality, and age, to understand whether utilization remained steady under the IRF PPS and whether IRFs selected less expensive and less medically severe cases after implementation of the IRF PPS. We constructed several measures of severity to capture these effects.

Comparison of data from periods before and after the IRF PPS is complicated by the fact that some observed trends in key measures, such as length of stay, are confounded by other changes. Moreover, the instructions provided for collecting data using the FIM™ instrument were changed and clarified just prior to the IRF PPS implementation, limiting the comparability of FIM™ data across time periods. Thus, our severity measures relied heavily on data from the IRF patients' preceding acute care stays, since we judged that the IRF PPS implementation should not affect coding in acute care settings.

Our analyses of conditions specified on the basis of their costliness (i.e., ventilator dependence, dialysis, and organ transplant) used data from the universe of IRF cases from 1999 through 2002. The remaining analyses that define patient severity relative to

that of similar patients require the use of the FIM™ scores in order to classify patients into groups based on their FIM™ motor and cognitive scores, condition, and age.

Results

Hypothesis 1: Fewer cases with costly conditions. Overall, we found no evidence that patients treated at IRFs were appreciably more or less likely to have specific, costly conditions following implementation of the IRF PPS.

Hypothesis 2: Reduced admission rates for more severe cases. There were only slight differences between the percentages of relatively severe cases pre- versus post-IRF PPS. In general, patients under the IRF PPS were more severely ill than those prior to the IRF PPS. Cases under the IRF PPS also had lower probabilities of death. This result, coupled with the greater cost per case requirements, suggests that better functioning patients are increasingly being seen in IRFs. Cases were predicted to have similar functional status, given their case mix, pre- versus post-IRF PPS implementation.

Hypothesis 3: Lower intensity of care. A decrease in the average length of stay under the IRF PPS was observed. This could be an indication that IRFs have succumbed to "moral hazard" and are reducing intensity of care. However, this seems to be part of a longer-term trend. Length of stay has been trending downward throughout the study period (1999 to 2002), with the trend moving further downward after 1999.

These overall trends do not suggest any dramatic effects on patient access from the implementation of the IRF PPS. The decline between 1999 and 2002 in length of stay appears to have been part of a trend that began prior to 2002. It is possible that changes in resource use could have occurred in anticipation of the IRF PPS or in response to other post-acute care payment systems that went into effect around that time. Any future refinement of the IRF PPS might need to account for the discrepancy between required and realized (observed) resource use. Such variability in trends from year to year warrants continued monitoring of the effects of the IRF PPS.

1. Introduction

As part of the Balanced Budget Act of 1997, the U.S. Congress mandated that the Centers for Medicare and Medicaid Services (CMS) implement a prospective payment system (PPS) for hospital inpatient rehabilitation care (IRF) for Medicare beneficiaries. This new system was implemented beginning on January 1, 2002. Under the IRF PPS, IRFs are compensated for providing inpatient rehabilitation care based on a pre-determined amount per case according to the patient's impairment, age, level of function, and co-morbid conditions, with additional adjustments made to compensate for cost differences due to factors such as wage differences across geographic areas and facility-specific factors (Carter et al., 2002).

The unit of payment in the IRF PPS is a Medicare-covered hospital stay, beginning with an admission to the rehabilitation hospital or a rehabilitation unit of an acute care hospital and ending with discharge from that facility. Payment is based in part on the patient's case mix group (CMG). Each case is classified into one of 94 CMGs. The CMGs are based on cause of impairment, age, and functional status as measured by the FIM^{TM} Instrument (Uniform Data System for Medical Rehabilitation, 1999). The FIM™ Instrument is an 18-item instrument assessing how independently a patient can accomplish activities in six domains: self-care, sphincter control, mobility, locomotion, communication, and social cognition. The CMGs are augmented by three comorbidity tiers that allow for classifying patients according to certain co-morbid conditions. Together, CMG and comorbidity tier assignments largely determine the costliness of a case. Payment modifications for short stays, transfers, and other unusual cases, along with further details of the IRF PPS, are explained in more detail by Carter et al. (2002).

One goal of the IRF PPS is to enhance access to IRF care by compensating IRFs based on their actual case mix. Prior to the IRF PPS, payment for inpatient rehabilitation care for Medicare beneficiaries had been made under the Tax Equity and Fiscal

Responsibility Act (TEFRA) of 1982. TEFRA capped annual payments to an inpatient rehabilitation facility at a facility-specific maximum that was determined using the IRF's base year of operation, which was used to estimate facility-specific costs. Under TEFRA, there was no adjustment made to payments due to changes in a facility's case mix following the base year. This raised concerns that TEFRA was, in effect, limiting beneficiary access by creating incentives for providers to specialize in relatively less severe – and therefore less expensive – cases. The IRF PPS could enhance access by providing greater levels of reimbursement for those with greater clinical needs (Stineman, 2002). A goal of the IRF PPS is to ensure beneficiary access to care. Another goal is to control Medicare's inpatient rehabilitation expenditures. For example, under TEFRA, facilities were fully compensated for patients who did not fulfill an entire course of rehabilitation, such as short stays and transfers (e.g., compensated as if the entire course of rehabilitation had been completed). Also, IRFs took advantage of incentives under TEFRA to maximize payment by increasing utilization and cost during the base year, thus resulting in increased expenditures for the Medicare program (Chan et al., 1997). By 1995, payments exceeded costs by 7% in freestanding rehabilitation facilities and 4% in rehabilitation units. In contrast, in the early 1990s costs exceeded payments (MedPAC, 1998, Chart 4.19).

The goal of this report is to assess whether the implementation of IRF PPS affected patient access. The case mix adjustment allowed by the IRF PPS could have resulted in increased access to care relative to that under TEFRA. However, it is also possible that providers instead found ways to maximize their payments while holding their costs down under the IRF PPS, just as providers did by maximizing costs in base years under TEFRA. For this study, we first developed hypotheses about access to care under the IRF PPS that are grounded in past experiences with other prospective payment system implementations. We then used data from periods before and after the IRF PPS implementation to test these hypotheses.

This is one of a series of reports on monitoring the effects of the IRF PPS on beneficiary access to care and responses to specific incentives created by the payment system. Our reports address the Congressional mandate for a study of IRF patient access to care. In addition to examining access to care for relatively severe cases, we have also conducted a series of analyses that address IRF utilization patterns, special payments for atypical patients, and resource use in IRFs (Beeuwkes Buntin et al., 2005), and coding changes (Carter and Paddock, 2005).

2. Background and Conceptual Framework

The implementation of prospective payment can trigger a range of effects among providers (Ellis and McGuire, 1996). Providers could succumb to *moral hazard* by reducing the amount of care delivered, for example by shortening lengths of stay or reducing therapy intensity. Providers could engage in *selection behavior*, changing their admission policies so as to restrict access for patients not likely to be profitable (the most medically severe cases in each CMG would be those most likely to be restricted). Providers could alter their *coding practices* of patient impairment in order to increase payments without changing their case mix; this coding change could occur in the form of deliberate upcoding or as a response to changes in coding instructions and incentives under the new payment system, which encourage the thorough coding of patient impairment. On the positive side, providers might respond to prospective payment by becoming more efficient, thereby producing equivalent health outcomes with fewer inputs. Another possible positive result is that providers who experienced fiscal pressure under the former payment system might be able to afford more medically severe cases than before.

The moral hazard effects of prospective payment systems across a variety of care settings have been documented. In a large, nationally representative sample of Medicare beneficiaries from 297 hospitals, Kahn et al. (1991) found that when comparing post-PPS with pre-PPS data, the length of stay dropped significantly for post-PPS data for all of the conditions studied despite patients being sicker at admission. This study also found that there was greater instability among patients at discharge following the PPS implementation, and that this instability was associated with increased mortality rates. Neu and Harrison (1988) found that this observed decrease in the average length of an acute care stay was accompanied by increases in skilled nursing facility and home health agency utilization following an acute care stay, indicating that care that had been

previously provided by acute care hospitals had potentially been shifted to other settings. The effect of the Balanced Budget Act (BBA) of 1997 on post-acute care has also been examined. For example, Angelelli et al. (2002) found that the lengths of stay and readmission rates of the costliest, most medically severe cases discharged to nursing facilities in Ohio post-BBA versus pre-BBA were quite steady over time, while, in contrast, Yip et al. (2002) found decreases in the intensity and duration of physical and occupational therapies among Medicare beneficiaries in three southern California skilled nursing facilities.

Selection behavior effects, namely, providers admitting greater proportions of relatively healthier and higher functioning patients, have been found as well. The above-mentioned study of Medicare beneficiaries in three southern California skilled nursing facilities following implementation of the Skilled Nursing Facility PPS (Yip et al., 2002) found that patients admitted post-PPS had conditions with better-defined (i.e., more predictable) care protocols. Newhouse (1989) found that acute PPS discharges for which the payment was relatively less generous were more likely to be admitted to "last resort" public hospitals under the acute PPS.

Changes in coding practices have occurred with prospective payment system implementation. One-half of the increase in the case mix index of Medicare patients at acute care hospitals in fiscal years 1987 and 1988 was attributed to changes in coding and administrative practices (Carter, Newhouse, and Relles, 1991). Coding changes may occur following the IRF PPS implementation, since providers now have an incentive to thoroughly code patient severity; for example, comorbidities garner additional payments under the IRF PPS that did not exist under the TEFRA system. In addition, the IRF Patient Assessment Instrument (PAI) used by IRFs under the IRF PPS to collect patient admission and discharge information on functional status was slightly modified from the FIM™ instrument that was used prior to the IRF PPS. For example, the IRF PAI now

specifies that bowel functioning should be scored at the least independent level observed during the week leading up to the assessment, while previously the level was scored based on the first 72 hours in the IRF. This change could have the effect of lowering the bowel functioning score. Both coding practice and coding instruction changes make it difficult to measure case-mix changes over time (Carter and Paddock, 2005).

3. Hypotheses

The theoretical and observed effects of prospective payment led us to develop the following hypotheses about changes in access to IRF care that might be realized following the IRF PPS implementation. Our work was designed to test these hypotheses:

1) Following the IRF PPS implementation, fewer patients with particularly costly conditions will be admitted from acute care.
2) More severe cases will have reduced admission rates under the IRF PPS. Specifically, relatively severe cases within case mix and comorbidity groups may experience reduced access to IRF care.
3) Patients will receive a lower intensity of care under the IRF PPS.

These hypotheses reflect two approaches to identifying the effects of the IRF PPS on access to care for relatively severe cases. The first hypothesis addresses whether the composition of IRF cases having specific, expensive conditions differs pre- versus post-IRF PPS implementation across case mix groups. The second and third hypotheses identify effects that occur mostly within case mix groups. The structure of the IRF PPS offers an incentive for facilities to treat relatively less severe cases within the same payment category; e.g., to treat patients with relatively high functional status within a given CMG. In addition, some across-case-mix group measures related to hypotheses 2 and 3 that do not focus on relative severity within CMG-comorbidity group were examined as well.

Understanding whether access to care changed for more severe cases under the IRF PPS is complicated by the fact that coding instructions and incentives changed with the implementation of the IRF PPS. Thus, the approach we used to create severity measures included only variables that are largely exogenous to payment system incentives and coding changes[1].

[1] As discussed below, this approach does not completely account for all potential selection mechanisms.

4. Data and Methods

Data Sources

We utilized several data sources for our analysis. We have complete data on Medicare bills for all IRF, acute care, home health, skilled nursing facility, and long-term care hospital stays for calendar years 1999 through 2002. The universe of IRF cases includes all Medicare-paid discharges from IRFs except for Maryland cases, since Maryland has its own prospective payment system and is exempt from the IRF PPS. We have FIM™ data on patient functional status at admission on a sample of cases in 1999 and 2002. The Uniform Data Systems for Medical Rehabilitation (UDSMR) and HealthSouth provided FIM™ data for a sample of IRFs in 1999. FIM™ data were collected for all cases in 2002 as part of the IRF PAI, which is completed at admission and discharge for each rehabilitation patient as mandated under the IRF PPS. These data contain descriptions of the patient and the hospitalization, including the condition requiring rehabilitation and the FIM™ items at admission and discharge. We matched the IRF Medicare bills to the FIM™ data in both 1999 and 2002, resulting in analysis data sets representing 65 percent and 95 percent of all cases in 1999 and 2002, respectively. The 1999 matched sample is largely representative of the IRF universe in that year, although racial minorities, those 95 years or older, and aged patients with end-stage renal disease were slightly underrepresented. The set of IRFs with FIM™ data in 1999 underrepresented IRF units of acute care hospitals, rural facilities, and those with a high proportion of low-income patients. Finally, we utilized the Medicare bills for the acute hospitalization that preceded admission to the IRF, provided it occurred in the six months preceding rehabilitation admission. In both 1999 and 2002, 95 percent of IRF cases had such a preceding acute care stay. We also have data for the universe of discharges on the acute care stays that occurred in the six months prior to the IRF admission; about 95% of the IRF stays had a preceding acute care stay. In addition, we have characteristics of the

hospitals in which the IRF patients had their preceding acute care stays from the PPS impact file.

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. Home office costs for HealthSouth providers are about 13 percent of total costs. Since the omission of these costs would distort the findings from analyses involving 2002 costs, we adjusted the 2002 costs by an adjustment factor. To derive the adjustment factor, we updated the latest available IRF cost report data (generally, cost reports beginning in FY2003 that did not include home office costs) to FY2004 using the estimated rate of increase in the hospital market basket. We obtained FY 2004 home office cost data from CMS for individual HealthSouth IRFs and added the home office costs to the estimated FY2004 IRF costs. The adjustment factor is the ratio of estimated costs including home office costs to estimated costs excluding home office costs. We then applied this adjustment factor to the 2002 cost per case that we had estimated using the 2002 cost report data that did not include home office costs. The FY2004 HealthSouth home office cost statement has information on home office costs allocated to 92 of the 98 HealthSouth IRFs in our analysis file. We used the average adjustment factor for the six IRFs for which we were not able to compute a facility-specific adjustment factor. For further information on this issue, see the IRF PPS final rule for FY2006 (Centers for Medicare and Medicaid Services, 2005).

Analytic Approach

Our analytic approach focused on employing measures that should be largely unaffected by potential coding or payment system changes. To accomplish this, we relied heavily on data from preceding acute care stays during the six months prior to the IRF admission, assuming that the IRF PPS would have no effect on coding practices in the acute care setting.

Hypothesis 1: Change in the mix of patients admitted from acute care with specific costly conditions. The specific conditions we chose to examine in the IRF population are ventilator dependence, dialysis, and organ transplant cases. These are conditions thought to be particularly expensive and it is of interest whether the IRF PPS is paying enough for these medically severe cases. Ventilator status increases cost for IRF cases by more than 25% and dialysis by 14% (Carter et al., 2002, Table 4.4). RAND's Technical Expert Advisory Panel suggested that organ transplants may be associated with high rehabilitation costs not accounted for in the IRF PPS, and they were examined for this reason.

We identified cases with these conditions using the bills for the acute care stay preceding the IRF stay to avoid potential problems with differences in coding of comorbidities in the 1999 versus 2002 IRF data. Ventilator cases were divided into three groups and identified as follows: (a) all cases with continuous mechanical ventilation for 96 consecutive hours or more in their preceding acute care stay (procedure code 96.72); (b) continuous mechanical ventilation support of either an unspecified duration or for less than 96 consecutive hours (procedure codes 96.70 and 96.71) with a primary diagnosis of a respiratory condition in their preceding acute care stay, as defined by multiple diagnosis category (MDC 4); and (c) continuous mechanical ventilation support of either an unspecified duration or for less than 96 consecutive hours and not having a primary respiratory diagnosis in their preceding acute care stay. Dialysis cases are identified by

having procedure codes 39.95, 54.98, 39.42, 38.95, and 39.27 in the claim for their preceding acute care stay. Organ transplant cases are identified by acute procedure codes for lung (33.50, 33.51 33.52), combined heart/lung (3.36), heart (37.5), bone marrow (41.00, 41.01, 41.02, 41.03, 41.04, 41.05, 41.06), intestine (46.97), liver (50.59), pancreas (52.80, 52.82) and kidney (55.69) transplants occurring in any of the acute care stays during the six months prior to IRF admission, since transplant cases may have repeated visits to an acute care facility between their transplant and the IRF admission.

Our analysis of the possible change in patient mix occurred in two steps. First, using the acute care bills, we identified all cases that had these conditions. We linked these acute care stays with Medicare-covered stays in IRFs, home health care agencies, skilled nursing facilities, and long-term care hospitals occurring within 30 days of the acute care stay discharge. We then examined 30-day post-acute care destinations for these cases to assess whether, for the years 1999 through 2002, any changes occurred in the number and percent of cases going to IRFs following acute care. Second, we examined the number and percent of IRF cases having these conditions during this time period, with a particular focus on identifying changes pre- and post- the IRF PPS implementation in 2002.

Hypothesis 2: Reduced admission rates for more severe cases. We examined this hypothesis for cases of all conditions as well as for the three patient subpopulations reflecting the most frequently treated conditions in IRFs, namely, hip fracture, lower extremity joint replacement, and stroke. To avoid confounding due to changes in patient classification following IRF PPS implementation, we defined these three groups using information from the preceding acute care stay. Hip fracture was defined using a principal inpatient diagnosis of "fractures of the neck of the femur (diagnosis codes 820.xx)." Hip fracture patients who were listed as having metastases to the bone or who suffered major trauma to a site other than a lower extremity were excluded from the sample so as to create a clinically uniform group of patients. Lower extremity joint

replacement was defined using the diagnosis-related groups (DRGs) for joint replacement procedures (209, 471) minus those patients classified above as hip fracture. Stroke was defined as intracerebral hemorrhage (431.xx), occlusion and stenosis of precerebral arteries with infarction (433.x1), occlusion of cerebral arteries with infarction (434.x1), and acute but ill-defined cerebrovascular disease (436.xx).

We would expect more severe cases to require longer lengths of stay, to be more costly, and to have lower functional status than less severe cases. Since the IRF PPS recognizes differences in cost due to case mix differences, we would expect that, if selection were occurring, IRFs might select less severe cases within case mix groups in order to maximize profit. Thus, we defined several measures of severity conditional on case mix group assignment as follows. Using length of stay to demonstrate, we computed the average length of stay for each CMG and comorbidity group (i.e., whether a case is or is not in one of the three comorbidity tiers)[2]. We then derived an indicator variable of whether a case is above or below the average for its own CMG-comorbidity group. Cases that are above the CMG-comorbidity group average were defined to be more severe. We created additional severity indicator variables for cost and FIM™ scores (motor, cognitive, and total scores). We also examined two additional measures of severity that are not conditional on case mix group membership: mortality rates as of 30 and 150 days post-IRF admission.

Ideally, we would have directly compared these measures for the 1999 and 2002 cases to assess changes in patient severity; however, there are several complications that prevented this from being a valid approach. First, FIM™ scores are expected to be lower in 2002 because of changes in data collection instructions and the incentive posed by the IRF PPS to code impairment more thoroughly; thus, a given FIM™ score could have

[2] We could have defined similar groups of patients according to CMG-comorbidity tier assignment, but found that CMG-comorbidity tier groups that corresponded to the highest comorbidity tiers often had extremely low sample sizes; thus, our definition allowed us to capture the variability among patients with versus those without comorbidities.

different meanings in 1999 versus 2002. Second, length of stay has been trending downward for years; any change in length of stay between 1999 and 2002 could be attributable to pre-existing trends rather than to patient severity. Cost per case could be decreasing along with length of stay. Finally, changes in the average acute care length of stay could hasten IRF admission in some years relative to others, thereby making the 30- or 150-day windows following IRF admission reflect different time periods in a patient's recovery and thus make mortality rates less comparable across time.

In order to derive severity measures for 1999 and 2002 that are directly comparable, we used a logistic regression model to predict severity as a function of case mix characteristics. We fit the logistic regression model to the 1999 matched bill-FIM™ data and made predictions for the universe of cases in 2002 and for the non-matched cases in the 1999 data, resulting in predicted severity measures for the universe of cases in 1999 and 2002 that are comparable[3]. The standard errors of the predicted severity estimates in 1999 and 2002 were estimated using the delta method to account for the variability in the predictions.

Logistic regression models were fit to the data to derive predicted severity measures for each of the seven dependent variables; these seven dependent variables were: an indicator of having a length of stay that is greater than the average given a case's CMG-comorbidity group; an indicator of having a cost per case that is greater than the CMG-comorbidity group average; an indicator of having a functional status score (motor, cognitive, or total FIM™ score) that is above the CMG-comorbidity group average; and mortality within 30 or 150 days following IRF admission. We used the following patient-level characteristics as covariates in our logistic regression models: race (white versus nonwhite); gender; age; comorbidities and complications from the preceding acute care stay; number of acute care stays during the six months prior to IRF

[3] Even using this strategy, however, we cannot completely rule out the possibility of unobserved selection because patient selection could occur within the covariate categories defined by our prediction models.

admission; characteristics of the acute care hospital in which the discharged patients had their preceding acute care stay (namely, average daily census, case mix index, disproportionate share of low-income patients, Medicaid utilization rate, number of beds, operating wage index, and urban/rural status); diagnosis-related group (DRG) from the preceding acute care stay[4]; and geographic region (state or census region[5]). Data on comorbidities came from the preceding acute care stay, provided that it occurred in the six months prior to the rehabilitation stay. The comorbidites included in our model were identified by Iezzoni et al. (1994) as conditions that are nearly always present prior to hospital admission and hence are extremely unlikely to represent complications arising during the hospitalization. These conditions included primary cancer with poor prognosis, metastatic cancer, chronic pulmonary disease, coronary artery disease, congestive heart failure, peripheral vascular disease, diabetes mellitus with and without end-organ damage, chronic renal failure, nutritional deficiencies, dementia, and functional impairment. All of these comorbidities were included in the logistic regression models for the entire sample; for separate analyses of each tracer condition, the following modifications were made to this list: The hip fracture models excluded metastatic cancer and chronic renal failure; the lower extremity joint replacement models excluded primary cancer with poor prognosis, metastatic cancer, diabetes mellitus with end-organ damage, chronic renal failure, nutritional deficiencies, and dementia; and the stroke models excluded cancer with a poor prognosis, metastatic cancer, and chronic renal failure.

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[4] We included those DRGs that had at least 1 percent prevalence in both the 1999 fitting sample and in the 2002 prediction sample.

[5] State was used as a predictor whenever there were a sufficient number of observed events in the data to allow for it such that the resulting model would be parsimonious. Census region was used to predict post-IRF admission mortality for the stroke, hip fracture, and lower extremity joint replacement samples, due to the relatively small proportion of deaths reported. The 30-day mortality rate in the joint replacement sample was very low, making it difficult to obtain a stable model fit with numerous predictors in the model; thus, geographic region and characteristics of the prior acute stay are omitted from this model.

Complications that were likely to have arisen during the acute care hospital stay were also examined. To develop this list, we began with the list of complications developed by Iezzoni et al. (1994) and adapted it, keeping only those complications that were likely to have continued to affect the patient at the time of acute care discharge and therefore to have influenced whether a patient sought post-acute care. For example, we excluded from the list transient metabolic derangements and side effects of medications. We augmented the list by adding important complications for the Medicare population that had been omitted from Iezzoni's list (for example, Iezzoni's list excluded stroke (for non-stroke patients), delirium, and acute renal failure). The complications that we used in our final analyses included post-operative pulmonary compromise, post-operative gastrointestinal hemorrhage, cellulitis or decubitus ulcer, pneumonia, mechanical complications due to a device, implant, or graft, shock or arrest in the hospital, post-operative acute myocardial infarction, shock/cardiorespiratory event, venous thrombosis and pulmonary embolism, acute renal failure, delirium, stroke (for non-stroke patients only), hip fracture (for non-hip fracture patients only), iatrogenic complications, and sentinel events. We considered adding 43 complications to the models, but retained only those for which at least one percent of cases in 1999 and 2002 had the complication for each tracer condition as well as for the entire sample.

Hypothesis 3: Lower intensity of care. We compared the predicted severity measures for having above-average length of stay and cost per case derived as described above for Hypothesis 2 to the observed percentages of cases having above-average lengths of stay and costs relative to their CMG-comorbidity groups. Declines in the observed resource use measures in 2002 versus 1999, or greater differences in observed resource use than in predicted resource use in 2002 versus 1999, could suggest that providers are stinting on care in response to prospective payment.

5. Results

Hypothesis 1: Following the IRF PPS implementation, fewer patients with particularly costly conditions will be admitted from acute care.

Table 1 shows the number and percent of cases leaving acute care for various post-acute care destinations, including IRFs, within 30 days of being discharged from an acute care hospital, for 1999-2002. The percentage of acute care patients discharged to IRFs is relatively steady during 1999 through 2002 for all of the conditions listed on Table 1 except for patients without a primary respiratory diagnosis who require less than 96 hours of ventilator support during their acute stay, whose rate of discharge to IRFs increased from 7.4% to 8.4%. While all of these rates held steady or increased, the absolute numbers of patients discharged to IRFs increased between 1999 and 2002 for all conditions. The percentage of these acute care cases receiving no formal Medicare-covered care 30 days following the acute stay, denoted by "None of the above" in Table 1, remained steady during 1999 through 2002 for all conditions except organ transplant cases, which increased by 3.4 percentage points between 1999 and 2002.

Table 1
Post-Acute Care Destinations of Persons with Specified Conditions, Number and Percent of Cases, 1999-2002

Ventilator support for 96+ hours

Post-Acute Care Discharge Destination	1999 # cases / %	2000 # cases / %	2001 # cases / %	2002 # cases / %
Home health care	8476 17.2	8564 17.0	8210 15.8	8653 15.4
IRF	5608 11.4	5858 11.6	5797 11.2	6289 11.2
Skilled nursing facility	17862 36.3	18104 36.0	18495 35.6	20092 35.7
Inpatient rehabilitation in acute setting	83 0.17	86 0.17	74 0.14	54 0.10
Long term care	6054 12.3	6729 13.4	7679 14.8	9028 16.1
None of the above	11123 22.6	10992 21.8	11639 22.4	12112 21.5

Table 1 (continued)

Primary respiratory diagnosis with other ventilator support

Post-Acute Care Discharge Destination	1999 # cases / %	2000 # cases / %	2001 # cases / %	2002 # cases / %
Home health care	8439 24.8	7881 24.0	7205 22.0	7798 22.5
IRF	1328 3.91	1344 4.10	1383 4.23	1458 4.20
Skilled nursing facility	8831 26.0	8588 26.2	8647 26.4	9292 26.8
Inpatient rehabilitation in acute setting	26 0.08	16 0.05	15 0.05	8 0.02
Long term care	825 2.43	880 2.68	924 2.82	1082 3.1
None of the above	14540 42.8	14088 43.0	14544 44.5	14979 43.3

Non-primary respiratory diagnosis with other ventilator support

Post-Acute Care Discharge Destination	1999 # cases / %	2000 # cases / %	2001 # cases / %	2002 # cases / %
Home health care	16539 24.6	16524 23.9	15921 21.9	16371 21.7
IRF	4993 7.41	5428 7.85	5847 8.05	6287 8.4
Skilled nursing facility	17295 25.7	17766 25.7	19015 26.2	19819 26.3
Inpatient rehabilitation in acute setting	90 0.13	78 0.11	69 0.1	58 0.08
Long term care	1535 2.28	1833 2.65	2087 2.87	2627 3.5
None of the above	26902 39.9	27540 39.8	29667 40.9	30144 40.0

Organ transplant

Post-Acute Care Discharge Destination	1999 # cases / %	2000 # cases / %	2001 # cases / %	2002 # cases / %
Home health care	1812 22.8	1915 22.3	2136 20.4	2225 76.8
IRF	141 1.77	166 1.93	172 1.65	216 1.9
Skilled nursing facility	134 1.68	136 1.58	154 1.47	141 1.3
Inpatient rehabilitation in acute setting	5 0.06	4 0.05	2 0.02	2 0.02
Long term care	26 0.33	17 0.20	22 0.21	32 0.28
None of the above	5836 73.4	6364 74.0	7968 76.2	8667 76.8

Dialysis

Post-Acute Care Discharge Destination	1999 # cases / %	2000 # cases / %	2001 # cases / %	2002 # cases / %
Home health care	25747 17.6	26276 17.1	25504 15.3	27434 15.6
IRF	5175 3.54	5784 3.77	6123 3.67	6269 3.6
Skilled nursing facility	17626 12.1	18957 12.4	21181 12.7	23978 13.6
Inpatient rehabilitation in acute setting	69 0.05	85 0.06	70 0.04	51 0.03
Long term care	1835 1.25	2212 1.44	2891 1.73	3494 1.98
None of the above	95821 65.5	100018 65.2	110975 66.6	115092 65.3

Table 2 shows the number and percent of IRF cases with selected conditions as defined by their preceding acute care stay (or in any acute care stay for the organ transplant cases) during the six months prior to IRF admission. The numbers of cases in the entire IRF population and for each condition increase until 2002, though the percent of IRF cases with each condition either holds steady or very slightly decreases across the years for each condition listed in Table 2. Tables 1 and 2 combined suggest that no major changes are occurring with respect to realized access to IRF care for patients with these conditions.

Table 2
Number and Percent of Cases Seen in IRFs with Particular Conditions, 1999-2002

Condition	1999 # cases / %	2000 # cases / %	2001 # cases / %	2002 # cases / %
Ventilator support for 96+ hours	7114 1.8	7264 1.8	7142 1.6	7663 1.6
Primary respiratory diagnosis with other ventilator support	1460 0.4	1439 0.3	1453 0.3	1584 0.3
Non-primary respiratory diagnosis with other ventilator support	5464 1.4	5859 1.4	6238 1.4	6637 1.4
Organ Transplant	290 0.1	322 0.1	353 0.1	423 0.1
Dialysis	10583 2.7	11374 2.7	11922 2.7	11631 2.5
Total IRF cases with a preceding acute stay in last 6 months	370405 95.2	396079 95.6	428375 95.9	455487 96.2
Total IRF cases	389266 100	414494 100	446532 100	473696 100

Hypothesis 2: More severe cases will have reduced admission rates under the IRF PPS. Specifically, relatively severe cases within case mix and comorbidity groups may experience reduced access to IRF care.

Table 3 shows the percent of patients in 1999 and 2002 predicted to be more severely ill than other patients in their CMG and comorbidity group based on length of stay, cost, and FIM™ scores, as well as predicted probabilities of death within 30 and 150 days of IRF admission. We examined predicted severity on all conditions as well as separately for stroke, hip fracture, and lower extremity joint replacement patients. In 1999, 42.9% of the cases were predicted to have a length of stay greater than the average

Table 3
Predicted Proportions of Inpatient Rehabilitation Patients Who Are Relatively Severe

Entire Sample	**1999 %**	**2002 %**	**% Change from 1999**	**Std. Error of Change**	**C statistic**
Longer length of stay	42.9	43.4	1.1	0.0024	0.625
Greater cost per case	41.1	42.5	3.4	0.0023	0.633
Lower FIM™ motor score	49.9	49.3	-1.2	0.0025	0.555
Lower FIM™ cognitive score	42.0	41.2	-1.9	0.0024	0.636
Lower FIM™ total score (motor + cognitive)	45.8	45.3	-1.2	0.0023	0.590
Greater probability of death (30 days)	2.8	2.7	-2.8	0.0009	0.750
Greater probability of death (150 days)	10.3	9.9	-4.1	0.0014	0.756
Sample size of prediction samples	363542	446002			
Stroke	**1999 %**	**2002 %**	**% Change from 1999**	**Std. Error of Change**	**C statistic**
Longer length of stay	46.1	46.9	1.6	0.0145	0.624
Greater cost per case	44.6	46.3	3.6	0.0147	0.622
Lower FIM™ motor score	50.5	50.2	-0.7	0.0148	0.568
Lower FIM™ cognitive score	49.4	50.0	1.1	0.0144	0.612
Lower FIM™ total score (motor + cognitive)	47.9	48.3	0.7	0.0146	0.601
Greater probability of death (30 days)	3.0	2.9	-1.8	0.0036	0.652
Greater probability of death (150 days)	10.7	10.5	-1.6	0.0058	0.655
Sample size of prediction samples	58798	57379			
Hip Fracture	**1999 %**	**2002 %**	**% Change from 1999**	**Std. Error of Change**	**C statistic**
Longer length of stay	45.6	45.5	-0.3	0.0194	0.660
Greater cost per case	44.8	46.4	3.6	0.0201	0.657
Lower FIM™ motor score	51.1	50.5	-1.2	0.0203	0.574
Lower FIM™ cognitive score*	45.0	45.0	0.0	0.0197	0.661
Lower FIM™ total score (motor + cognitive)	46.9	46.6	-0.7	0.0199	0.635
Greater probability of death (30 days)	2.0	2.0	1.4	0.0046	0.710
Greater probability of death (150 days)	7.9	7.7	-2.1	0.0077	0.720
Sample size of prediction samples	41557	45688			
Lower Extremity Joint Replacement	**1999 %**	**2002 %**	**% Change from 1999**	**Std. Error of Change**	**C statistic**
Longer length of stay	41.6	41.9	0.7	0.0098	0.665
Greater cost per case	39.0	40.6	4.1	0.0100	0.679
Lower FIM™ motor score	46.2	45.8	-0.8	0.0104	0.567
Lower FIM™ cognitive score	30.7	30.4	-1.0	0.0096	0.618
Lower FIM™ total score (motor + cognitive)	40.6	40.0	-1.5	0.0103	0.572
Greater probability of death (30 days)	0.3	0.3	-2.3	0.0006	0.673
Greater probability of death (150 days)	1.1	1.1	-3.0	0.0018	0.723
Sample size of prediction samples	71480	107124			

* Change is not statistically significant ($p > 0.001$).

length of stay for their CMG and comorbidity status, while, in 2002, 43.4% of the cases were predicted to have greater than average length of stay. These years differed by 0.5 percentage points, or a 1.1 percent increase. The small difference suggests that there was not a meaningful change with respect to this severity measure between 1999 and 2002; given the large sample size, almost all of our comparisons, including this one, are statistically significant, and we therefore note on the table those results that are not statistically significant at the p=0.001 level. The greater than average cost indicator suggests that patients were more severely ill in 2002, with increases ranging from 3.4 to 4.1 percent for the conditions shown on Table 3, suggesting that cases in 2002 were slightly more severe than those in 1999. The differences between 1999 and 2002 with respect to the percentages of cases that are more severe, based on having lower predicted FIM™ scores, ranged from -1.2 to -1.9 percent for the universe (or, a range of 0.5-0.8 points on the FIM™ score scale), indicating that cases were relatively comparable with respect to these severity measures. The largest differences were seen for the measure of high probability of death (150 days post-IRF admission); the lower percentage in 2002, 9.9 percent, suggests that patients in that year are slightly less severe than those in 1999, where the predicted probability of death was 10.3 percent. This result, combined with the finding that patients were predicted to have relatively higher costs, suggests that better functioning patients who are most likely to benefit from inpatient rehabilitation care are increasingly being seen following IRF PPS implementation. The results for stroke, hip fracture, and lower extremity joint replacement patients largely mirror those of the full sample, though the differences with respect to predicted FIM™ cognitive score and total score and death probabilities are less than what is observed for the full sample.

The final column on Table 3 provides the c-statistic for each logistic regression prediction model from which the severity measure is predicted. The c-statistic is a measure of the predictive ability of the model; its range is 0.5 (for no predictive ability) to 1 (for perfect predictive ability). Most of the c-statistics on Table 3 are in the range of 0.6-0.7, indicating that these models have relatively low predictive performance; models with c-statistics below 0.6 are particularly poor predictors. This relatively low predictive performance is not surprising given that we have already conditioned on CMGs and comorbidity status, as these were designed to reflect the relative severity of cases. The models of probability of death have better predictive power, with c-statistics over 0.7 for most of the mortality outcomes.

We verified that the relationship between predicted severity in 1999 and 2002 held for a constant set of IRFs that were in our samples for both of these years. The results were quite similar to those presented in Table 3 and thus we do not include them here. We conclude from this finding that changes in the set of IRFs that treated patients between 1999 and 2002 do not explain the differences between the two years.

Hypothesis 3: Patients will receive a lower intensity of care under the IRF PPS.

Reductions in resource use, as indicated by length of stay and cost per case, could be indicative of moral hazard effects. Our analytical strategy to explore this hypothesis was to compare observed percentages of cases having greater than average length of stay and cost per case versus predictions of these quantities to assess whether cases may be inappropriately receiving lower levels of care. This analysis was constrained to the matched sample cases, since CMG assignments can be made only for the cases with FIM™ data. We therefore had to confirm that the sample of cases in 1999 could be compared to that of 2002. The first two sets of columns of Table 4 show that the 1999 and 2002 samples can indeed be compared for this analysis – the predicted proportions of relatively severe cases in the 1999 and 2002 universe agree with those for the samples, suggesting that the case mix of the sample and universe agree in each year. Next, we

compared the predicted proportions of cases with relatively large length of stay and cost (middle two columns of Table 4) to the observed proportions (last two columns of Table 4). The observed percent of more severe patients in 2002 is much lower than the predicted percent; while the predicted percent of cases with greater than average lengths

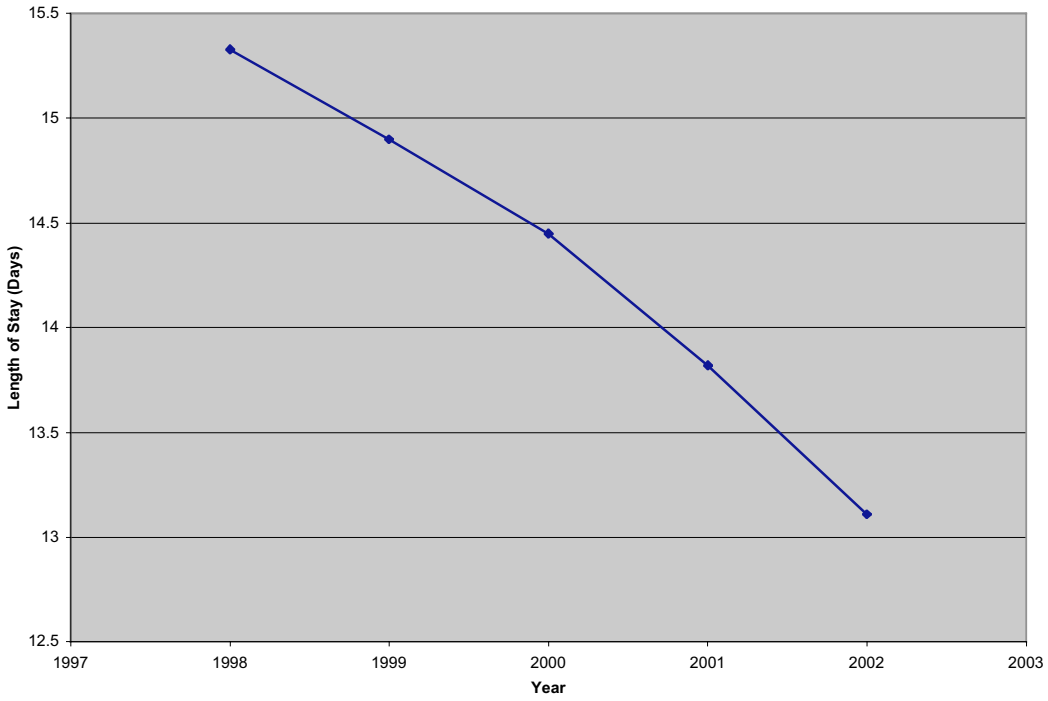
Table 4
Comparison of the Predicted Percent of Relatively Severe Cases with Respect to Length of Stay and Cost Per Case. Number and Percent of Cases

Entire sample		**Predictions for universe**		**Predictions for sample**		**Observed**	**for sample**
		1999	**2002**	**1999**	**2002**	**1999**	**2002**
Longer length of stay	n	363542	446002	240636	432865	240636	432865
	%	42.9	43.3	42.9	43.4	42.9	30.3
Greater cost per case	n	363542	446002	234393	423717	234393	423717
	%	41.1	42.4	40.6	42.5	40.6	38.2
Stroke		**Predictions for universe**		**Predictions for sample**		**Observed**	**for sample**
		1999	**2002**	**1999**	**2002**	**1999**	**2002**
Longer length of stay	n	58798	57379	38952	55635	38952	55635
	%	46.1	46.9	46.3	46.9	46.3	35.5
Greater cost per case	n	58798	57379	37980	54432	37980	54432
	%	44.6	46.3	44.2	46.2	44.2	42.5
Hip Fracture		**Predictions for universe**		**Predictions for sample**		**Observed**	**for sample**
		1999	**2002**	**1999**	**2002**	**1999**	**2002**
Longer length of stay	n	41557	45688	26621	44390	26621	44390
	%	45.6	45.5	45.4	45.6	45.4	32.0
Greater cost per case	n	41557	45688	25927	43468	25927	43468
	%	44.8	46.4	44.1	46.5	44.1	42.1
Lower Extremity Joint Replacement		**Predictions for universe**		**Predictions for sample**		**Observed**	**for sample**
		1999	**2002**	**1999**	**2002**	**1999**	**2002**
Longer length of stay	n	71480	107124	48432	104330	48432	104330
	%	41.6	41.9	41.7	42.0	41.7	27.0
Greater cost per case	n	71480	107124	46952	102078	46952	102078
	%	39.0	40.6	38.4	40.7	38.4	36.6

of stay in the 2002 sample is 43.4 percent, the observed proportion is much lower at 30.3 percent. Smaller, though noticeable, decreases in the percentage of patients having greater than average cost per case are observed for the entire sample and for stroke, hip fracture, and lower extremity joint replacement (Table 4). Before concluding that these

observed decreases in length of stay and cost are strictly due to the IRF PPS, the presence of prior trends in these measures must be considered. Figure 1 shows the trend in the average length of stay for the universe of IRF cases during 1998 through 2002. Length of stay fell steadily during 1998 through 2000, and it fell slightly more sharply between 2001 and 2002. Declines in length of stay had also been seen in the early 1990s; length of stay declined by 5.5% during 1990 through 1995 (MedPAC, 1998, Chart 4-17).

Figure 1
Average Length of Stay of IRF Cases, 1998-2002



In addition to examining the relative severity of cases, we also compared the observed averages of length of stay, cost per case, age, and mortality rates for 1999 versus 2002 for the IRF universe. Table 5 shows the observed mean values of the variables from which the measures of being a more severe case were derived as well as two age-based severity measures for the universe. As expected, average lengths of stay decreased by 2002 for all conditions. Average costs per case were lower in 2002 for the entire universe and for the

Table 5
Observed Mean Values of Severity Indicators in Universe, 1999 and 2002

Entire Sample	**1999 Mean**	**2002 Mean**	**Change since 1999**	**Percent change**
Length of stay, days	14.83	13.02	-1.81	-12.2
Cost per case	11180.18	11020.08	-160.10	-1.4
Age (years)	75.98	75.53	-0.45	-0.6
Is the patient older than 85 years?	0.1463	0.1315	-0.0149	-10.2
Mortality (30 days post-IRF admission)	0.0282	0.0252	-0.0030	-10.7
Mortality (150 days post-IRF admission)	0.1034	0.0924	-0.0109	-10.6
Stroke	**1999 Mean**	**2002 Mean**	**Change since 1999**	**Percent change**
Length of stay, days	19.11	17.30	-1.81	-9.5
Cost per case	14913.13	15033.55	120.42	0.8
Age (years)	76.50	76.07	-0.43	-0.6
Is the patient older than 85 years?	0.1442	0.1343	-0.0100	-6.9
Mortality (30 days post-IRF admission)*	0.0296	0.0265	-0.0031	-10.4
Mortality (150 days post-IRF admission)	0.1069	0.0987	-0.0082	-7.6
Hip Fracture	**1999 Mean**	**2002 Mean**	**Change since 1999**	**Percent change**
Length of stay, days	15.31	14.00	-1.31	-8.5
Cost per case	10998.36	11452.71	454.35	4.1
Age (years)	80.84	80.26	-0.58	-0.7
Is the patient older than 85 years?	0.3026	0.2751	-0.0275	-9.1
Mortality (30 days post-IRF admission)*	0.0199	0.0194	-0.0005	-2.6
Mortality (150 days post-IRF admission)*	0.0791	0.0798	0.0007	0.9
Lower Extremity Joint Replacement	**1999 Mean**	**2002 Mean**	**Change since 1999**	**Percent change**
Length of stay, days	10.03	9.16	-0.88	-8.8
Cost per case	7320.74	7599.05	278.31	3.8
Age (years)	74.30	73.57	-0.73	-1.0
Is the patient older than 85 years?	0.0570	0.0466	-0.0104	-18.2
Mortality (30 days post-IRF admission)*	0.0028	0.0025	-0.0003	-9.9
Mortality (150 days post-IRF admission)*	0.0114	0.0104	-0.0009	-8.3

stroke cases. IRF cases are younger in 2002 than 1999 by about half a year, which holds for all three of the tracer conditions as well as for the entire sample. There were very slight decreases in post-IRF admission mortality rates in 2002.

6. Discussion

The severity measures presented here suggest that true case mix, both within and across case mix groups, remained relatively constant between 1999 and 2002, as indicated by the similarity of the prevalence of specified conditions shown in Tables 1 and 2 and by the similarity of predicted probabilities of relatively more severe patients in 1999 and 2002. Thus, realized access to IRF care appears to have been maintained following IRF PPS implementation. The predicted severity measures showed only slight differences between what was observed in 1999 versus 2002, suggesting that cases were only a bit less severe in 2002 versus 1999. The most noticeable differences are that cases were predicted to have higher costs per case under the IRF PPS versus pre-IRF PPS, indicating greater resource use needs. Interestingly, cases in 2002 were predicted to have lower probabilities of death versus those in 1999, suggesting that higher functioning cases that could benefit from inpatient rehabilitation care – and thus required greater resources for recovery – were increasingly being admitted under the IRF PPS.

The observed average length of stay is considerably lower in 2002 for the entire sample as well as for stroke, hip fracture, and lower extremity joint replacement cases; patients were also younger in 2002 and had slightly lower mortality rates in 1999 versus 2002. We found that hip fracture and joint replacement patients were more expensive in 2002 versus 1999 on average, but they were not necessarily more expensive than similar patients had been in 1999; this could be due to shifts that occurred in the proportion of cases admitted to higher-weighted CMGs following IRF PPS implementation that could have moved patients into more expensive CMGs (Carter and Paddock, 2005). Overall, the severity measures suggest that cases really were not meaningfully more severe in 2002 versus 1999.

Decreases in the actual average lengths of stay between 1999 and 2002 were observed, in contrast to the similarity of the predicted proportions of patients expected to

have larger than average length of stay and cost per case in 1999 versus 2002. Length of stay has been trending downward over recent years, with the trend moving further downward after 1999. This overall trend does not suggest an abrupt response to the IRF PPS. Thus, the change between 1999 and 2002 for length of stay appears to have been part of a trend that began prior to 2002. It is possible, however, that changes could have occurred in anticipation of the IRF PPS or in response to other post-acute care payment systems that went into effect around that time.

We did not find evidence that patients treated at IRFs were appreciably more or less severely ill following the IRF PPS implementation versus beforehand. Despite this, we have found that FIM™ scores decreased in 2002 versus 1999 (Beeuwkes Buntin et al., 2005) and other, similar manifestations of coding change have occurred (Carter and Paddock, 2005). Future refinements to the IRF PPS should account for the discrepancies between predicted and observed severity.

Limitations of this study are (a) the models we used to predict relative severity had only fair predictive ability, and (b) the possibility remains that these results are biased due to the occurrence of unobserved selection not captured by the covariates of our model. However, we believe that it is unlikely that providers would be selecting on patient characteristics that are unrelated to the observable covariates included in our models and simultaneously not selecting on observables that are predictive of outcomes. Year-to-year variability in trends warrants continued monitoring of the effects of the IRF PPS.

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