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TECHNICAL REPORT

Effects of Payment Changes on Trends in Access to Post-Acute Care

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Supported by the Centers for Medicare and Medicaid Services

RAND HEALTH

The analyses upon which this publication is based were performed under Contract 500-2004-00033C, entitled "Inpatient Rehabilitation Facility Prospective Payment System Monitoring, Access, and Refinements," funded by the Centers for Medicare & Medicaid Services, Department of Health and Human Services. The contents of this publication do not necessarily reflect the views or policies of the Department of Health and Human Services, nor does the mention of trades names, commercial products, or organizations imply endorsement by the U.S. government. The author assumes full responsibility for the accuracy and completeness of the ideas presented.

Published 2005 by the RAND Corporation
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Preface

Since the inception of the Inpatient Rehabilitation Facility Prospective Payment System (IRF PPS) in 2002, RAND 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 how the implementation of new Medicare post-acute payment systems has affected the use of inpatient rehabilitation facilities, skilled nursing facilities, and home health 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 carried out under the auspices of RAND Health, a unit of the RAND Corporation. Comments or inquiries should be sent to the first author of this report, Melinda Beeuwkes Buntin (Buntin@rand.org). We would like to thank the IRF PPS project team including Grace Carter, Regina Hollins, Dan Relles, Debra Saliba, and Neeraj Sood and CMS staff Philip Cotterill, Susanne Seagrave, and Jeannette Kranacs for helpful comments. For more information about RAND Health, please visit <http://www.rand.org/health/>. The research was conducted in 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.

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Charts

Acronyms

ADC	Average daily census
AHA	American Hospital Association
AIC	Akaike's Information Criterion
AMI	Acute myocardial infarction
BBA	Balanced Budget Act of 1997
BBRA	Balanced Budget Refinement Act of 1999
BIPA	The Benefits Improvement and Protection Act
CMS	Centers for Medicare and Medicaid Services
DRG	Diagnosis-related group
HHA	Home health agency
HHC	Home health care
IPS	Interim payment system
IRF	Inpatient rehabilitation facility
LTCH	Long-term care hospital
MedPAC	Medicare Payment Advisory Committee
MSA	Metropolitan statistical area
PAC	Post-acute care
PPS	Prospective payment system
RUG	Resource utilization group
SNF	Skilled nursing facility
TEFRA	Tax Equity and Fiscal Responsibility Act

Executive Summary

In 1997, Congress mandated the development and implementation of prospective payment systems for post-acute care (PAC PPSs). Its goal was to introduce incentives for efficiency and reduce spending. However, some worried that PAC providers would respond in ways that would reduce beneficiary access to care. This concern was particularly acute for more severely ill patients who may be less profitable than typical patients under these systems. In addition, there were concerns that the PAC PPSs would cause shifts in the burden of care across sites.

This report represents one of the first efforts to examine the cumulative effect of these payment changes on patient access to care. The post-acute care payment system changes we study are the Home Health Agency Interim Payment System (HHA IPS), the Skilled Nursing Facility Prospective Payment System (SNF PPS), the Home Health Agency Prospective Payment System (HHA PPS), and the Inpatient Rehabilitation Facility Prospective Payment System (IRF PPS). We examine "realized access" to care by measuring utilization of Medicare-paid IRFs, SNFs, and HHA care, and how it has changed in response to these prospective payment systems enacted in the late 1990s and early 2000s. For each payment system we look at both the immediate effects of the payment system on the use of the site of care it affected directly, and the longer-term effects of the payment system. In order to account for potential substitution across sites, we also look at the effects of payment system changes on alternative sites of care. Finally, we consider the question of whether more severely ill patients have seen their access to care decline more than other patients as a result of these changes.

The study focuses on elderly Medicare patients discharged from acute care facilities between 1996 and 2003 with a diagnosis of hip fracture, stroke, or lower extremity joint replacement. Models are used to predict the probability of patients going to a post-acute care location (no Medicare post-acute care, IRF, SNF, or HHC) before and after each payment system was enacted, controlling for underlying trends in PAC use, patient characteristics, and discharging hospital characteristics. We assess the importance of the payment system changes in the choice of PAC site by simulating how much each payment system changed the predicted probabilities of using IRF care, SNF care, and HHC.

Our results are displayed in the summary table below. We find that although the effects of the payment systems on the use of PAC varied, most reduced the use of the site of care they

Summary Table
Payment System Changes and Effects

Payment System Implementation Schedule	Date	Changes and Goals	Hypothesized Effects	Observed Significant Effects
Home Health Agency Interim Payment System (HHA IPS)	Oct-97	The IPS was a temporary system put in place by the BBA. Under the interim payment system, HHAs are paid the lesser of (1) actual reasonable costs; (2) the per-visit limits; or (3) the per-beneficiary limits. It was projected to reduce payments to home health agencies by $3.1 billion in FYs 1998 and 1999.	Negative effect on HHA use with implementation and following implementation, especially for severely ill patients. Increase in use of alternative sites over time.	**Hip Fracture:** slight negative implementation effect on HHA use, modest positive time trend effect on IRF use **Stroke:** large negative implementation effect on HHA use, modest negative time trend effect on SNF use, slight negative time trend effect on HHA use **Joint Replacement:** modest negative implementation effect on SNF and HHA use, slight positive time trend effect on IRF use, slight negative time trend effect on SNF and HHA use
Skilled Nursing Facility Prospective Payment System (SNF PPS)	Jul-98	The SNF PPS pays SNFs prospectively on a case-mix adjusted per-diem basis, a change from the former cost-based system. The estimated reduction in SNF payments during the first PPS year averaged 17 percent.	Negative effect on SNF use with implementation and following implementation, especially for severely ill patients. Increase in use of alternative sites over time.	**Hip Fracture:** slight negative implementation effect on IRF use, modest negative implementation effect on SNF use, slight positive time trend effect on HHA use **Stroke:** slight negative time trend effect on SNF use, modest positive time trend effect on HHA use **Joint Replacement:** slight negative implementation effect on IRF use, large negative implementation effect on SNF use, slight positive time trend effect on IRF use, modest positive time trend effect on HHA use
Home Health Agency Prospective Payment System (HHA PPS)	Oct-00	The HHA PPS pays HHAs prospectively on a case-mix adjusted per-episode basis, a change from the former cost-based system with per-beneficiary limits. The HHA PPS was designed to be budget neutral to IPS in FY 2001 (the BBRA postponed the 15% reduction in the budget neutrality target).	Negative effect on HHA use with implementation and following implementation. May increase use of HHC by severely ill patients. Increase in use of alternative sites over time.	**Hip Fracture:** slight negative implementation effect on IRF and HHA use, slight negative time trend effect on IRF use **Stroke:** slight negative implementation effect on IRF use, large negative implementation effect on HHA use, slight positive time trend effect on SNF use **Joint Replacement:** large negative implementation effect on HHA use, slight negative time trend effect on IRF use
Inpatient Rehabilitation Facility Prospective Payment System (IRF PPS)	Jan-02	The IRF PPS pays IRFs prospectively on a case-mix adjusted per-discharge basis, a change from the former cost-based system. The IRF PPS was designed to be budget neutral.	Little effect on use of IRFs overall, may increase use of IRFs by severely ill patients.	**Hip Fracture:** slight positive implementation effect on SNF use, slight negative time trend effect on SNF use **Stroke:** slight positive implementation effect on IRF use **Joint Replacement:** slight positive implementation effect on IRF use, modest positive implementation effect on SNF use, slight negative implementation effect on HHA use

directly affected and boosted the use of other sites of care. However, since these payments systems were implemented nationally, we are limited to an uncontrolled pre/post analysis and cannot draw strong conclusions about the causal effects of payment changes. There was a marked decline in the use of home health care with the implementation of the HHA IPS, which persisted in the period following its implementation for stroke and joint replacement patients. Similarly, the implementation of the SNF PPS was associated with a significant decline in SNF use for hip fracture and joint replacement patients and an increase in HHC use over time for all three conditions. As anticipated, use of HHC decreased with the implementation of the HHA PPS for all three conditions. In the period after the HHA PPS implementation there was an increase in use of SNF care for stroke patients. The IRF PPS was associated with greater SNF and IRF use for joint replacement patients. In the period following the IRF PPS, there is evidence of a trend away from SNF use for hip fracture patients.

We also ran a model that included interactions for more severely ill patients with the payment system variables to see if they were differentially affected by the changes in payment systems giving facilities incentives to constrain costs and avoid unprofitably expensive patients. Including these 10 interaction variables across three PAC location choices resulted in only a few weakly significant effects so these payment system changes do not appear to have affected the severely ill more than others. This may be because many of the new payment systems during this time were case mix adjusted, while the prior payments were cost-based with per-beneficiary limits. While this is good news, continued attention should be given to this issue in the future. In addition, it is also interesting to note that the changes described above were least significant and pronounced for hip fracture patients and most pronounced for stroke patients. This is a cause for concern because stroke patients are the group for whom there is the most evidence that aggressive post-acute care rehabilitation produces better outcomes.

Overall, most of the payment system changes that were intended to contain costs had the effect of decreasing the use of the site of care directly affected. But in many cases they also had the effect of increasing the use of alternative care sites. These changes do not, however, appear to have affected the severely ill more than others.

Introduction

Post-acute care (PAC) was the fastest growing category of Medicare spending from the early 1990s until the Balanced Budget Act of 1997 and subsequent Balanced Budget Refinement Act of 1999. These Acts of Congress altered Medicare's PAC payment policies dramatically, shifting reimbursements for providers from a cost basis to prospective payment systems (PPSs). The PAC PPSs were designed to introduce incentives for efficiency and to reduce spending, but there are concerns that PAC providers and facilities have, and will, respond to them in ways that negatively affect beneficiary access to appropriate care. In addition, there are concerns that the PAC PPSs could cause shifts in the burden of care across sites.

Early evidence suggests that the payment changes are constraining use and containing overall costs without changing gross patient outcomes (McCall et al., 2003; MedPAC, 2003a). However, policymakers remain concerned that the payment changes are causing shifts in sites of care that could harm patients. The need to monitor access to PAC care generally, and Inpatient Rehabilitation Facility (IRF) care specifically, has been voiced many times. It was emphasized in CMS' final rule for the IRF PPS, and more recently in a special issue of the Milbank Quarterly on disability issues (Dejong et al., 2002). Dejong et al. specifically pointed to the need to monitor the volume of care delivered in each PAC setting and the need to monitor access to care after acute discharge. MedPAC reports have also called for the monitoring of PAC use across sites and for multivariate analyses of PAC use and trends (2002, p. 23; 2003, pp. 93, 113; 2004, p. 141). These concerns are compounded by a general lack of clinical consensus about what types of PAC are appropriate for which patients, which may leave patients particularly exposed to financial pressures (Jette and Keysor, 2002).

In this report we address these concerns by investigating the effects of all of the major changes in post-acute care payment systems on patients' use of care. We do so looking at all patients discharged from acute care with selected conditions, over a long period of time (1996 through 2003), and using multivariate models that control for changes in case mix and other factors. We also examine the effects of payment changes on more versus less severely ill patients to see if patients expected to be more costly are differentially affected by the payment changes.

Background

The goal of post-acute care is to restore recently hospitalized patients to their prior level of functioning. It is also used to improve the transition from hospital to the community; post-acute care facilities provide services to patients needing additional support to assist them to recuperate following discharge from an acute hospital.

Patients can access PAC services in many settings including skilled nursing facilities (SNFs), inpatient rehabilitation facilities (IRFs) and patients' homes with services from home health agencies (HHAs).[1] Each of these settings offers a different level of care. IRFs provide intensive rehabilitation (three or more hours a day of therapy) in an inpatient setting. SNFs can also provide inpatient rehabilitation under the Medicare benefit, although it is generally less intensive than that provided in an IRF (Gage, 1999). Home health agencies provide therapy, nursing care, and assistance from home health aides.[2]

Interest in post-acute care has risen with the marked increase in its use following the implementation of the acute care hospital PPS. Between 1988 and 1997, Medicare spending for post-acute care services increased at an average annual rate of 25 percent (MedPAC, 2003a). Chart 1 shows the trends in total Medicare spending on post-acute care over time, and spending by post-acute care setting as a percentage of total Medicare spending. This increase was due to both a shift to PAC as a way to reduce length of stay after the acute care prospective payment system was put in place, as well as class-action lawsuits which liberalized the definitions of eligibility for service provision and coverage (*Fox v. Bowen* 1986 and *Duggan v. Bowen* 1988) (McCall et al., 2003; Chan et al., 1997; Manton et al., 1993; Steiner and Neu, 1993; Neu et al., 1989; Lewis et al., 1987).

Medicare beneficiaries frequently use post-acute care: 40 percent of beneficiaries used post-acute care following hospital discharge in 1996, in 2001 the number was down slightly but PAC was still used by a third of hospitalized beneficiaries. Total Medicare spending on PAC in 1996 was $35.7 billion, up from $14 billion in 1994. After myriad reforms in the post-acute care payment systems, this figure declined in 1999 due to reductions in home health use but reached

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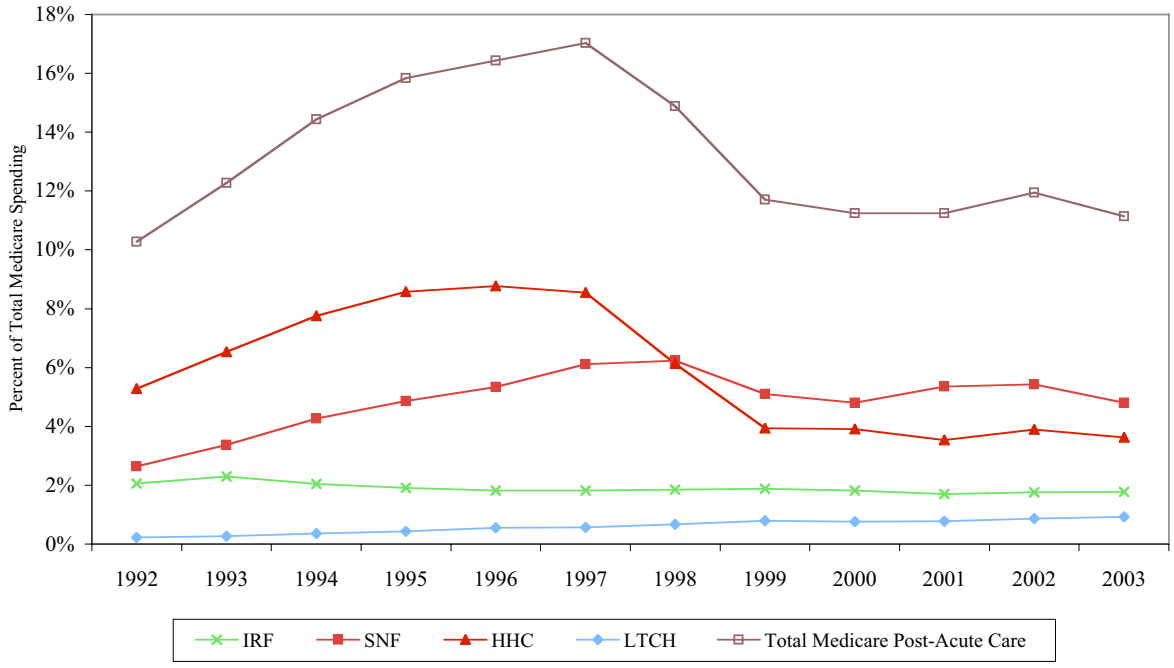
[1] Services provided in long-term care hospitals (LTCHs), outpatient departments, clinics, or physicians' offices could also be considered post-acute care under some circumstances. Custodial care provided in nursing homes can be provided to patients when they leave the hospital, but it is generally considered long-term care rather than post-acute care.

[2] A distinction is usually made between home health care that occurs post-hospitalization and that which is "community-referral." Here we do not examine home health use that is not preceded by an acute care discharge.

$30.6 billion in 2001 and is on the rise again. Post-acute care currently makes up about 12 percent of Medicare's total spending (MedPAC, 2003a). Given the amount of money spent on post-acute care, it is important to understand access to and use of this benefit, and how it has responded to recent payment system changes.

Chart 1
Spending on Post-Acute Care by Setting as Percentage of Total Medicare Spending, 1992 to 2003



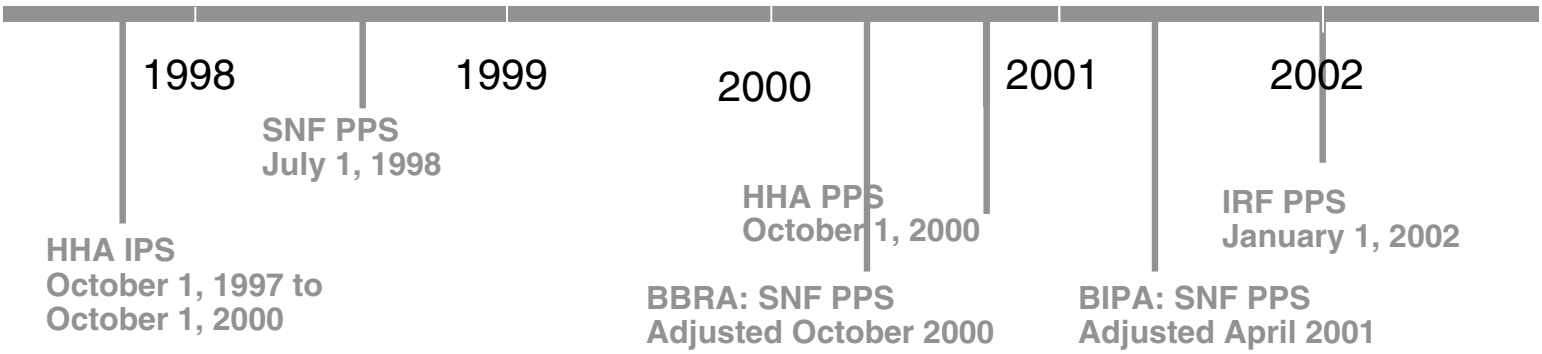
Notes: Dollars are program spending figures and do not include beneficiary copayments. Spending for 2002 and 2003 is estimated.
Source: CMS, Office of the Actuary.

Payment System Changes

As prospective payment systems are implemented in post-acute care settings, they are altering trends in use. The amount of services provided by each facility type has responded to changes in the payment systems (Street et al., 2003; McCall et al., 2003; White, 2003; Cotterill and Gage, 2002). The BBA of 1997 immediately put in place an interim payment system (IPS) for home health services which limited reimbursement by both reducing the per-visit cost limits in place and adding an aggregate per-beneficiary payment limit (McCall et al., 2003). In July 1998 the SNF prospective payment system was the first permanent post-acute care PPS implemented (Cotterill and Gage, 2002). Previously, SNFs had received per-diem payments plus reimbursement for ancillary services including rehabilitation therapy. Under the PPS, SNFs are

paid on an all-inclusive per-diem basis. The prior payment system (under TEFRA—the Tax Equity and Fiscal Responsibility Act) was based on cost, while the new payment system is prospective and case mix adjusted. SNF PPS payment rates were intended to achieve substantial budgetary savings.

The prospective payment systems for home health services and inpatient rehabilitation facilities have been in place since October 1, 2000, and January 1, 2002, respectively. Under the home health PPS, HHAs are paid for 60-day episodes. The HHA PPS was designed to be budget neutral to the HHA IPS until October 2002 when it was subject to a 15 percent reduction in the per-beneficiary spending limits. The IRF PPS was also designed to be budget neutral, and one of its goals was to compensate IRFs fairly for more severely ill patients. Previously, facility payments were based on historical cost per discharge, and were not adjusted for case mix. Under the IRF PPS, facilities are paid an adjusted amount per discharge. The amount is adjusted based on case mix and facility characteristics. The timeline below shows when each of these payments systems was implemented and the Balanced Budget Refinement Act (BBRA) and the Benefits Improvement and Protection Act (BIPA) implementations, which represented major adjustments.[3]



Trends in the Use of Post-Acute Care

Medicare spending for PAC services in aggregate declined by almost 10 percent between 1996 and 2001, due primarily to a nearly 50 percent decline in spending for home health services following the BBA. Over the same time period, the total number of beneficiaries using PAC decreased by 18 percent, from 4.3 to 3.5 million users (MedPAC, 2003a). However, use of all

[3]The long-term care hospital PPS was implemented October 1, 2002. The effects of the LTCH PPS are not addressed here.

post-acute care other than home health care increased between 1996 and 2001. Between 1996 and 2001, aggregate payments for SNF services increased by 37 percent and aggregate payments for IRF services increased by 20 percent (MedPAC, 2003a). Total Medicare spending for SNF services in fiscal year 2002 was $14.5 billion, about 5.6 percent of total Medicare spending for all services (MedPAC, 2004). Another interesting trend during this period was a significant increase in the proportion of users 85 years and older who used PAC. Other demographic characteristics remained relatively constant between 1996 and 2001 (MedPAC, 2003a).

The effects of prospective payment on different types of patients and on the care provided once PAC is accessed has been the focus of prior research. Angelelli et al. (2002) observed a small decrease in the proportion of the costliest patients admitted to SNFs in 1999 in Ohio compared with pre-BBA years, a decrease in home health care use, and no changes in rehospitalization rates for the costliest patient types. McCall et al. (2003) observed that changes in treatment patterns included more beneficiaries receiving no post-acute care, much less use of home health services both initially and after institutional post-acute care, and slightly more use of rehabilitation and long-term care hospitals. However, no consistent increases in adverse outcomes were observed. MedPAC (2004) has also been focusing on access to care and found that while the majority of beneficiaries appear to have little or no delay in accessing SNF services, beneficiaries needing certain types of complex care or special services (for example, IV therapy, dialysis, specialized beds, expensive prescription drugs, or specialized feeding) may experience delays of a few days, weeks, or longer in accessing these services. MedPAC (2004) also found that nearly 90 percent of the beneficiaries surveyed about their experiences in 2000 reported that they had little or no problem with accessing home health services. MedPAC plans to continue to monitor access to HHC and financial incentives to provide care to the most complex patients.

Regarding the level of care received, White (2003) observed that following the implementation of the SNF PPS, SNF residents were more likely to receive moderate levels of rehabilitation and less likely to receive either no rehabilitation or an extremely high level of rehabilitation. White also observed that freestanding and hospital-based SNFs responded differently to the PPS. For-profit freestanding SNFs reduced average rehabilitation charges per resident by 47 percent between 1997 and 2000 while non-profit freestanding SNFs reduced average rehabilitation charges by 23 percent. Hospital-based SNFs slightly increased

rehabilitation charges per resident per day over this period. Yip et al. (2002) found that patients admitted to three SNFs in southern California after PPS implementation were more likely to have orthopedic problems or stroke and poorer self-reported physical health. They had significantly shorter lengths of stay in rehabilitation and received significantly less therapy.

Examining changes before and after the implementation of prospective payment for SNFs and HHC, MedPAC found substantial declines in the use of HHC, and increases in use of SNFs and other PAC providers. This indicates some practical "substitutability" between post-acute care settings. There is little to indicate that these settings necessarily produce the same outcomes, but in practice there is evidence of one setting being used instead of another. This may be due to changes in patterns of medical care that have led to substantial overlap in the types of services furnished by different Medicare-recognized acute and post-acute care providers (Young, 1997). For some diagnoses, MedPAC observed that SNF use in 2001 may be partly replacing home health services. For example, for septicemia discharges (Diagnosis-related group (DRG) 416), home health use declined from 21 to 10 percent, while SNF use increased from 21 to 27 percent (MedPAC, 2003a). Cotterill and Gage (2002) suggested that some portion of the increase in utilization of IRF services between 1997-1998 and 2000 may have been influenced by implementation of the SNF PPS and HHA IPS at that time. The staggered PPS implementation dates may have caused variation in fiscal pressures across settings over time and shifts in sites of care (Bronskill et al., 2002; Cotterill and Gage, 2002). Clearly, there has been a surge in research regarding post-acute care, but there remains a gap in the literature on the cumulative effects of the PAC payment system changes (McCall et al., 2003; White, 2003; Angelelli et al., 2002; Komisar, 2002; Stineman, 2002; Yip et al., 2002).

Conceptual Framework

Our goal is to measure access to PAC and how it changed with the implementation of Medicare's new payment systems. Access to care is a measure of the quality of the care process, is a precursor to good quality of care, and is valued as a positive outcome in its own right. Access is usually defined in terms of adequate availability of care, timeliness of care use, and use of needed services. In this report, we examine "realized access" as represented by utilization of post-acute care (Andersen et al., 1983; Lurie, 2002).

The evidence suggests that different payment changes may have different effects depending on their magnitude, timing, and design. We examine changes in realized access to post-acute care following the five major payment system changes that took place during the 1996 to 2003 period. The post-acute care payment system changes we study are the HHA Interim Payment System (1997), the SNF Prospective Payment System (1998), the HHA Prospective Payment System (2000), and the IRF Prospective Payment System (2002). We also look at the Balanced Budget Refinement Act and the Benefits Improvement and Protection Act, which boosted SNF payment rates in 2000 and 2001, respectively. For each payment system we look at both the immediate effects of the payment system on the use of the site of care it affected directly, and on the longer-term effects of the payment system since changes may unfold as providers learn about and adapt to the system. Given the potential for substitution across sites, we also look at the effects of payment system changes on alternative sites of care. As described above, the payment systems varied markedly in their design. They used different units of payment: the SNF PPS per diem encourages providers to limit their expenditures per day, but does not provide an incentive to limit length of stay. The HHA PPS provides an incentive to limit expenditures per episode and the IRF PPS pays per discharge. Also, some had provisions aimed at controlling costs more aggressively than others. The AHA projected that the HHA IPS would save $3.1 billion in 1998 and 1999 and in the final rule CMS estimated that the SNF PPS would save $30 million in 1998 (AHA, 1998). In contrast, the IRF PPS was designed to be budget neutral. Nonetheless, all of the prospective payment systems share the feature that providers who deliver care that costs less than the case payment, or serve patients who are less costly than the average patient in their payment group, can keep the difference as profit. Ellis and McGuire (1996) discuss this range of actions that providers can take in response to the implementation of prospective payment: the one we examine here is *selection* behavior.

Providers engaging in selection change their admission policies so as to restrict access for patients not likely to be profitable. In order to examine whether there is evidence of selection behavior we create a composite measure of patient illness severity and examine whether trends in care use for these more severely ill patients differed from those of less severely ill patients.

Finally, in order to model the changes in PAC use and to relate them correctly to payment system changes versus changes due to other factors, it is important to understand the determinants of PAC use. Researchers have found a number of patient-level, provider-specific, and area factors affect the use of PAC and choice of post-acute care sites. Individual demographic and clinical characteristics are important determinants of PAC use. Factors including age, gender, race, marital status, functional status, history of disability, medical condition, and comorbidities influence the sites to which patients are discharged (Neu et al., 1989; Manton et al., 1993; Steiner and Neu, 1993; Kane et al., 1996; Lee et al., 1997; Liu et al., 1998; Gage, 1999; Bronskill et al., 2002; Finlayson, 2002; Shatto, 2002; MedPAC, 2003a); Beeuwkes Buntin et al., 2005). Factors beyond patient characteristics also influence use of post-acute care. These include facility-level predictors such as the volume of Medicare patients served, hospital size, and status as a teaching hospital (Blewett et al., 1995; Neu et al., 1989; Steiner and Neu, 1993; Bronskill et al., 2002). We incorporate measures of these factors into our analyses to control for these effects. PAC supply characteristics play a key role in PAC use as well (Neu et al., 1989; Swan and Benjamin, 1990; Kenney and Dubay, 1992; Dubay, 1993; Steiner and Neu, 1993; Young, 1997; Liu et al., 1998; MedPAC, 2003a). However, since these effects can themselves be altered by payment system changes we do not include them in our models as developing models to account for endogenous effects of this type was beyond the scope of this project.

Hypotheses

The theoretical and observed effects of prospective payment and the goals of the different payment systems led us to the guiding hypotheses listed below.

- The immediate effects of the HHA IPS and SNF PPS, which were intended to constrain cost growth, will be to reduce the use of HHA and SNF, respectively. The HHA IPS limited payments through per-beneficiary limits, while the SNF PPS payments were initially considered less generous than TEFRA payments because they did not reimburse for the actual cost of providing care. Both were projected to produce large savings as described above. Reductions in use will differentially affect more severely ill patients. In addition, over time, the HHA and SNF payment systems will be associated with greater use of alternative sites of PAC (i.e., in the case of the HHA IPS with greater use of IRF and SNF care.)[4,5]
- The HHA PPS will be associated with a negative effect on use of HHC, but may increase use of HHC by severely ill patients since the HHA payments were previously not case mix adjusted. We expect the HHA PPS might also have a negative effect over time on HHC use since CMS introduced further cuts in payments in 2002. In addition, over time, the HHA PPS will be associated with greater use of alternative sites of PAC.
- The IRF PPS, which was designed to be budget neutral, will have little effect on the use of IRF care overall. It might increase use for more severely ill patients since the lack of a case mix adjustment under the prior reimbursement system (TEFRA) could have limited access, and older facilities had been locked into low TEFRA base payments.

Below we describe the data and methods used to explore these hypotheses. Before doing that, however, it is important to note that since these payments systems were implemented nationally, we are limited to an uncontrolled pre/post analysis. Our data and methods thus allow us to look

[4] Facilities with higher costs prior to the implementation of the PPSs would also be expected to respond more strongly to the new incentives. Unfortunately, examining this hypothesis was beyond the scope of this report.
[5] These hypotheses imply additional corollary effects. The hypothesized initial declines in the use of site HHA and SNF care when their payment changes are implemented are expected to shift patients from that setting to others – but primarily to no formal PAC in the short term. The hypothesis that over time alternative sites of care will be used more frequently could then be manifest through further reductions in the site of care directly affected or by patients shifting out of the no formal PAC category.

only at associations between payment changes and changes in realized access. In other words, we are not able to draw strong conclusions about the causal effects of payment changes on care use.

Data and Methods

Sample Studied

We have complete data on all elderly Medicare patients discharged from hospitals between January 1996 and June 2003. Within this group we chose to focus on the largest patient groups using all types of PAC: stroke patients, hip fracture patients, and lower extremity joint replacement patients. These conditions account for approximately 7 percent of Medicare acute care discharges and one-quarter of discharges to PAC. 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. Stroke was defined as intracerebral hemorrhage (431.xx), occlusion and sterosis of precerebral arteries with infarction (433.x1), occlusion of cerebral arteries with infarction (434.x1), and acute but ill-defined cerebrovascular disease (436.xx). Joint replacement was defined using the DRGs for joint replacement procedures (209, 471) minus those patients classified above as hip fracture and minus those with reattachment procedures 84.26, 84.27 and 84.28. (During our base period, the fraction of hip fracture patients receiving a replacement during their initial acute hospitalization increased.) We also examine one medical condition in less detail: congestive heart failure (428.xx). Congestive heart failure was judged by project clinicians to be the most clinically uniform medical cause of admission to acute care that has a reasonable number of patients subsequently admitted to IRF care (approximately 5,000 patients per year).

Measures

Our dependent variable was the first post-acute care site used after discharge from an acute care hospital. We chose to use the first site because a majority of acute care discharges use only one site in their post-acute care episode. Seventy-two percent of our tracer condition population used only one site of care, while 93 percent of all acute care discharges use only one site of care. We considered post-acute care use to be IRF use, SNF use, or HHC that began within 30 days of discharge from acute care and was covered by Medicare.[6] We grouped care

[6] We defined acute care hospitals using Medicare provider numbers. However, we dropped acute care admissions that took place outside of the 50 states plus the District of Columbia and admissions to children's hospitals and psychiatric hospitals and units. We counted critical access hospitals (rural primary care hospitals) as acute care hospitals (provider numbers 1300 to 1399). We also excluded all patients residing in or receiving acute care in the

delivered in swing beds with SNF care. We also constructed files that contain data on patients receiving care in LTCHs for all years, under DRG 462 (rehabilitation) in acute settings for all years, and outpatient settings in 1999 and 2003. After examining the low level of use of LTCHs, outpatient therapy, and DRG 462, we drop them from further analysis. Each of these types of care was defined using Medicare provider numbers and/or claim types.

Patients who were readmitted to the hospital during the 30-day window were kept in the sample but acute care was not counted as a PAC site. Although Medicare rules allow SNF patients to delay entry for more than 30 days after their acute care discharge (in order to gain enough strength to undertake rehabilitation) this did not greatly affect our analyses: 97.3 percent of SNF patients in our sample began SNF care within 30 days of discharge if they used it at all. Patients who died in the hospital or within 30 days of discharge were dropped from the sample. This excluded population was small – 6 percent for hip replacement deaths, 10 percent for stroke deaths, and less than 1 percent of joint replacement patients died within 30 days.[7]

We assembled, and included as independent variables in our models, a wide array of clinical, individual, and discharging hospital characteristics that might affect PAC choices.

Individual Predictors. We identified a number of patient-level characteristics hypothesized to affect use of PAC care and type of PAC used. To allow for non-linear effects of age on PAC use in our models we classified patients into 3-year age bands. We also included gender, race and place of residence (defined as a metropolitan statistical area (MSA), an area adjacent to a MSA, or rural area/not adjacent to an MSA) in our analyses. All of these patient-level predictors were created using fields on the inpatient claims. In addition, we used the Medicare Denominator file to create indicators for whether patients were receiving Medicaid at the time of their acute care admission or within 4 months of discharge. (Those who went on Medicaid soon after discharge were presumed to have been income-eligible for coverage, but not yet enrolled.)

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state of Maryland as that state has its own hospital prospective payment system that makes it impossible to distinguish admissions to IRF facilities from acute admissions. In addition, care delivered in LTCHs often qualifies as institutional PAC as well. We do not analyze LTCHs here, however, since there are relatively few of them. Less than 0.05 percent of Medicare patients discharged from acute care use these facilities, and the facilities do not all provide post-acute care. A few LTCHs, for example, serve a primarily psychiatric population (Liu et al., 2001).

[7] While this population is small, it could be argued that they are a key group of seriously ill patients. However, the data suggests that they are not good candidates for PAC as their rates of PAC use are considerably lower than those of the Medicare population as a whole over the time period examined.

Clinical Predictors. To capture the complexity of patients at the time of hospital discharge we included a large set of comorbidities and complications tailored to our stroke, hip fracture, and joint replacement patients. These were derived from diagnoses on the hospital discharge records. The comorbidities used in our analyses were the chronic conditions 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, severe chronic liver disease, diabetes mellitus with and without end-organ damage, chronic renal failure, nutritional deficiencies, dementia, and functional impairment.

The second type of case mix variable was complications that were likely to have arisen during the hospital. To develop this list, we adapted the list of complications developed by Iezzoni et al. (1994). From that list, we kept only those complications that were likely to have a continued effect after hospital discharge, and therefore to potentially influence the choice of site for post-acute care (e.g., we excluded transient metabolic derangements and side effects of medications). In addition, we augmented the list to include some important complications for the Medicare population that had been omitted from Iezzoni's list. The resulting list of complications included post-operative pulmonary compromise, post-operative gastrointestinal hemorrhage, cellulitis or decubitus ulcer, septicemia, pneumonia, mechanical complications due to a device, implant, or graft, shock or arrest in the hospital, post-operative acute myocardial infarction (AMI), post-operative cardiac abnormalities other than AMI, procedure-related perforation or laceration, venous thrombosis and pulmonary embolism, acute renal failure, miscellaneous complications, delirium, dementia, stroke (for hip fracture and joint replacement patients only), and hip fracture (for stroke and joint replacement patients only).

We also created some condition-specific clinical variables. For hip fracture and joint replacement patients we created indicators of the type of replacement the patient received. Hip fracture patients were classified as having no surgery to pin their hip (i.e., hip replacement), a total replacement, a partial replacement, and/or a revision of a previous joint replacement. We also coded the location of the fracture. For joint replacement patients we coded these indicators, whether they were for a hip or knee, and whether multiple replacements were conducted. For stroke patients we created indicators for the type of stroke.

Characteristics of Discharging Hospitals. Patterns of care and approaches to discharge planning in the acute care hospital can influence the PAC use of patients. Accordingly, we included a number of covariates to capture the orientation of acute care hospitals. They include size (average daily census or ADC), teaching status (resident to ADC ratio), ownership status (government, private non-profit, or for-profit), Medicare patient percentage, case mix index of the hospital, and low-income patient percentage. These measures were created using cost report and provider of service data available from the CMS website.

PAC Payment Changes. Trends in PAC use and the effects of the various PAC payment changes are captured using dummy and index variables. A variable for the number of quarters since the first quarter we observe (here the second quarter of 1996) is included to capture underlying trends in the use of PAC. Dummy variables for the seasons are also included in the model to account for seasonal patterns in the severity of illness of patients presenting with these conditions (Laake and Sverre, 1996; Aronow and Ahn, 2004). Dummy variables for the implementation of the HHA IPS, SNF PPS, the HHA PPS, and the IRF PPS are included to capture the shift in the proportion of patients going to each setting associated with the implementation of these policies. They are set equal to zero before the fourth quarter of 1997, the third quarter of 1998, the fourth quarter of 2000 and the first quarter of 2002, respectively, and set equal to one beginning in those quarters. We also included linear terms for the number of quarters since the implementation of each of these policies to capture changes in the "slope" of the time trend due to phase-in effects and ongoing changes in the use of PAC over time. This variable is set to 1 in the quarter following implementation, and increases by 1 in each subsequent quarter.

This specification is based on a number of assumptions. It assumes that a linear time trend and seasonal dummies can capture pre-change effects. Most importantly, it assumes that the payment system changes have ongoing, incremental, linear effects in all the periods after they are implemented. Thus, for example, it assumes that the effects of later payment changes such as the IRF PPS should be measured only after controlling for the implementation and unfolding effects of all of the prior PPSs. It also assumes that the payment changes we did not include in the model, such as the outpatient hospital PPS, do not affect the care patterns we examined.

Severity. We also ran versions of our models that interacted these payment change variables with indicators for more severely ill persons, defined as those who were predicted to

have a higher probability of death.[8] This indicator is intended to capture patient illness severity in a single variable and these interactions are used to test our hypotheses about the differential effects of prospective payment systems on sicker versus healthier patients. The high probability of death was calculated as follows: 1) all of the health status variables in each model were used to predict death within 150 days of discharge for the sample of beneficiaries who were discharged in the first 215 days of 1999; 2) the coefficients from these models were applied to the whole sample to predict likelihood of death; 3) those with a predicted probability of death in the top 25 percent of the distribution for that condition were considered to have a higher probability of death. We used data from a single year to estimate probability of death so that we had a common model of risk across all years. We also included this composite measure of severity in our models as an additional case mix adjustor.

[8] In order to assess the validity of this severity indicator, we examined IRF resource use and length of for the "high probability of death" group versus the less severe group. We found that the more severely ill patients going to IRFs did have a higher degree of resource use and a longer average length of stay. The severely ill hip fracture and joint replacement patients' cost per discharge was approximately $1,500 more and their length of stay two days longer. For stroke patients, whose costs were more variable within the groups, the difference was not as great.

Statistical Analysis

We first identified hospitalized hip fracture, stroke, and lower extremity joint replacement patients, and then examined how each diagnostic group's sociodemographic and clinical characteristics varied by PAC site used. We also examined how PAC use varied by characteristics of the discharging acute hospital. We then fit multinomial logistic regression models, which allow us to incorporate multiple sites into a single choice model and estimate them jointly, of the form:

$\ln \Omega_{mb}(X) = \ln \frac{\Pr(y = m \mid x)}{\Pr(y = b \mid x)} = \overline{x\beta_{mb}}$, (where b was the comparison group, no Medicare-paid post-acute care). The covariate vector included patient demographics, complications and comorbidities, discharging hospital characteristics, condition-specific factors, a quarter count, a dummy variable and a post implementation quarter count for each payment system change, and a composite measure of severity. This model allows us to see which patient characteristics and payment system changes predicted use of SNF care, IRF care, or HHC after discharge from acute care in a multivariate framework for more and less complex patients.[9] These logit models demonstrated that there are many different kinds of factors affecting PAC use, that those factors differ between our hip fracture, stroke, and joint replacement samples, and that it is critical to use condition-specific models to adjust measures of access. We also fit sequential logistic regression models in which the first level model predicted use of SNF or IRF care versus no Medicare-paid institutional care and the second level predicted use of IRF versus SNF care conditional on the use of institutional care. The predictions from these models were virtually identical to those from the multinomial logit models, so for ease of exposition we have presented only the multinomials.[10] We tested our assumptions about the specification of the payment change and time trend effects by comparing our model to a fully flexible model with a dummy

[9] An alternative analytic strategy would have been to use nested logit models, because of the independence of irrelevant alternatives assumption required with the multinomial logit. We attempted to fit such models, however, we could not estimate them because the only choice-specific attributes of the PAC options available to include in the models were distances from the site to beneficiaries' homes.

[10] The fits were for hip fracture: AIC=1951948 for the two-level model and 1914868 for the multinomial model, for stroke: AIC= 2911411 for the two-level model and 2780111 for the multinomial model, and for joint replacement: AIC= 3160593 for the two-level model and 2858921 for the multinomial.

variable for each quarter. The fit of our "constrained" model was remarkably similar to that of the unconstrained model.[11]

Finally, we assessed the importance of the payment system changes in the choice of PAC site by simulating how much each payment system changed the predicted probabilities of using IRF care, SNF care, and HHC. To look at the effect of payment systems on PAC use we computed standardized predictions in which only payment system effects were varied across all of our observations, and then predicted the odds of using IRF care, SNF care, and HHC for each observation (Lane and Nelder, 1982). The resulting predicted rates of use demonstrate the extent to which our models imply the payment systems shifted patients across PAC sites, holding other factors constant.

[11] The differences in the AICs between the constrained and the unconstrained models were extremely small: 427 for hip fracture; 12 for stroke; and 163 for joint replacement.

Results

Table 1 shows the first site of post-acute care to which beneficiaries with our tracer conditions were discharged after their acute care stay, by year for 1996 to 2003. Patients in our hip fracture, stroke, and joint replacement samples use PAC at high rates. In 2002, over 85 percent of hip fracture and joint replacement patients used some type of Medicare-covered post-acute care within 30 days of their acute care discharge. More than two-thirds of stroke patients used formal PAC. Roughly 22 percent of hip fracture patients and 33 percent of joint replacement patients used IRF care as their first site of PAC. Hip fracture patients were much more likely to use SNF care, however, and stroke patients received home health care at a higher rate than hip fracture patients. Most congestive heart failure patients did not use Medicare-covered PAC in the 30 days after discharge, but of those who did the vast majority used home health care or SNF.

The patterns of use of PAC did, however, change over time. Use of IRF care over this period increased for all four conditions. In contrast, the use of home health care declined for all four conditions although there was a slight increase between 2001 and 2002 for stroke and joint replacement and it appeared to be leveling off in the first half of 2003. The patterns in use of SNF care varied by year: increasing through 1998 and then tailing off through 2003. CHF was an exception to this pattern; SNF use did decline between 1998 and 1999, but increased through 2003. Since the utilization rates of long-term care hospitals, acute care rehabilitation, and outpatient therapy are so low, we do not include patients using those settings in our tables and models discussed below.[12] Use of LTCHs increased over this period for hip fracture and stroke patients but remained below 2 percent.

The characteristics of the hip fracture, stroke, and joint replacement samples are shown in Table 2. The hip fracture sample is older – over half of the hip fracture patients are age 80 or older – and more heavily female, as expected. None of the three groups have a high level of complications, but all three groups have a substantial rate of comorbidities. The hip fracture sample has especially high rates of heart disease, pulmonary disease, diabetes, and dementia.

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[12] Appendix I shows the first type of post-acute care to which beneficiaries with our tracer conditions were discharged after their acute stay in 1999, and includes information on discharges followed by therapy delivered in outpatient settings. These numbers are not directly comparable to those shown in Table 1 since outpatient therapy can occur before the use of other types of care and thus supplant that location as the "first" location post-discharge. It shows that such therapy is rarely the treatment chosen after discharge from acute care for these four conditions. For this reason, we decided not to obtain the Part B files necessary to track the use of outpatient therapy over time. For the rest of our analyses, outpatient therapy is grouped into the no Medicare-paid PAC category.

Table 1
First Location of Post-Acute Care Within 30 Days of Discharge, 1996 to 2003

Hip Fracture Patients	**1996**		**1997**		**1998**		**1999**		**2000**		**2001**		**2002**		**2003**	
First PAC Location	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
No Medicare-Paid PAC	19,026	9.2%	17,246	8.6%	16,324	8.4%	15,674	8.2%	13,936	7.4%	13,679	7.1%	12,064	6.3%	11,852	6.0%
Home Health	19,637	9.5%	15,854	7.9%	12,583	6.5%	12,297	6.4%	11,976	6.3%	11,503	6.0%	11,271	5.9%	11,636	5.9%
IRF	37,475	18.2%	35,064	17.4%	35,252	18.2%	37,192	19.3%	39,307	20.7%	41,107	21.4%	42,720	22.4%	45,942	23.3%
SNF	127,850	62.0%	131,446	65.2%	128,011	66.0%	124,534	64.8%	121,722	64.2%	122,552	63.9%	121,318	63.7%	124,102	63.0%
Acute rehab	413	0.2%	399	0.2%	470	0.2%	619	0.3%	518	0.3%	516	0.3%	322	0.2%	260	0.1%
LTCH	1,854	0.9%	1,502	0.7%	1,407	0.7%	1,898	1.0%	2,026	1.1%	2,497	1.3%	2,852	1.5%	3,174	1.6%
Total	**206,255**	**100%**	**201,511**	**100%**	**194,047**	**100%**	**192,214**	**100%**	**189,485**	**100%**	**191,854**	**100%**	**190,547**	**100%**	**196,966**	**100%**
Death Rate within 30 days of discharge	5.38		5.43		5.68		6.08		6.16		6.27		6.58		6.54	
Rehospitalization Rate within 30 days of discharge	11.53		11.91		12.09		12.87		13.12		13.69		14.22		15.05	
Stroke Patients	**1996**		**1997**		**1998**		**1999**		**2000**		**2001**		**2002**		**2003**	
First PAC Location	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
No Medicare-Paid PAC	76,665	27.4%	73,356	27.2%	74,162	29.3%	72,781	30.1%	69,893	30.5%	77,939	32.0%	75,310	31.3%	75,990	31.3%
Home Health	57,953	20.7%	52,229	19.3%	40,669	16.1%	37,476	15.5%	35,198	15.4%	34,660	14.3%	34,671	14.4%	34,928	14.4%
IRF	56,581	20.2%	54,740	20.3%	51,490	20.4%	51,144	21.1%	49,659	21.7%	51,411	21.1%	52,504	21.8%	53,360	22.0%
SNF	84,957	30.3%	86,532	32.0%	82,967	32.8%	76,638	31.7%	70,355	30.7%	74,440	30.6%	73,364	30.5%	73,480	30.2%
Acute rehab	579	0.2%	523	0.2%	599	0.2%	733	0.3%	592	0.3%	571	0.2%	324	0.1%	266	0.1%
LTCH	3,266	1.2%	2,798	1.0%	2,802	1.1%	3,184	1.3%	3,471	1.5%	4,178	1.7%	4,419	1.8%	4,956	2.0%
Total	**280,001**	**100%**	**270,178**	**100%**	**252,689**	**100%**	**241,956**	**100%**	**229,168**	**100%**	**243,199**	**1.0**	**240,592**	**1.0**	**242,980**	**100%**
Death Rate within 30 days of discharge	8.79		9.11		9.46		9.92		9.89		10.18		10.21		10.69	
Rehospitalization Rate within 30 days of discharge	12.49		12.78		13.01		11.33		15.39		13.99		14.51		14.90	
Joint Replacement Patients	**1996**		**1997**		**1998**		**1999**		**2000**		**2001**		**2002**		**2003**	
First PAC Location	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
No Medicare-Paid PAC	38,131	15.1%	34,586	13.6%	35,282	14.3%	37,114	15.0%	37,983	14.6%	46,662	15.7%	48,812	15.2%	55,324	15.4%
Home Health	68,198	27.0%	61,999	24.5%	54,266	21.9%	54,153	21.9%	56,679	21.8%	63,045	21.2%	69,642	21.7%	80,206	22.3%
IRF	62,360	24.7%	65,644	25.9%	66,338	26.8%	69,556	28.2%	79,714	30.7%	94,317	31.8%	106,256	33.1%	121,288	33.7%
SNF	81,872	32.4%	89,726	35.4%	89,866	36.3%	83,932	34.0%	83,435	32.1%	90,497	30.5%	93,877	29.3%	100,782	28.0%
Acute rehab	576	0.2%	618	0.2%	753	0.3%	1,079	0.4%	785	0.3%	1,008	0.3%	682	0.2%	614	0.2%
LTCH	1,402	0.6%	883	0.3%	747	0.3%	995	0.4%	1,099	0.4%	1,489	0.5%	1,671	0.5%	1,926	0.5%
Total	**252,539**	**100%**	**253,456**	**100%**	**247,252**	**100%**	**246,829**	**100%**	**259,695**	**100%**	**297,018**	**100%**	**320,940**	**100%**	**360,140**	**100%**
Death Rate within 30 days of discharge	0.35		0.40		0.38		0.38		0.37		0.34		0.35		0.32	
Rehospitalization Rate within 30 days of discharge	5.85		6.00		6.08		6.24		6.34		6.49		6.71		6.45	
Congestive Heart Failure Patients	**1996**		**1997**		**1998**		**1999**		**2000**		**2001**		**2002**		**2003**	
First PAC Location	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
No Medicare-Paid PAC	274,364	50.2%	280,013	50.4%	303,721	55.4%	308,482	57.5%	322,526	58.4%	346,059	60.9%	348,030	59.8%	386,030	58.6%
Home Health	199,782	36.5%	193,107	34.7%	157,676	28.8%	144,308	26.9%	139,532	25.3%	124,208	21.9%	129,379	22.2%	149,826	22.8%
IRF	4,681	0.9%	5,285	1.0%	6,201	1.1%	7,265	1.4%	8,216	1.5%	9,181	1.6%	9,999	1.7%	11,748	1.8%
SNF	66,622	12.2%	75,852	13.6%	78,657	14.4%	74,585	13.9%	79,361	14.4%	85,240	15.0%	91,094	15.6%	106,036	16.1%
Acute rehab	65	0.0%	75	0.0%	93	0.0%	115	0.0%	131	0.0%	111	0.0%	62	0.0%	78	0.0%
LTCH	1,331	0.2%	1,553	0.3%	1,710	0.3%	2,178	0.4%	2,587	0.5%	3,084	0.5%	3,748	0.6%	4,636	0.7%
Total	**546,845**	**100%**	**555,885**	**100%**	**548,058**	**100%**	**536,933**	**100%**	**552,353**	**100%**	**567,883**	**100%**	**582,312**	**100%**	**658,354**	**100%**
Death Rate within 30 days of discharge	6.64		6.62		6.73		6.71		6.64		6.72		7.26		7.21	
Rehospitalization Rate within 30 days of discharge	23.77		24.22		24.48		24.93		25.14		25.35		19.60		20.18	

Notes: Table includes all Medicare discharges from acute care including those for patients under 65 years of age and those in the nursing home before their acute stay. Outpatient therapy is not included as a post-acute care site. Those patients receiving only outpatient therapy are grouped in the "No Medicare-Paid PAC" category. We only have 6 months of data for 2003. These data have been calendarized by multiplying by 2.

Table 2
Means of Characteristics , 1996 to 2003

Variable	Hip Fracture Mean	Hip Fracture Standard Deviation	Stroke Mean	Stroke Standard Deviation	Joint Replacement Mean	Joint Replacement Standard Deviation
Demographics						
Female	0.783	0.412	0.598	0.490	0.652	0.476
White	0.936	0.245	0.843	0.364	0.927	0.261
Black	0.036	0.186	0.117	0.322	0.047	0.213
Hispanic	0.008	0.090	0.013	0.113	0.008	0.090
65<=AGE<=67	0.026	0.160	0.071	0.258	0.122	0.327
68<=AGE<=70	0.037	0.189	0.089	0.285	0.152	0.359
71<=AGE<=73	0.057	0.231	0.111	0.314	0.170	0.376
74<=AGE<=76	0.083	0.276	0.129	0.335	0.172	0.378
77<=AGE<=79	0.114	0.318	0.139	0.345	0.152	0.359
80<=AGE<=82	0.140	0.347	0.135	0.342	0.109	0.311
83<=AGE<=85	0.155	0.362	0.120	0.325	0.068	0.252
86<=AGE<=88	0.149	0.357	0.094	0.293	0.035	0.183
AGE>88	0.238	0.426	0.111	0.315	0.019	0.138
Lives in an MSA	0.713	0.452	0.716	0.451	0.692	0.462
Lives adjacent to an MSA	0.157	0.363	0.158	0.365	0.166	0.372
Beneficiary is covered by Medicaid	0.211	0.408	0.206	0.404	0.082	0.275
Complications						
Post-operative pulmonary compromise	0.010	0.102	0.013	0.112	0.005	0.067
Post-operative GI hemorrhage or ulceration	0.007	0.082	0.010	0.098	0.003	0.051
Cellulitis or decubitus ulcer	0.021	0.143	0.017	0.130	0.005	0.072
Septicemia	0.001	0.026	0.001	0.038	0.000	0.018
Mechanical complications due to device or implant	0.008	0.091	0.006	0.076	0.014	0.116
Miscellaneous complications	0.008	0.088	0.001	0.038	0.014	0.116
Shock or cardiorespiratory arrest	0.002	0.043	0.003	0.050	0.001	0.032
Post-op heart attack (AMI)	0.010	0.100	0.009	0.095	0.004	0.061
Post-op cardiac abnormalities other than AMI	0.001	0.037	0.002	0.046	0.001	0.025
Procedure-related laceration or perforation	0.003	0.051	0.004	0.062	0.001	0.036
Venous thrombosis or pulmonary embolism	0.006	0.076	0.004	0.067	0.006	0.077
Iatrogenic complications	0.045	0.207	0.002	0.045	0.047	0.212
Sentinel Events	0.001	0.033	0.001	0.034	0.001	0.036
Comorbidities						
Acute renal failure	0.007	0.086	0.008	0.088	0.004	0.060
Delirium	0.020	0.141	0.013	0.115	0.012	0.108
Cancer with a Poor Prognosis	0.010	0.099	0.009	0.093	0.003	0.054
Metastatic Cancer	0.006	0.075	0.008	0.090	0.001	0.031
Chronic Pulmonary Disease	0.172	0.377	0.126	0.331	0.100	0.300
Coronary Artery Disease	0.207	0.405	0.244	0.429	0.155	0.362
Congestive Heart Failure	0.169	0.375	0.162	0.368	0.055	0.228
Peripheral Vascular Disease	0.041	0.198	0.060	0.237	0.019	0.136
Severe Chronic Liver Disease	0.004	0.064	0.003	0.052	0.002	0.039
Diabetes with End Organ Damage	0.015	0.120	0.033	0.178	0.008	0.087
Chronic Renal Failure	0.008	0.091	0.009	0.095	0.002	0.043
Nutritional Deficiencies	0.022	0.146	0.020	0.138	0.002	0.049
Dementia	0.226	0.418	0.115	0.319	0.012	0.108
Functional Impairment	0.047	0.212	0.297	0.457	0.009	0.096
Diabetes without End Organ Damage	0.134	0.341	0.232	0.422	0.126	0.332
Pneumonia	0.035	0.185	0.047	0.212	0.007	0.086
Stroke	0.006	0.075	--	--	0.002	0.041
Hip fracture	--	--	0.005	0.068	--	--
Composite Measure of Severity	0.255	0.436	0.262	0.440	0.258	0.438
Discharging Hospital Characteristics						
Non-Profit Hospital	0.750	0.433	0.733	0.442	0.779	0.415
Government Hospital	0.116	0.320	0.131	0.337	0.094	0.292
Average Daily Census of Hospital	177.518	159.269	184.966	167.865	197.224	164.922
Resident to ADC ratio of Hospital	0.100	0.210	0.113	0.228	0.130	0.294
Percentage of Low Income Patients	0.130	0.090	0.137	0.098	0.128	2.865
% Medicare days	0.492	0.124	0.495	0.131	0.480	0.123
Case Mix Index of Hospital	1.440	0.227	1.436	0.247	1.520	0.242
Condition-Specific Factors						
Pertrochanteric Fracture	0.492	0.500	--	--	--	--
Total hip replacement	0.029	0.169	--	--	0.290	0.454
Partial hip replacement	0.332	0.471	--	--	0.019	0.138
Total Knee Replacement	--	--	--	--	0.582	0.493
Knee Revision	--	--	--	--	0.051	0.220
Hip Revision	0.002	0.040	--	--	0.059	0.235
Hip Replacement	--	--	--	--	0.367	0.482
Knee Replacement	--	--	--	--	0.632	0.482
Bilateral Procedure	--	--	--	--	0.042	0.200
Basilar Artery Infarct	--	--	0.003	0.055	--	--
Carotid, verterbral, or multiple artery	--	--	0.063	0.243	--	--
Hemoraghic Stroke	--	--	0.073	0.261	--	--

The stroke sample has relatively high rates of heart disease, diabetes, and functional impairment. The joint replacement sample has high rates of diabetes, coronary artery disease, and pulmonary disease. The differences in the characteristics of the areas in which the typical member of these groups live are not notable, but joint replacement patients are discharged from larger hospitals.

Our multinomial logit regression models allow us to see the relationships between individual, patient, and area characteristics and choice of post-acute care location, controlling for other variables. The models also allow us to see whether use patterns emerge around the payment system changes. Using our multinomial models, we constructed case mix adjusted probabilities of use of PAC for our hip fracture, stroke, and joint replacement patients that visually display the effects of the payment systems. Charts 2, 3, and 4 show the adjusted probabilities of discharging hip fracture, stroke, and joint replacement patients to each post-acute care setting. The probability of patients with a hip fracture being discharged without Medicare covered PAC – versus to an IRF, SNF, or HHC – is falling over this time period, while increasing for stroke patients and remaining about the same for joint replacement patients. The probability of going to an IRF increased over time for all three conditions, but especially strongly in joint replacement patients. The probability of going to a SNF peaked in the beginning of 1998 for all three conditions, but fell overall. The probability of using home health care declined for all three conditions, with notable declines associated with the implementation of the HHA IPS and the HHA PPS. Without the payment system changes our models assume that the trends displayed on these charts prior to the first payment system change at the end of 1997 would have continued.

Chart 2
Predicted Probabilites of Hip Fracture Patients Going to Each PAC Location, 1996 to 2003

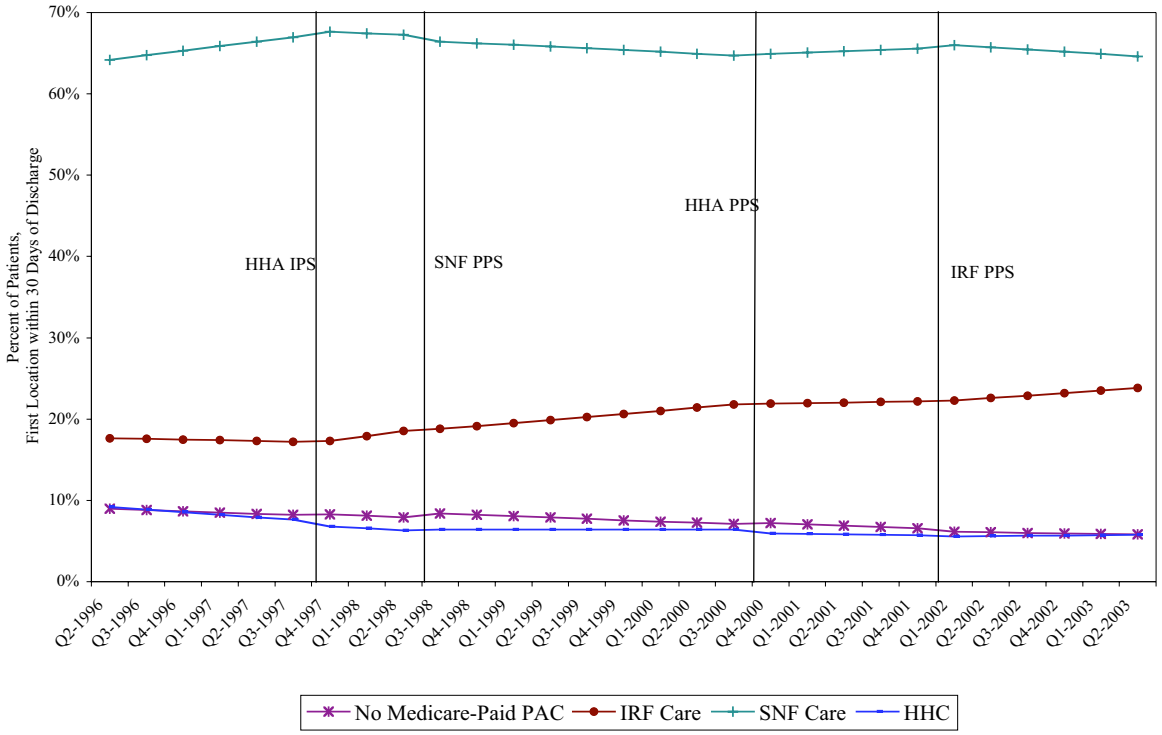


Chart 3
Predicted Probabilites of Stroke Patients Going to Each PAC Location, 1996 to 2003

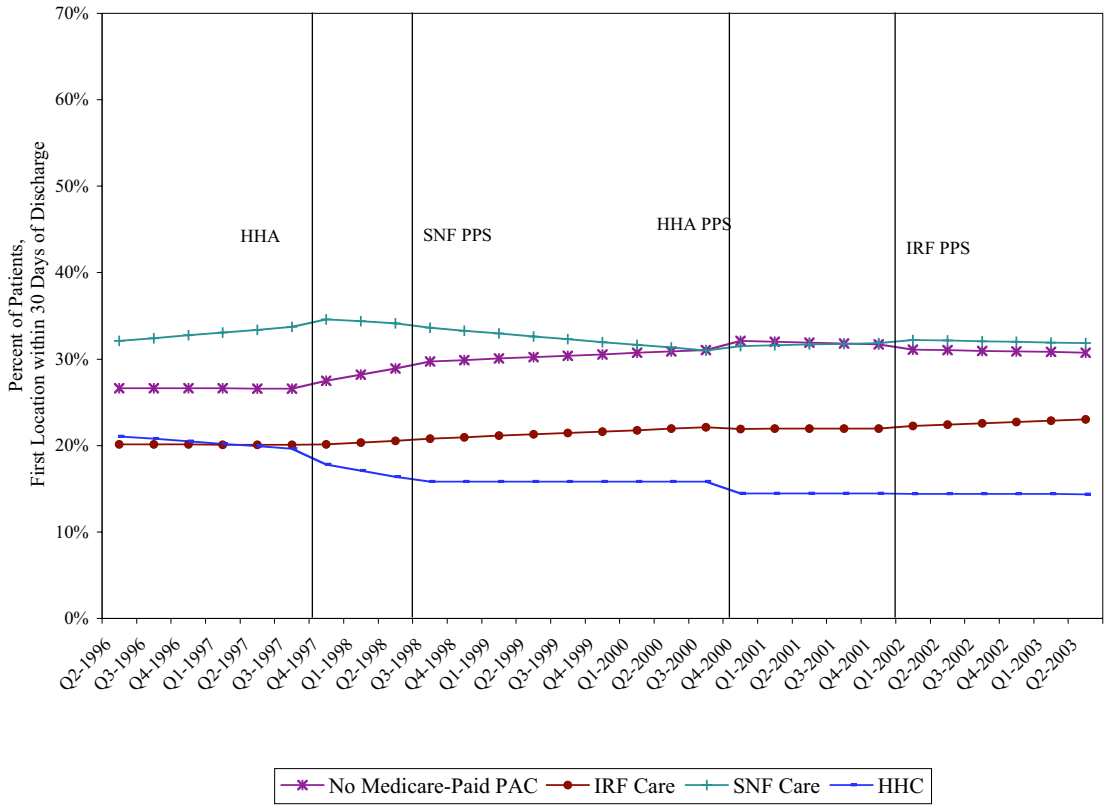
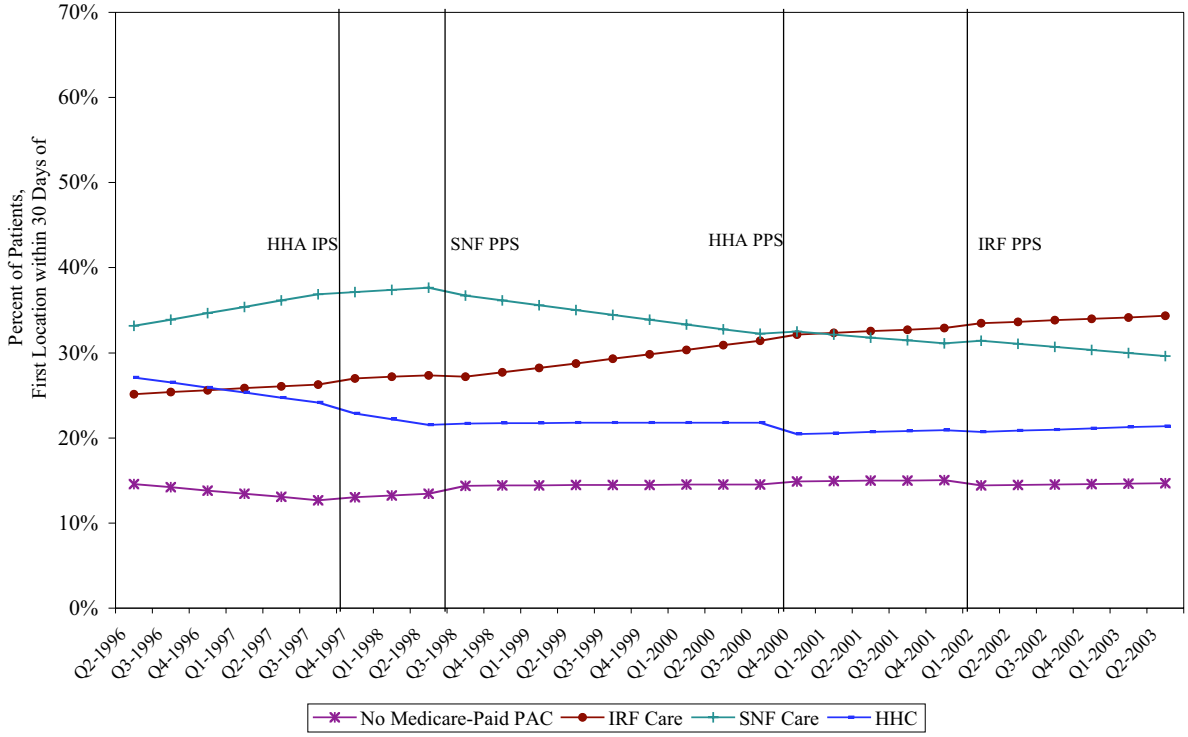


Chart 4
Predicted Probabilites of Joint Replacement Patients Going to Each PAC Location, 1996 to 2003



Tables 3a, 3b, and 3c present the detailed results from these logistic regressions using pooled data for the period January 1996 through June 2003. The results for these select variables show us the significance of the changes in utilization patterns associated with payment system changes. The first set of columns shows the predictors of patients going to IRF care, the second SNF care, and the third HHC. A positive coefficient in the first column of numbers within each set generally indicates that patients are more likely to be discharged to an IRF versus get no Medicare-paid post-acute care (the reference group). The implementation effect coefficients should be interpreted as the shift due to implementation, while the time trend effects should be interpreted as a change in slope for each quarter after implementation. However, because the signs and magnitudes of the effects are difficult to interpret from the multinomial logit regression output, we provide corresponding estimates of the changes in the probability of going to each PAC location in the next three columns. A negative percentage in these columns indicates that the patient was less likely to go to that PAC location after the payment system change noted in the row title. A negative percentage in these columns for a time trend effect shows the predicted change in the probability of going to that site in the post-implementation period, evaluated at the quarter following the implementation.

We also ran a model that included interactions for more severely ill patients with the payment system variables to see if they were differentially affected by the changes in payment systems. Including these 10 interaction variables across three PAC location choices resulted in only a few weakly significant effects, as discussed below. The changes in the other coefficients, including the payment change variables, when these interactions were included were very small in magnitude and the effects were not quantitatively different. The results from these models are, therefore, not shown in the attached tables.

Reviewing Tables 3a, 3b, and 3c, our multinomial logit regression models show significant trends in where patients went after discharge from acute care and how that was affected by the various PAC payment systems implemented between 1996 and 2003. The models show that there was an underlying trend of an increase in use of SNF care across all three conditions. Use of home health care was going down for hip fracture and stroke patients with time, while increasing for joint replacement patients. IRF use was increasing for hip fracture and joint replacement patients.

Table 3a
Multinomial Regressions, First PAC Site, Hip Fracture Patients , 1996 to 2003

				Change in Predicted Probability to Site			
Variable	IRF Coefficient (Std. Error)	SNF Coefficient (Std. Error)	HHC Coefficient (Std. Error)	No Medicare-Paid PAC	IRF	SNF	HHC
Baseline Time Trend (Quarter Dummy)	0.0131 *	0.0276 **	-0.0211 **				
	(.0047)	(.0041)	(.0055)				
HHA Interim Payment System Implementation Effect (10/97)	-0.0173	-0.0231	-0.1040 **	0.18%	0.14%	0.10%	-0.42%
	(.0271)	(.0234)	(.0320)				
HHA Interim Payment System Time Trend Effect	0.0467 *	-0.0071	0.0074	-0.01%	0.68%	-0.67%	0.01%
	(.0161)	(.0140)	(.0195)				
SNF Prospective Payment System Implementation Effect (7/98)	-0.1045 *	-0.0938 *	-0.0297	0.59%	-0.30%	-0.60%	0.30%
	(.0362)	(.0315)	(.0443)				
SNF Prospective Payment System Time Trend Effect	-0.0165	-0.0013	0.0372 *	0.00%	-0.23%	0.00%	0.23%
	(.0154)	(.0134)	(.0188)				
HHA Prospective Payment System Implementation Effect (10/0	-0.0581 *	-0.0345	-0.1245 **	0.28%	-0.24%	0.39%	-0.44%
	(.0227)	(.0203)	(.0283)				
HHA Prospective Payment System Time Trend Effect	-0.0156 *	0.0078	-0.0085	-0.02%	-0.27%	0.34%	-0.05%
	(.0073)	(.0065)	(.0091)				
IRF Prospective Payment System Implementation Effect (1/02)	0.0495	0.0510 *	0.0303	-0.30%	0.05%	0.33%	-0.08%
	(.0283)	(.0256)	(.0355)				
IRF Prospective Payment System Time Trend Effect	-0.0012	-0.0200 *	0.0045	0.09%	0.20%	-0.39%	0.10%
	(.0087)	(.0079)	(.0109)				
Pseudo R^2	0.0746						
Percentage of PAC patients at this location				7.47 %	20.24 %	65.68 %	6.60 %
Sample Size (N)	1,326,537						

Notes: The comparison group is No Medicare-Paid PAC.
* indicates significance at the 0.05 level, ** at the 0.001 level.

Table 3b
Multinomial Regressions, First PAC Site, Stroke Patients , 1996 to 2003

Variable	IRF Coefficient (Std. Error)	SNF Coefficient (Std. Error)	HHC Coefficient (Std. Error)	Change in Predicted Probability to Site: No Medicare-Paid PAC	IRF	SNF	HHC
Baseline Time Trend (Quarter Dummy)	0.0002	0.0120 **	-0.0131 **				
	(.0030)	(.0027)	(.0029)				
HHA Interim Payment System Implementation Effect (10/97)	-0.0284	-0.0185	-0.1200 **	0.85%	0.08%	0.51%	-1.44%
	(.0170)	(.0155)	(.0172)				
HHA Interim Payment System Time Trend Effect	-0.0169	-0.0479 **	-0.0574 **	0.74%	0.24%	-0.54%	-0.43%
	(.0101)	(.0091)	(.0104)				
SNF Prospective Payment System Implementation Effect (7/98	-0.0019	-0.0149	0.0068	0.09%	0.05%	-0.33%	0.19%
	(.0223)	(.0203)	(.0233)				
SNF Prospective Payment System Time Trend Effect	0.0185	0.0179 *	0.0638 **	-0.54%	-0.06%	-0.15%	0.75%
	(.0096)	(.0087)	(.0100)				
HHA Prospective Payment System Implementation Effect (10/(	-0.0465 **	-0.0019	-0.1226 **	0.82%	-0.29%	0.99%	-1.51%
	(.0137)	(.0127)	(.0149)				
HHA Prospective Payment System Time Trend Effect	0.0025	0.0248 **	0.0110 *	-0.26%	-0.16%	0.43%	0.00%
	(.0044)	(.0041)	(.0048)				
IRF Prospective Payment System Implementation Effect (1/02)	0.0333 *	0.0292	0.0115	-0.44%	0.26%	0.30%	-0.12%
	(.0166)	(.0155)	(.0184)				
IRF Prospective Payment System Time Trend Effect	0.0049	-0.0070	-0.0024	0.04%	0.13%	-0.16%	-0.01%
	(.0051)	(.0048)	(.0057)				
Pseudo R^2	0.0855						
Percentage of PAC patients at this location				29.62 %	21.33 %	32.53 %	16.52 %
Sample Size (N)	1,589,792						

Notes: The comparison group is No Medicare-Paid PAC.
* indicates significance at the 0.05 level, ** at the 0.001 level.

Table 3c
Multinomial Regressions, First PAC Site, Joint Replacement Patients, 1996 to 2003

Variable	IRF Coefficient (Std. Error)	SNF Coefficient (Std. Error)	HHC Coefficient (Std. Error)	Change in Predicted Probability to Site: No Medicare-Paid PAC	IRF	SNF	HHC
Baseline Time Trend (Quarter Dummy)	0.0433 **	0.0567 **	0.0070 *				
	(.0035)	(.0034)	(.0034)				
HHA Interim Payment System Implementation Effect (10/97)	-0.0373	-0.0696 **	-0.0858 **	0.54%	0.54%	-0.52%	-0.56%
	(.0198)	(.0190)	(.0196)				
HHA Interim Payment System Time Trend Effect	-0.0502 **	-0.0633 **	-0.0521 **	0.49%	0.04%	-0.47%	-0.06%
	(.0116)	(.0112)	(.0116)				
SNF Prospective Payment System Implementation Effect (7/98	-0.0787 *	-0.0989 **	-0.0207	0.58%	-0.23%	-1.15%	0.80%
	(.0257)	(.0248)	(.0260)				
SNF Prospective Payment System Time Trend Effect	0.0242 *	-0.0121	0.0446 **	-0.13%	0.37%	-0.88%	0.64%
	(.0111)	(.0107)	(.0111)				
HHA Prospective Payment System Implementation Effect (10/(	-0.0150	0.0075	-0.0876 **	0.21%	0.04%	0.97%	-1.22%
	(.0147)	(.0147)	(.0152)				
HHA Prospective Payment System Time Trend Effect	-0.0148 **	0.0035	0.0031	0.01%	-0.34%	0.24%	0.09%
	(.0046)	(.0046)	(.0047)				
IRF Prospective Payment System Implementation Effect (1/02)	0.0659 **	0.0759 **	0.0338 *	-0.48%	0.18%	0.68%	-0.38%
	(.0166)	(.0167)	(.0172)				
IRF Prospective Payment System Time Trend Effect	-0.0021	-0.0020	0.0000	0.01%	-0.02%	-0.02%	0.02%
	(.0051)	(.0051)	(.0053)				
Pseudo R^2	0.069						
Percentage of PAC patients at this location				14.29 %	30.13 %	33.41 %	22.17 %
Sample Size (N)	1,787,114						

Notes: The comparison group is No Medicare-Paid PAC.
* indicates significance at the 0.05 level, ** at the 0.001 level.

When the BBA mandated the implementation of the HHA IPS in October 1997, the use of home health care went down for all three conditions immediately, and continued to decline for stroke and joint replacement patients in the periods following implementation. The HHA IPS was associated with a reduction in the probability of hip fracture and joint replacement patients

going to home health care of 0.4 and 0.6 percentage points, respectively. The HHA IPS reduced the likelihood of a stroke patient going to HHC by about 1.4 percent immediately, and an additional 0.4 percent in the quarter after the payment system changed. There is evidence of a decrease in use of SNFs upon implementation of the HHA IPS for joint replacement patients, and for both stroke and joint replacement patients in the period following implementation.

With the implementation of the SNF PPS in July 1998 there was an immediate decline in SNF use, which was significant for hip fracture and joint replacement patients. After the SNF PPS implementation there was an increase in home health use for all three conditions. The implementation of the SNF PPS was also associated with a decline in use of IRFs for hip fracture and joint replacement patients. In the periods following the implementation of the SNF PPS, however, joint replacement patients use more IRF care.

The HHA PPS implementation in October 2000 was associated with a large decrease in the use of home health care for all three conditions. The likelihood of going to HHC after the HHA PPS decreased by 0.4 percent for hip fracture patients, 1.5 percent for stroke patients, and 1.2 percent for joint replacement patients. The HHA PPS was associated with a decline in IRF use for hip fracture and stroke patients upon implementation and an increase in stroke patients' use of SNFs and HHAs in the period following implementation.

The implementation of the IRF PPS in January 2002 was associated with an increase in both IRF and SNF use for joint replacement patients. For this group, the likelihood of going to both IRF and SNF increased immediately, by 0.2 percent and 0.7 percent, respectively. For hip fracture patients, the IRF PPS was associated with an immediate increase in use of SNFs, and a subsequent decline in use of SNFs. For stroke patients, the IRF PPS was associated with an increase in use of IRFs.

Limitations

There is clearly room to improve on the methods we have used here and to pursue the next logical steps in this line of inquiry. Our models do not capture PAC payment changes other than the implementation of new payment systems, such as the BBRA or the BIPA. Thus, some of those effects may be partially captured by other indicators. In particular, the increases in SNF use around the time of the HHA PPS and IRF PPS may result from the BBRA and BIPA payment supplements to SNFs. We could also define the severely ill in other ways: for example, based on their probability of long-term institutionalization. When more data become available for analysis we could have a longer time frame over which to examine the effects of the IRF PPS.

Conclusions

Although the effects of the payment systems on the use of PAC varied, most were as predicted and were consistent with the existing literature. There was a marked decline in the use of home health care with the implementation of the HHA IPS, and another decline after the HHA PPS. The decline in the use of HHC after the HHA IPS persisted in the quarters following its implementation for stroke and joint replacement patients. These patients were mostly being shifted from SNF and HHC to no formal care during this time period. This marked continued decline in HHC use after the implementation of the HHA IPS, which was highly significant for stroke and joint replacement patients, may have been because the IPS involved substantial fiscal cuts, was implemented first and relatively quickly so that providers likely took additional time to adjust to it, and because there was a perception that the BBA foretold a crackdown on all post-acute care. The SNF PPS was associated with lower use of SNF care for hip fracture and joint replacement patients and increases over time in HHC use for stroke and joint replacement patients. Some of the payment changes appeared to have immediate consequences for alternative sites including the IRF PPS, which was associated with greater SNF use for hip fracture and joint replacement patients. The IRF PPS was also associated with greater use of IRF care for stroke and joint replacement patients. Across the entire time period examined the proportion of hip fracture and joint replacement patients receiving no formal PAC was relatively flat, but the proportion of stroke patients receiving no formal PAC increased.

Of course, there were unanticipated effects. For example, the decreases in SNF use around the HHA IPS (which were contrary to our hypothesis) were possibly due to over-expansion in the SNF industry, and anticipatory effects of the SNF PPS. In addition, the declines in use of IRFs for hip fracture and joint replacement patients after the SNF PPS and the declines in stroke patients' use of IRFs after the HHA PPS were unexpected but may have been due to the BIPA or BBRA.

There were virtually no differential effects for severely ill patients associated with any of the payment system changes. While this is good news, continued attention should be given to this issue in the future. In addition, it is also interesting to note that the changes described above were least significant and pronounced for hip fracture patients and most pronounced for stroke patients. This is a cause for concern because stroke patients are the group for whom there is the

most evidence that aggressive post-acute rehabilitation produces better outcomes (Kramer et al., 1997; Kane et al., 1996, 1998, 2002).

It is important that all of the changes associated with the PAC payment reforms be studied in the context of changes in patient costs and outcomes. For example, declines in the use of any given PAC site would be of greatest concern if they were associated with poorer patient outcomes overall. In addition, it should be noted that these analyses reflect the latest data available, but that they cover only the early stages of the IRF PPS implementation. Therefore, it is important to continuously monitor the impact of the implementation of the IRF PPS as additional data, including data on Medicare costs and outcomes, become available.

Appendix 1:
Outpatient Therapy

First PAC Location 1999	Congestive Heart Failure		Joint Replacement		Hip Fracture		Stroke	
	Frequency	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*	*Frequency*	*Percent*
No Medicare-Paid PAC	228,166	56.3	27,059	11.4	12,785	7.1	58,496	26.2
Home Health	103,723	25.6	49,217	20.7	11,146	6.2	32,769	14.7
OPD Therapy	8,109	2.0	12,084	5.1	4,881	2.7	12,478	5.6
Phy/Supp Therapy	1,431	0.4	3,761	1.6	177	0.1	986	0.4
IRF	5,625	1.4	64,041	26.9	34,043	18.9	46,315	20.7
SNF	56,615	14.0	79,641	33.5	114,721	63.7	68,875	30.8
Acute rehab	102	0.0	1,212	0.5	664	0.4	856	0.4
LTCH	1,502	0.4	936	0.4	1,634	0.9	2,727	1.2
Total	**405,273**	**100.0**	**237,951**	**100.0**	**180,051**	**100.0**	**223,502**	**100.0**
Death Rate Within 30 Days of Discharge	6.8		0.4		6.0		9.8	
Rehospitalization Rate Within 30 Days of Discharge	23.3		6.6		12.1		13.8	

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