The Optimal Outcomes of Post-Hospital Care Under Medicare

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Objective. To estimate the differences in functional outcomes attributable to discharge to one of four different venues for post-hospital care for each of five different types of illness associated with post-hospital care: stroke, chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), hip procedures, and hip fracture, and to estimate the costs and benefits associated with discharge to the type of care that was estimated to produce the greatest improvement.

Study Setting/Data Sources. Consecutive patients with any of the target diagnoses were enrolled from 52 hospitals in three cities. Data sources included interviews with patients or their proxies, medical record reviews, and the Medicare Automated Data Retrieval System.

Analysis. A two-stage regression model looked first at the factors associated with discharge to each type of post-hospital care and then at the outcomes associated with each location. An instrumental variables technique was used to adjust for selection bias. A predictive model was created for each patient to estimate how that person would have fared had she or he been discharged to each type of care. The optimal discharge location was determined as that which produced the greatest improvement in function after adjusting for patients' baseline characteristics. The costs of discharge to the optimal type of care was based on the differences in mean costs for each location.

Data Collection/Extraction Methods. Data were collected from patients or their proxies at discharge from hospital and at three post-discharge follow-up times: six weeks, six months, and one year. In addition, the medical records for each participant were abstracted by trained abstractors, using a modification of the Medisgroups method, and Medicare data were summarized for the years before and after the hospitalization.

Principal Findings. In general, patients discharged to nursing homes fared worst and those sent home with home health care or to rehabilitation did best. Because the cost of rehabilitation is high, greater use of home care could result in improved outcomes at modest or no additional cost.

Conclusions. Better decisions about where to discharge patients could improve the course of many patients. It is possible to save money by making wiser discharge planning decisions. Nursing homes are generally associated with poorer outcomes and higher costs than the other post-hospital care modalities.

Key Words. Home health, nursing home, rehabilitation, cost-effectiveness

The change in Medicare's hospital payment policies to a prospective payment system (PPS) spurred post-acute care activities (Morrisey, Sloan, and Valvona 1988; Neu, Harrison, and Heilbrunn 1989; Neu and Harrison 1988). The resultant earlier discharges from hospitals (Kahn, Rubenstein, Draper, et al. 1990) created a demand for post-acute care services where many of these patients could recuperate and perhaps be rehabilitated. All three major post-acute care entities—home health care agencies, skilled nursing homes, and rehabilitation facilities—experienced substantial growth in the wake of the PPS (DesHarnais, Cheney, and Fleming 1988; Guterman and Dobson 1986; Gornick and Hall 1988; Prospective Payment Assessment Commission 1993), and the acuity levels of nursing home care and home health increased (Shaughnessy and Kramer 1990).

As hospitals moved to discharge patients "quicker and sicker" (Kahn, Rubenstein, Draper, et al. 1990), the question arose about whether patients were discharged to settings sufficient for post-acute care. Hospital discharge planners generally recognize variations in patient characteristics when making their recommendations. Factors considered include the patient's functional ability, availability of caretakers at home, ethnicity, age, sociodemographics, previous hospitals, and dependence on technology (Naylor and Prior 1999). Discharge planners are more likely to send complicated patients for post-hospital care, but the outcomes associated with these different assignments are not clear.

In order to seek more rational discharge planning a number of important questions, such as which post-acute care (PAC) location will give a particular patient the best functional outcomes, need to be answered. This study builds on earlier studies that involve addressing the question and evaluating who should get what kind of care after discharge and the association of

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functional outcomes with different types of PAC (Kane et al. 1996; Kane, Finch, Blewett, et al. 1996; Kane, Chen, Finch, et al. 1998). The specific focus of these analyses is to determine (1) whether the actual discharge location produces the optimal (greatest) functional improvement, and (2) the extent of the differences between the optimal functional outcomes and the functional outcomes in actual discharge locations. Medicare patients discharged from hospitals were followed for up to one year after discharge to monitor the outcomes attributable to the PAC they received.

METHODS

Setting

The three cities selected for this study—Pittsburgh, Houston, and the Twin Cities (Minneapolis and St. Paul)—represented different patterns of medical services and different parts of the country. Each had to provide an adequate supply of each of the three types of PAC under study. Five DRGs that accounted for a substantial proportion of PAC and that represented both medical and rehabilitative conditions were selected for study: stroke (DRG 14), congestive heart failure (DRG 127), chronic obstructive pulmonary disease (DRG 88), hip fracture (DRG 210), and hip replacement (DRG 209). Collectively, these DRGs accounted for almost half of the Medicare-sponsored PAC (Neu and Harrison 1986). The hip fracture category was subsequently divided into two subgroups when we realized that two different major modes of treatment (pinning and arthroplasty) were used.

In each city, hospitals enrolled in the study on a voluntary basis. With the support of a local foundation we were able to convince almost all of the hospitals in Pittsburgh to participate (18 of 20). We obtained the cooperation of all 19 hospitals in the Twin Cities but were able to enroll only 15 of the 31 eligible hospitals in Houston.

Data Collection

Because we wanted to use information similar to that available to clinicians at the time of their discharge decisions, we identified potential study patients prior to their discharge from the enrolled hospitals. Study nurses in each of the 52 hospitals followed admission records and talked with floor nurses to identify potentially eligible elderly Medicare subjects with appropriate DRGs, who were then approached in a target time window of 72 hours prior to discharge. (When discharge was delayed, the study patients were reinterviewed or their status updated.) Each potential study subject was informed about the study. Those who gave informed consent to participate were interviewed about their current level of functional activity and the level prior to the event that led to their hospitalization. They were also asked about their expected course and their participation in discharge planning. Study patients were interviewed again in person at six weeks, six months, and one year post-hospital discharge. At each interview they were asked about their functional status, specific symptoms relative to their condition, and the use of formal and informal services. Each patient was asked on each occasion for permission to contact the person who provided the majority of informal care. This primary informal caregiver was interviewed at each follow-up period by telephone to ascertain the nature and burden of the care provided and the use of formal services.

The medical record of each study patient for the critical hospitalization was reviewed by a specially trained team of qualified record abstractors using a modified version of Medisgroups (Iezzoni and Moskowitz 1988). Information was collected on a series of original and adapted measures of severity and comorbidity: (1) the physiologic scale from the APACHE system, which measured the generic physiologic status of a patient upon admission based on the physiologic score used in the APACHE II (Acute Physiology, Age, Chronic Health Evaluation) system (Knaus, Draper, and Wagner 1985); (2) Comorbidity score, which measures the nature and extent of comorbities present both prior to hospitalization as well as those occurring during the hospitalization (Iezzoni, Shwartz, and Burnside 1989); (3) DRG-Specific Severity scores, which represent a composite score of clinical items unique to that specific DRG; and (4) a clinical instability score adapted from the RAND study on the impact of PPS (Kosecoff, Kahn, Rogers, et al. 1990) to measure patients' clinical status at discharge.

Dependent Variables. The primary dependent variable was patients' functional outcome (activity of daily living [ADL] score), measured as the change in functional status between the time of hospital discharge and six weeks, six months, and twelve months post-discharge. In this study, the ADL score included functional levels for seven domains of ADL: bathing, feeding, toileting, transferring, walking, dressing, and continence. For each individual patient, the level of dependency for each of the seven ADL domains was measured, and these dependency levels were translated into seven dependency scores (one for each domain) using a weighted scoring system; these seven scores were then summed into one dependency score. This weighted scoring system was developed by a panel of experts based on magnitude estimation techniques where weighted scores were assigned to every performance level for each domain (Finch, Kane, and Philp 1995). Each patient, for each relevant point in time thus has a unique dependency score (six weeks, six months, and one year post-discharge) that represents the weighted sum of the patient's areas and extent of dependency. This method has two advantages over simply summing the numbers of disabilities: (1) it avoids establishing an artificial dichotomy between disabled and nondisabled, and (2) it allows different areas of disability to be valued differently (Kane, Finch, Blewett, et al. 1996). To account for those who died, death was included as the value one point greater than the maximum dependency achieved by summing the maximal values for each ADL (5,431 points). Sensitivity analysis using different scores for death did not yield a significant effect on ADL scores until the score assigned to death reached one standard deviation above the maximum total score.

In addition to ADL scores, special condition-specific outcomes measures for congestive heart failure and chronic obstructive pulmonary disease were also used as a dependent variable for the analyses. For the hip procedures and hip fracture patients, a walking score was used. These condition-specific outcomes were created using weighted scores of symptoms.

Independent Variables. Independent variables used in the analyses included patient characteristics obtained from patient interview and case-mix information abstracted from the patient's medical record. Three ADL scores obtained by the same magnitude estimation techniques described in the previous subsection were used as independent variables: discharge ADL score, sum of the ADL and IADL (instrumental activities of daily living) scores prior to hospitalization, and the patient's self-expected ADL score at six weeks post-hospital discharge. The IADL is an expanded version of the same weighted ADL scale reflecting slightly more complex tasks: preparing meals, using the telephone, taking medications, shopping, and house cleaning. The IADLs were incorporated to assess only the prior functioning levels when all of the patients had the opportunity to perform such tasks. The patients' expected level of disability was used as a proxy for the prognoses since the prognoses by the physicians were not available.

The possible range for the sum of the seven-item dependency magnitude estimation ADL score used here was from zero (no dependencies) to 5,350 (completely dependent in seven functions), and the possible range for the sum of the prior ADL and IADL score was from 0 to 6,614. In the analysis, the ADL and sum of prior ADL and IADL dependency scores for both the dependent and independent variables were converted to a 0–100 scale (by obtaining the percentage of the maximal score), where zero represented total disability or death and 100 represented no disability. A greater change in ADL scores indicated greater functional improvement at the time of follow-up.

Other independent variables included the presence of speech or hearing deficiencies, age, gender, race, patient's living arrangements (living alone, with relatives, or with others), cognitive status, patient's ability to exercise prudent judgment, presence of a urinary catheter, health status prior to hospitalization, HMO membership status, city of residence, patient's role in discharge decision making, initial length of hospital stay, hospital's PAC facility ownership status, social and economic status of the caregiver, and whether informal support was previously provided. (We opted not to ask about the availability of informal assistance but rather whether the patient had actually received any assistance in the recent past for fear of eliciting false expectations about potential assistance.) Cognitive status was assessed by the number of errors on the basic ten-item Short Portable Mental Status Questionnaire (Pfeiffer 1975). In an effort to account for the patient's ability to exercise prudent judgment, we used a test of the patient's awareness of his/her own body (Fink, Green, and Bender 1952). A dichotomized version of a scale developed by Coulton and her associates was used to assess the patient's role in post-hospital care decision making, where a score of 1 indicated an active role and 0 suggested virtually no role in discharge decision making (Coulton, Dunkle, Chun-Chun, et al. 1988). Patients were also asked to rate their health status prior to hospitalization using a four-level response (excellent to poor). Because income was not consistently reported, the patient's Medicaid enrollment status (determined from Medicare denominator files) was used as a proxy. In addition, information on each subject's HMO membership status upon enrollment in the study was obtained from the Medicare denominator file, which included HMO status at the time of discharge from the hospital. For the 29 patients for whom this information was missing at time of discharge, HMO status at 12 months post-discharge was utilized.

In addition to the patient characteristics obtained from the interview, four severity measures (admission acute physiology score, comorbidity, DRG-specific severity scores, and instability) were abstracted from patients' medical records using a modification of the Medisgroup® severity index (Iezzoni and Moskowitz 1988). The quality of the data available in the medical records was much better for admission information than for data around the time of discharge. Rather than assuming that missing information implied improved status, we opted to use admission data for two of four of our severity scores listed here. These severity measures were used to control for medical issues, in addition to DRG, that might influence the discharge decision and functional outcomes:

Admission APS (Acute Physiology Score). This variable measured the generic physiologic status of the patient upon admission based on the physiologic score used in the APACHE II system (Knaus, Draper, and Wagner 1985). The values ranged from 0 to 15.

Comorbidities. This variable, based on previous work (Iezzoni, Shwartz, and Burnside 1989), measured the nature and extent of comorbidities present prior to hospitalization as well as those occurring during the hospitalization. The range of possible scores was from 0 to 20 points.

DRG-specific Severity Scores. A separate severity score was designed for each DRG (except hip procedure) based on admission information. Each severity score represented a composite score of clinical items unique to that specific DRG. For example, the stroke severity score ranged from 1 to 6 to represent six levels of severity, with 1 for minor or no neurologic abnormalities to 6 for coma. The range of hip fracture severity scores was 1 to 5 where non-displaced fracture of the femoral neck was scored as 1 and hip fracture with pulmonary edema on chest x-ray was scored as 5.

Instability. This variable was adapted from the RAND study on the impact of PPS (Kosecoff, Kahn, Rogers, et al. 1990) and measured patients' clinical status at discharge. These measures included fever, new incontinence, new shortness of breath, new elevated heart rate, new elevated respiratory rate, new elevated blood pressure, and new cardiac arrhythmias. This formed a dichotomous variable with potential values of 0 or 1, where a score of 1 indicates that a patient had at least one measure of instability.

Analysis

The approach to the data required several steps. Because this study did not randomly assign patients to different types of post-acute care facilities (nonrandomization of treatment), the process of selection in discharge to post-acute care settings had to be modeled in order to estimate the unbiased predicted functional outcomes of post-acute care. In this study, the instrumental variables (IV) estimation method was used to address the selection bias. Instrumental variables estimation used one or more IVs, which were observable factors that influenced treatment but did not directly affect patient outcomes, to mimic a randomization of patients to different likelihoods of receiving alternative treatments (McClellan, McNeil, and Newhouse 1994). The instrumental variable estimation method used in this analysis was devised by Dubin and McFadden (1984). The instrumental variable estimation used a two-stage approach.

The two-stage approach used in this study can be expressed as

First-stage equation (discharge location for PAC):

$$L_1 * = \alpha_0 + \alpha_1 Z_i + v_i$$

Second-stage equation (patient functional outcomes in PAC setting $j =$ home, home care, nursing home, or rehabilitation facility):

$$Y_i = \beta_0 + \beta_1 X + \beta_2 L_i * + \varepsilon_i$$

where

$Y =$ patient functional outcomes in post-acute care setting j;
$X =$ vector of exogenous variables;
$v_i =$ error term for the selection equation;
$L_i =$ discharge location for post-acute care;
$Z =$ a vector of exogenous explanatory variables;
$L_i * =$ the predicted probability that a PAC setting is chosen;
$\varepsilon_i =$ error term for the substantive equation.

The first stage of IV estimation was the calculation of predicted probabilities of discharge locations for individual patients through use of a multinomial logit equation. (These predicted values are shown in the appendix.) The independent variables for the first-stage multinomial logit model included patient functional status measured as discharge ADL score, sum of prior ADL and IADL scores, expected ADL score at six weeks post-discharge, age, gender, race, living arrangement, cognitive status, prior caregiver help, the patient's ability to exercise prudent judgment, use of a urinary catheter, health status prior to hospitalization, HMO membership status, city of residence, the patient's role in discharge decision making, initial length of hospital stay, hospital's PAC facility ownership status, availability of social support for the patient, and four severity measures (admission APS, comorbidity, instabilitiy, and DRG-specific scores). Although some patients made as many as six different moves during the first six weeks after discharge, we opted to use the initial discharge location as the dependent variable in the first-stage model to analyze the effects of post-acute care settings on outcomes. Because over 98 percent of moves represented discharge from an institutional type of post-acute care to home, a rehospitalization, or moves within the same type of setting, it was reasonable to attribute their outcomes to the first service they received, since all subsequent care could be influenced by the results of the initial care.

In the second stage, the predicted values from the multinomial logit equation of patient hospital discharge location were used as independent variables to control for selection effects in an ordinary least squares regression model where follow-up functional outcome was the dependent variable. Predictions of the effects of various post-acute care locations on functional outcomes were calculated from the second-stage equation. In order to avoid the multicollinearity problem, one or more of the independent variables in the first-stage equation were not included in the second-stage equation. For each DRG, the hospital's ownership of any types of PAC facilities (yes or no), as well as the availability of social support for the patient that affected hospital discharge location but not subsequent functional outcomes, were used as independent variables in the first-stage equation but not in the second-stage equation. Therefore, for the second-stage equation, the independent variables for post-acute care functional outcomes included all variables used in the first-stage model except two: the hospital's ownership of any types of PAC facilities and the availability of social support for the patient. In addition, predicted probabilities for discharge locations from the first-stage multinomial logit model were used as instruments.

In order to obtain valid estimates, assumptions are required for this two-stage IVs estimation approach. The standard assumptions for the IVs estimation approach are that the correlation between Z_i and ε is zero, which implies that the effect of Z on functional outcomes (Y) must be through an effect of Z on L (PAC setting), and the covariance between PAC setting and instruments is nonzero. Angrist, Imbens, and Rubin (1996) showed conventional assessments to determine the validity of instruments. Five assumptions are made for the IVs approach: (1) the stable unit treatment value assumption (which implies that potential outcomes for each person i are unrelated to the treatment status of other individuals), (2) exclusion restriction (which implies the absence of a direct effect of the instrumental variables on outcomes), (3) nonzero average causal effect of the instrument on treatment, (4) monotonicity of the effect of IVs on the choice of treatment, and (5) random assignment for the IVs. According to Angrist, Imbens, and Rubin, the stable unit treatment value assumption, exclusion restriction, nonzero average causal effect of instrument on treatment, and monotonicity of the effect of IVs on choice of treatment (PAC type) are crucial assumptions for the IV estimation. On the other hand, the violation of random assignment for the IVs would not have a serious effect when the IVs estimation approach was employed (Angrist, Imbens, and Rubin 1994).

Several specification tests were conducted to examine these assumptions. The assumption for the nonzero average causal effect of instrument on PAC type was tested by examining the coefficients of IVs in the first-stage model. The significant coefficient in the multinomial logit model indicated that a significant correlation between the IVs and the PAC type was present. Thus, there is no violation for the assumption of nonzero average causal effect of instrument on PAC type. Similarly, our data showed no violation for the stable unit treatment value assumption. Both the exclusion restriction and the monotonicity assumptions could be tested by the degree of correlation between the instrument and the treatment status (in our case the PAC type). The higher the correlation between the instrument and the treatment status the stronger the instrument, and then the smaller the odds for violations of both the exclusion restriction and the monotonicity assumptions. Therefore, a specification test was conducted to examine the correlation between the instrument and the selection variables (PAC type). This specification test for the instrument yielded Chi-square statistics of 27.03, 9.99, 12.78, 20.50, and 31.22 with p-value $< .01$ for stroke, COPD, CHF, hip procedure, and hip fracture patients, respectively. (They were 24.25, 14.05, 20.15, 18.88, and 21.82 when living alone and role of discharge decision were used for the IVs.) This result suggested that the instruments were strong and that the odds of violating the exclusion restriction and the monotonicity assumption was fairly small. The results from these specification tests suggested that the instruments used in this study were valid.

In addition, the independence of irrelevant alternative (IIA) property, which implied that the odds ratio in the multinomial logit model was independent of the other alternatives, was tested according to the method developed by Hausman and McFadyen (1984). The test statistic is 8.99 with 20 degrees of freedom (df) for the specification of stroke patients; 7.68, 18 df for CHF patients; 9.52, 19 df for hip procedure patients; and 11.07, 21 df for hip fracture patients. These results indicated no evidence of misspecification of the multinomial logit model, that is, the null hypothesis that independence from irrelevant alternatives held. For COPD patients, the specification test is not applicable since there are only two discharge locations possible.

After estimating the coefficients of the second-stage equation in the two-stage IVs estimation models, two additional steps were involved to obtain the optimal PAC location. First, for each patient, predicted functional outcomes in different discharge locations were estimated using the coefficients developed from the second-stage equation. Each patient would have four predicted functional outcomes corresponding to each of the four PAC settings: home without formal PAC, home care, nursing home, and rehabilitation facility, and one of the predicted values would be the case mix–adjusted functional outcome for the patient's actual PAC setting. Second, the predicted functional outcomes from the other three PAC settings were compared to the predicted outcomes in the actual PAC setting. The optimal PAC location was defined as the PAC location that yielded the highest predicted functional improvement score, and this score had to be at least one-and-a-half standard deviations higher (better) than the functional improvement score from the patient's actual (observed) PAC location. If no PAC location met this criterion, the actual discharge location was judged to be the optimal PAC location.

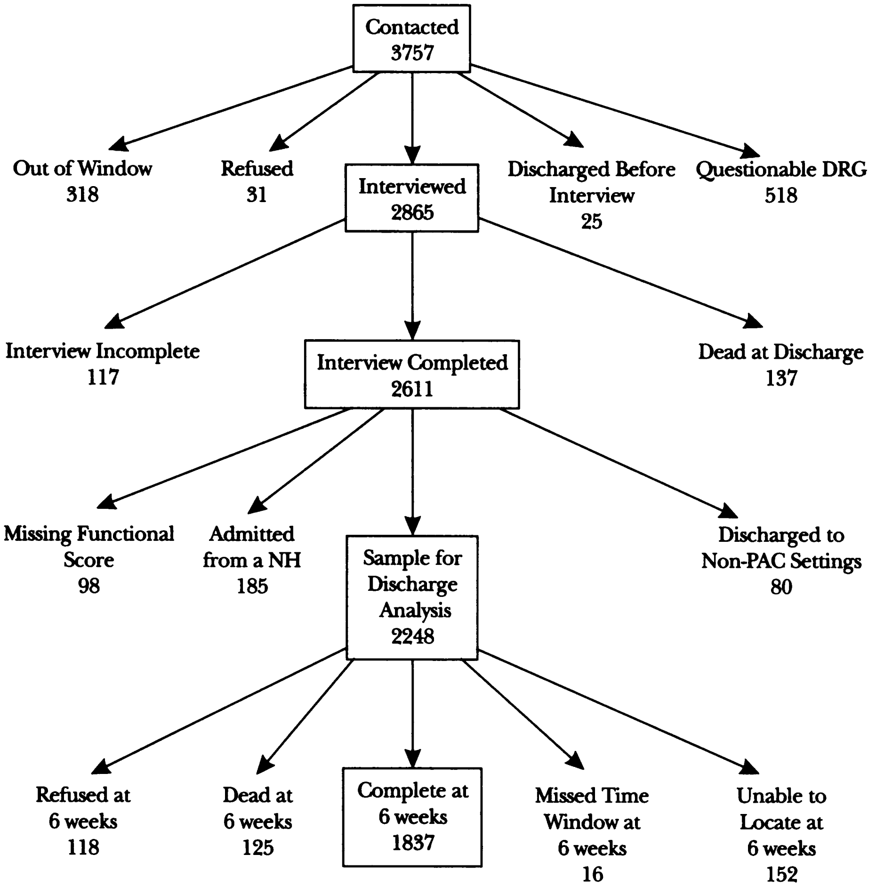
This procedure was carried out separately for each of the five clinical conditions and for the functional outcomes at six weeks, six months, and one year post-hospital discharge. The procedure was then repeated to study only survivors at each follow-up point.

RESULTS

In all, 3,757 patients were initially targeted; 530 were ineligible because of their age (<65) or because their DRGs proved inappropriate. Among 3,227 eligible patients, two patients were discharged before the interview, 189 patients (5.8 percent) refused to participate in the study, and 213 patients (6.6 percent) did not complete the discharge interview. For those patients who completed the discharge interview, 173 patients (5.4 percent) were eliminated from the study because they were not discharged from the hospital within the 72-hour time window from the discharge interview, 137 patients died before discharge, 185 patients were admitted from a nursing home, and 89 patients were discharged to another hospital. The final sample size was then 2,248 (70 percent of eligible patients). Figure 1 traces the sample loss. At the end of the study year 2,186 subjects were retained for analysis, including 466 patients who had died within 12 months of hospital discharge.

Table 1 provides comparisons for the characteristics of patients in the study by the discharge location for each DRG. The results of the Scheffe multiple comparison test (for continuous variables) and Chi-square statistics (for categorical variables) demonstrated that for *stroke* patients, discharge ADL scores, patient's self-expected ADL scores at six weeks post-discharge, the

Figure 1: Sample Size



sum of prior ADL and IADL scores, age, ethnicity, cognitive status, prior health status, admission APS score, and stroke-specific severity score were statistically different among discharge locations. In addition, the percentages of patients who lived alone prior to hospitalization, had prior caregiver help, had a urinary catheter, had instability, had hearing or speech impairment, and who lived in either Houston or Pittsburgh, as well as the percentage of patients who were HMO members, were also statistically significantly different among discharge locations. For *COPD* patients, statistically significant differences among discharge locations occurred for the following factors: sum of prior ADL and IADL scores, patient's self-expected ADL scores, average informal

Table 1: Patient Characteristics by Discharge Locations

	HOME, N = *160*		*HCARE*, N = *125*		*NH*, N = *123*		*REHAB*, N = *79*		
Stroke	*Mean*	*(s.d.)*	*Mean*	*(s.d.)*	*Mean*	*(s.d.)*	*Mean*	*(s.d.)*	*p-Value**
Discharge ADL (range 0–100)†	69.87	(24.89)	56.25	(24.80)	33.96	(19.98)	37.56	(15.33)	<.001
Prior ADL/IADL (range 0–100)‡	89.68	(15.96)	86.13	(19.48)	84.23	(19.45)	92.24	(10.18)	<.001
Expected ADL (range 0–100)§	90.82	(14.99)	83.60	(19.46)	65.22	(19.44)	73.33	(18.86)	<.001
Age (range 65–100)	75.41	(7.51)	76.81	(7.19)	81.12	(7.29)	75.47	(7.56)	.004
Touch test errors	1.66	(1.71)	1.63	(1.62)	3.24	(1.30)	2.13	(1.61)	<.001
Cognitive status (range 0–10)	3.19	(3.15)	3.27	(3.06)	5.98	(3.73)	3.89	(3.69)	<.001
Prior health status (range 1–5)	2.92	(0.89)	2.67	(0.91)	2.71	(0.91)	2.99	(0.91)	.02
Admission APS score (range 1–10)	3.37	(2.82)	3.63	(3.13)	4.91	(4.12)	4.24	(3.39)	.001
Comorbidity score (range 0–20)	6.95	(5.01)	7.66	(5.09)	7.62	(5.38)	6.76	(4.24)	NS
Stroke-specific scores (range 1–5)	2.99	(1.30)	3.12	(1.34)	3.81	(1.64)	3.81	(1.67)	<.001
Patient is female	53.8%		60.8%		65.0%		63.3%		NS
Patient lives alone	29.4%		40.0%		46.3%		35.4%		.03
Patient is white	85.0%		75.2%		95.9%		87.3%		<.001
Patients who had prior caregiver help	53.8%		63.2%		61.0%		48.1%		NS
Speech impaired	20.0%		31.2%		56.1%		41.8%		<.001
Hearing not intact	29.4%		25.6%		59.3%		30.4%		<.001
Using catheter	13.8%		16.0%		55.3%		31.6%		<.001
Did not discuss discharge plan	75.0%		69.6%		84.6%		82.3%		.02
Patient lives in Houston	23.8%		32.8%		8.9%		24.1%		<.001
Patient lives in Pittsburgh	36.9%		36.8%		35.8%		48.1%		NS
Patient is HMO member	19.4%		15.2%		35.8%		10.1%		<.001
Instability scores presented	24.4%		17.6%		43.9%		29.1%		<.001

continued

Table 1: *Continued*

	HOME, N = *209*		*HCARE*, N = *127*		
COPD	*Mean*	*(s.d.)*	*Mean*	*(s.d.)*	*p-Value**
Discharge ADL (range 0–100)†	77.42	(18.28)	73.19	(19.96)	.048
Prior ADL/IADL (range 0–100)‡	91.01	(12.52)	84.19	(17.59)	<.001
Expected ADL (range 0–100)§	95.74	(8.76)	91.66	(13.40)	<.001
Age (range 65–100)	74.11	(6.55)	75.25	(6.61)	NS
Touch test errors	0.78	(1.32)	0.71	(1.23)	NS
Cognitive status (range 0–10)	1.54	(2.01)	1.70	(1.74)	NS
Prior health status (range 1–5)	2.79	(0.91)	3.06	(0.89)	.008
Admission APS score (range 1–10)	4.85	(3.33)	5.74	(3.66)	.026
Comorbidity score	6.50	(4.94)	8.21	(5.45)	.004
COPD-specific scores (range 1–5)	3.06	(1.42)	3.52	(1.52)	.006
Patient is female	54.5%		55.9%		NS
Patient lives alone	35.4%		41.7%		NS
Patient is white	92.3%		82.7%		NS
Patients who had prior caregiver help	64.6%		77.2%		.007
Speech impaired	5.3%		3.9%		.015
Hearing not intact	15.3%		17.3%		NS
Did not discuss discharge plan	72.7%		78.0%		NS
Using catheter	7.7%		10.2%		NS
Patient is HMO member	18.2%		10.2%		NS
Patient lives in Houston	22.0%		12.6%		.031
Patient lives in Pittsburgh	43.4%		59.8%		.008
Instability scores presented	21.1%		23.6%		NS

Note: No patients were discharged to nursing homes or rehabilitation facilities.

continued

Table 1: *Continued*

CHF	*HOME,* N = *276*		*HCARE,* N = *168*		*NH,* N = *46*		
	Mean	*(s.d.)*	*Mean*	*(s.d.)*	*Mean*	*(s.d.)*	*p-Value**
Discharge ADL (range 0–100)†	77.29	(20.04)	68.76	(13.01)	53.26	(23.54)	<.001
Prior ADL/IADL (range 0–100)‡	76.79	(12.76)	78.71	(17.87)	83.24	(20.55)	<.001
Expected ADL (range 0–100)§	90.23	(10.16)	83.20	(14.72)	77.43	(19.98)	<.001
Age (range 65–100)	76.80	(7.01)	78.71	(17.87)	83.24	(20.55)	<.001
Touch test errors	0.93	(1.42)	1.17	(1.57)	2.22	(1.89)	<.001
Cognitive status (range 0–10)	2.20	(2.18)	2.51	(2.49)	3.63	(2.50)	<.001
Prior health status (range 1–5)	2.66	(0.90)	2.69	(0.88)	2.80	(0.98)	NS
Admission APS score (range 1–10)	5.06	(3.32)	5.05	(3.48)	5.85	(3.62)	NS
Comorbidity score	9.54	(4.70)	9.49	(5.46)	10.07	(5.15)	NS
CHF-specific scores (range 1–5)	2.97	(1.41)	3.04	(1.34)	3.24	(1.35)	NS
Patient is female	52.5%		69.6%		60.9%		.002
Patient lives alone	38.4%		48.2%		60.9%		.007
Patient is white	80.8%		81.0%		93.5%		NS
Patients who had prior caregiver help	62.0%		73.2%		69.6%		.046
Speech impaired	8.0%		10.1%		15.2%		NS
Hearing not intact	22.8%		26.8%		52.2%		<.001
Did not discuss discharge plan	79.0%		77.4%		84.8%		NS
Using catheter	15.2%		26.2%		41.3%		<.001
Patient is HMO member	17.0%		13.1%		19.6%		NS
Patient lives in Houston	26.5%		19.6%		6.5%		.007
Patient lives in Pittsburgh	39.9%		44.6%		30.4%		NS
Instability scores presented	18.5%		29.8%		34.8%		.005

Note: No patients were discharged to rehabilitation facilities.

continued

Table 1: *Continued*

	HOME, N = *183*		*HCARE*, N = *81*		*NH*, N = *65*		
Hip Procedure	*Mean*	*(s.d.)*	*Mean*	*(s.d.)*	*Mean*	*(s.d.)*	*p-Value**
Discharge ADL (range 0–100)†	66.29	(16.74)	57.00	(16.82)	50.31	(17.65)	<.001
Prior ADL/IADL (range 0–100)‡	91.87	(11.97)	87.67	(14.01)	85.00	(16.72)	<.001
Expected ADL (range 0–100)§	77.26	(12.22)	73.74	(11.91)	70.89	(16.65)	<.001
Age (range 65–100)	71.75	(5.93)	75.47	(7.30)	78.42	(6.62)	<.001
Touch test errors	0.37	(0.92)	0.64	(1.22)	1.20	(1.53)	<.007
Cognitive status (range 0–10)	0.81	(0.91)	0.98	(1.11)	2.11	(2.57)	<.001
Prior health status (range 1–5)	1.95	(0.88)	2.36	(0.91)	2.41	(0.98)	<.001
Admission APS score (range 1–10)	1.36	(1.74)	1.29	(1.59)	1.84	(2.26)	NS
Comorbidity score	4.89	(5.04)	7.98	(5.82)	7.55	(6.00)	<.001
Patient is female	59.0%		65.4%		73.8%		NS
Patient lives alone	23.0%		40.7%		71.7%		<.001
Patient is white	96.7%		90.1%		95.7%		NS
Patients who had prior caregiver help	57.9%		77.8%		63.0%		.006
Speech impaired	0.1%		3.7%		10.9%		.008
Hearing not intact	5.5%		11.1%		23.9%		.002
Did not discuss discharge plan	88.0%		92.6%		84.8%		NS
Using catheter	16.4%		16.0%		30.4%		NS
Patient is HMO member	30.6%		25.9%		39.1%		NS
Patient lives in Houston	17.5%		11.1%		4.6%		.025
Patient lives in Pittsburgh	19.1%		48.1%		49.2%		<.001
Instability scores presented	11.5%		13.6%		30.4%		.016

continued

Table 1: *Continued*

	HOME, N = *120*		*HCARE*, N = *115*		*NH*, N = *282*		*REHAB*, N = *89*		
Hip Fracture	*Mean*	*(s.d.)*	*Mean*	*(s.d.)*	*Mean*	*(s.d.)*	*Mean*	*(s.d.)*	*p-Value**
Discharge ADL (range 0–100)†	52.74	(17.84)	48.13	(20.13)	42.27	(14.39)	41.46	(16.55)	<.001
Prior ADL/IADL (range 0–100)‡	89.26	(16.66)	85.73	(18.76)	84.48	(15.63)	86.68	(16.19)	<.001
Expected ADL (range 0–100)§	82.83	(16.45)	80.47	(16.53)	73.92	(15.60)	73.56	(15.81)	<.001
Age (range 65–99)	77.49	(7.57)	78.65	(6.61)	83.43	(6.67)	79.49	(7.84)	<.001
Touch test errors	1.03	(1.50)	1.26	(1.68)	2.01	(1.71)	1.51	(1.74)	<.001
Cognitive status (range 0–10)	2.08	(2.39)	2.81	(2.93)	3.59	(3.18)	2.37	(2.49)	<.001
Prior health status (Range 1–5)	3.01	(0.89)	2.87	(0.79)	2.79	(0.83)	2.92	(0.89)	NS
Admission APS score (range 1–10)	2.59	(2.58)	2.16	(2.32)	2.25	(2.21)	2.27	(2.49)	NS
Comorbidity score (range 0–20)	8.17	(5.78)	9.94	(5.81)	7.95	(5.62)	8.71	(6.10)	.02
Hip specific scores (range 1–5)	2.48	(1.02)	2.57	(1.03)	2.96	(1.07)	2.96	(1.09)	<.001
Patient is female	76.7%		76.5%		84.0%		79.8%		NS
Patient lives alone	32.5%		40.9%		52.8%		46.1%		.002
Patient is white	95.8%		97.4%		97.5%		92.1%		NS
Patients who had prior caregiver help	55.0%		61.7%		57.1%		60.7%		NS
Speech impaired	6.7%		15.7%		18.4%		15.7%		.03
Hearing not intact	16.7%		25.2%		44.3%		30.3%		<.001
Using catheter	34.2%		36.5%		52.1%		32.6%		<.001
Did not discuss discharge plan	75.8%		78.3%		80.1%		76.4%		NS
Patient lives in Houston	22.5%		23.5%		3.9%		44.9%		<.001
Patient lives in Pittsburgh	25.8%		37.4%		26.6%		42.7%		.01
Patient is HMO member	16.7%		15.7%		33.7%		5.6%		<.001
Instability scores presented	26.7%		22.6%		34.4%		20.2%		.02

*Continuous variables were compared by Scheffe multiple comparison test; categorical variables were compared by Chi-square test.

†The original scores are arranged from 0 to 5350; the new scores are arranged from 0 (complete dependency or death) to 100 (completely independent).

‡The original scores are arranged from 0 to 6614; the new scores are arranged from 0 (complete dependency or death) to 100 (completely independent).

§The original scores are arranged from 0 to 5350; the new scores are arranged from 0 (complete dependency or death) to 100 (completely independent).

care hours per week at six weeks post-discharge, ethnicity, percentage of patients who had prior caregiver help, and percentage of patients who lived in either Houston or Pittsburgh. Among *CHF* patients, the discharge locations were significantly different for the following factors: discharge ADL scores; patient's self-expected ADL scores at six weeks post-discharge; sum of prior ADL and IADL scores, age, gender, cognitive status, admission APS score, and CHF-specific severity score; percentage of patients who lived alone; percentages of patients who had prior caregiver help or had a urinary catheter; percentages of patients who had hearing impairment, had instability, or lived in Houston; and the percentage of patients who were HMO members. For *hip procedure* patients, the following patient characteristics were statistically significantly different among discharge locations: discharge ADL scores, patient's self-expected ADL scores at six weeks post-discharge, the sum of prior ADL and IADL scores, age, cognitive status, prior health status, admission APS score, comorbidity score; percentage of patients who lived alone, who had prior caregiver help; who had speech or hearing impairment, who had instability, and who lived in either Houston or Pittsburgh; and the percentage of patients who were HMO members. Statistically significant differences were found in the *hip fracture* patients among discharge locations for discharge ADL scores, patient's self-expected ADL scores at six weeks post-discharge, sum of prior ADL and IADL scores, cognitive status, admission APS score, comorbidity score, hip fracture severity score; percentage of patients who lived alone, had speech or hearing impairment, had instability, had a urinary catheter, lived in either Houston or Pittsburgh, and had a role in discharge decision making; and the percentage of patients who were HMO members.

Outcomes

Table 2 presents the measures of goodness of fit for both the first-stage multinomial logistic regression model and the second-stage ordinary least squares regression model. Because the multinomial logic regressions do not provide a measure of the amount of variance explained similar to the coefficient of determination (R^2) as does the ordinary least squares regression, the predicted (hit) rate, which is the proportion of patients classified correctly by place of discharge for various models for different DRGs, was used to test the accuracy of the models. To interpret the accuracy of the classification, the predicted rate was compared with the rate of correct classification if one simply classified all patients into the most frequent (modal) discharge location

Table 2: Predictive Power for the Two-Stage Instrumental Variables Estimation Equations

Predictive Power for the First-Stage Multinomial Logit Model: Discharge Locations

Condition	*% Discharged to Modal Location*	*% Correctly Classified*	p-*Values**
Stroke	32.9	59.5	<.001
COPD	62.2	71.1	.011
CHF	56.3	63.5	.003
Hip procedure	55.6	68.1	<.001
Hip fracture	46.5	59.2	<.001

**P*-values were calculated by comparing predictive power of classification model to using modal category.

Predictive Power for the Second-Stage Model: Change in Function from Discharge to Six Weeks Post-Discharge

	Post-Acute Care Location			
Condition	*Home*	*Home Care*	*Nursing Home*	*Rehabilitation*
Stroke	0.41**	0.53**	0.35**	0.26**
COPD	0.35**	0.48**		
CHF	0.15**	0.55**	0.21	
Hip procedure	0.59**	0.36**	0.38**	
Hip fracture	0.38*	0.49**	0.31**	0.22*

*Significance level $p < .05$; **significance level $p < .01$.

Note: Adjusted R^2 values in second-stage model are based on multiple linear regression models corrected for selection bias.

(as opposed to assuming an equal distribution across sites). The adjusted R^2 (amount of variance explained) was used for the second-stage regression model. Table 2 displays the adjusted R^2 for models of each of the discharge locations outcomes at six weeks post-discharge. In most cases, the second-stage model used in this study explained a substantial proportion of variance in functional outcomes. The six-weeks models for rehabilitation were not significant because of sample size limits. The explanatory models for six months and one year were statistically significant.

The mean predicted (adjusted) functional outcomes measured by ADL scores (corrected for selection bias by IV estimation) at actual place of discharge for stroke, congestive heart failure, and hip fracture patients are shown in Figure 2. Stoke patients who went to nursing homes and rehabilitation were more dependent at discharge from the hospital than were stroke patients who were discharged to the community (home with or without formal home health care). Stroke patients who were discharged to formal home health care or rehabilitation regained a significant amount of function, and those discharged home without formal home health care showed a modest functional improvement, while those who went to nursing homes had functional decline. Although patients who received home care were more dependent on discharge than were those who went home with no formal care, their status was reversed by six months post-discharge.

When congestive heart failure patients were evaluated by discharge location, differences in functional status were present prior to hospitalization and at the time of discharge. All three groups became more dependent over time, although discharge to formal home care produced some evidence of improvement at six weeks.

Among patients who had hip fractures, those who went home with no formal care were less dependent at hospital discharge. All groups showed continued improvement through six months, but their functional status at twelve months post-discharge declined compared to its level at six months post-discharge.

Optimal Discharge Location

The optimal PAC location was defined as the PAC location that yielded the highest predicted functional improvement score. If this score was not at least one-and-a-half standard deviations higher (better) than the actual (observed) functional improvement score (a probability of .1 using a one-tailed standard pooled variance *t*-test), the actual discharge location was judged to be the optimal PAC location. The degree of agreement depended on several factors: the condition studied, the outcome measure used, and whether decedents were included. Table 3 contrasts the proportion of patients assigned to each potential discharge setting by using the location that produced the optimal functional outcomes at each of the three follow-up times compared to the proportion of patients who were actually discharged to that location. The percent concordance refers to the proportion of cases where the optimal and actual discharge locations were the same.

In general, the level of concordance was low, ranging from 23 percent to 50 percent, which indicated that, for many patients, the actual discharge location was not the post-acute care setting where they could achieve the maximum functional improvement. For stroke patients the levels of concordance were 23 percent, 30 percent, and 27 percent for six weeks, six months, and one year, respectively. To maximize the functional outcomes at six weeks, a greater percentage of patients should have been discharged

Figure 2: Selection Adjusted Mean Functional Dependency Score by Place of Discharge at Each Time Point

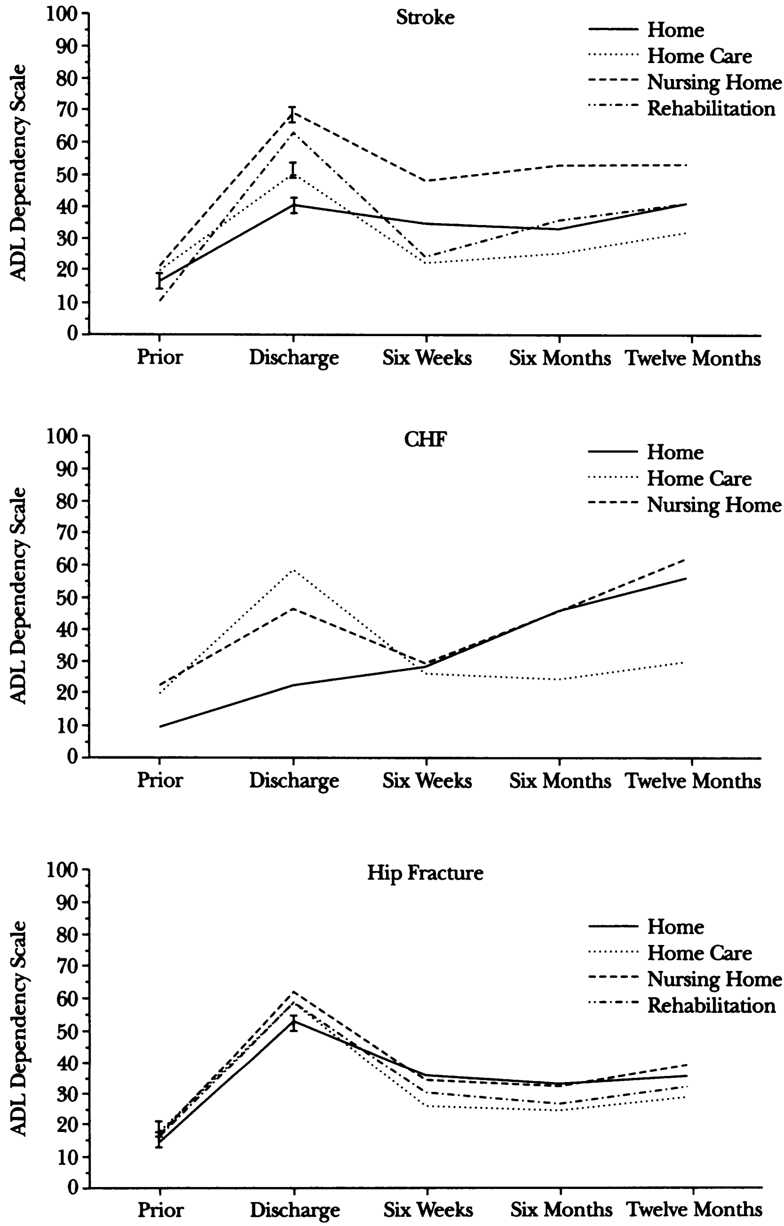


Table 3: Actual and Optimal Post-Acute Care Placements for Each Time Period Post-Discharge

	Percent of Patients Going to PAC Location				
	Home	*Home Care*	*NH*	*Rehab*	*% Concordance*
Stroke					
Actual	32.8	25.7	25.3	16.2	
6 weeks best	16.6	45.4	7.2	30.8	52
6 months best	23.6	51.3	2.5	22.6	26
12 months best	15.6	48.3	6.2	30.0	25
COPD					
Actual	62.2	37.8			
6 weeks best	23.5	76.5			54
6 months best	21.1	78.9			43
12 months best	53.3	46.7			56
CHF					
Actual	56.3	34.3	9.4		
6 weeks best	16.7	75.1	8.2		51
6 months best	23.9	59.6	16.5		41
12 months best	34.3	49.8	16.9		47
Hip Procedure					
Actual	55.6	24.6	19.8	–†	
6 weeks best	21.0	48.0	31.0	–	59
6 months best	23.7	49.8	26.4	–	34
12 months best	23.7	40.7	35.6	–	32
Hip Fracture					
Actual	19.8	19.0	46.5	14.7	
6 weeks best	14.9	53.8	21.6	9.7	50
6 months best	17.5	46.4	15.3	20.8	29
12 months best	26.4	41.1	11.4	21.1	23

†Estimations for rehabilitation are not available because of the small number of patients.

home with formal home health care while fewer should have been discharged to nursing homes or home without formal home health care. Similarly, to optimize functional improvement at six months and one year post-discharge, more patients should have been discharged to home health care and fewer patients should have been discharged to nursing homes and home without formal home health care.

For chronic obstructive pulmonary disease, about two-thirds of patients were actually discharged home without any formal home health care; only one-third received formal home health care. The optimization results indicated an opposite direction. To achieve the maximum functioning at six weeks and six months post-discharge, two-thirds of these patients should have gone home with formal home health care, and only one-third of COPD patients should have been discharged home without formal home health care. To maximize one-year functional outcomes, 50 percent of the COPD patients should have been discharged home without formal home health care and 50 percent should have been discharged to formal home health care.

For congestive heart failure and hip procedure patients, to achieve maximum functional outcomes at all three time periods, more patients (over 50 percent) should have been discharged to formal home health care instead of no formal home health care. For both conditions, the proportion actually discharged to nursing homes closely approximated the results obtained for an optimal proportion of nursing home discharges over the time periods.

The results of the optimal discharge location analysis for hip fracture patients demonstrated that a greater percentage (over 40 percent) of patients should have been discharged to formal home health care and fewer (less than 15 percent) should have been discharged to nursing homes. This pattern was consistent at each follow-up time point.

In summary, for each DRG and at all three follow-up time points, to optimize the functional outcomes, a greater percentage of patients should be discharged to formal home health care and a lesser percentage should be discharged to nursing homes compared to the actual discharge locations.

The interpretations of the most appropriate discharge locations changed when different outcome measures were used for patients who survived to each follow-up time point. By one year after discharge 21 percent of the sample had died. This proportion varied by diagnosis. The highest mortality rate was among those with congestive heart failure, where 48 percent had died by one year. Of the patients with chronic obstructive pulmonary disease, 35 percent had died; 21 percent of the stroke patients, 13 percent of the hip fracture patients, and only 8 percent of hip procedure patients had died by one year after discharge.

The comparison of actual and optimal post-hospital care location based on the predicted ADL functional scores was again conducted for surviving patients at each of three follow-up time points displayed in Table 4. In addition, the two-stage IVs estimation technique was also applied to obtain the predicted condition-specific outcome scores, and the optimal discharge location was determined for all of the DRGs except stroke, for which no such measure was developed. Because the number of patients included decreased with each follow-up point, the actual distribution of patients to each discharge location was slightly different at each time. Therefore, for comparison purposes, the actual discharge figures were based on the numbers of patients surviving at six weeks.

Table 4: Comparison of Actual Post-Acute Care Placements Versus Optimal Placements Among Surviving Patients at Three Post-Discharge Time Periods

Stroke	Home ADL Score	Home Care ADL Score	Nursing Home ADL Score	Rehabilitation ADL Score
Actual Placement†	33%	28%	22%	17%
6 weeks Optimal Placement	19%	46%	7%	28%
6 months Optimal Placement	24%	48%	3%	25%
12 months Optimal Placement	18%	46%	6%	30%

COPD	Home ADL Score	Home COPD Score	Home Care ADL Score	Home Care COPD Score
Actual Placement	60%		40%	
6 weeks Optimal Placement	19%	26%	81%	74%
6 months Optimal Placement	25%	44%	75%	56%
12 months Optimal Placement	58%	35%	43%	65%

CHF	Home ADL Score	Home CHF Score	Home Care ADL Score	Home Care CHF Score	Nursing Home ADL Score	Nursing Home CHF Score
Actual Placement	54%		38%		8%	
6 weeks Optimal Placement	15%	13%	76%	44%	9%	43%
6 months Optimal Placement	27%	35%	73%	65%	–‡	–
12 months Optimal Placement	46%	47%	54%	53%	–	–

continued

Table 4. *Continued*

	Home		*Home Care*		*Nursing Home*	
Hip Procedure	*ADL Score*	*Walking Score*	*ADL Score*	*Walking Score*	*ADL Score*	*Walking Score*
Actual Placement	56%		25%		20%	
6 weeks Optimal Placement	19%	32%	50%	63%	31%	4%
6 months Optimal Placement	25%	46%	49%	42%	26%	12%
12 months Optimal Placement	23%	35%	41%	64%	36%	0.4%

	Home		*Home Care*		*Nursing Home*		*Rehabilitation*	
Hip Fracture	*ADL Score*	*Walking Score*	*ADL Score*	*Walking Score*	*ADL Score*	*Walking Score*	*ADL Score*	*Walking Score*
Actual Placement	19%		20%		46%		15%	
6 weeks Optimal Placement	15%	23%	52%	33%	21%	4%	12%	40%
6 months Optimal Placement	19%	60%	43%	0.2%	16%	0.2%	22%	39%
12 months Optimal Placement	25%	59%	40%	4%	12%	35%	23%	2%

†Distribution of actual cases is different from that in Table 3 because only survivors are addressed here.

‡Sample size was too small to obtain a stable estimate.

For stroke patients, the interpretations of the most appropriate location remained the same when analysis was conducted on surviving patients. More stroke patients should have been discharged to formal home health care. For COPD patients, the results of both the functional score and the condition-specific outcomes measures were consistent and showed that patients' six-week, six-month, and twelve-month outcomes would have improved if more patients had received formal home health care. For CHF patients, the functional score outcomes at all follow-up time points suggested that a greater percentage of patients should be discharged to formal home health care and fewer patients should be discharged home without formal home health care. If the condition-specific score was used, many more patients should have gone to nursing homes to achieve a better six-week outcome, but the six-month and twelve-month outcomes would have improved if more patients had been discharged to formal home health care.

Using the ADL functional score with the hip procedure patients indicated, more patients at each follow-up time point should be discharged to formal home health care and fewer should go home with no formal care. In addition, the six-month and twelve-month results suggested that fewer hip procedure patients should be discharged to nursing homes. The results from the walking score draw a similar conclusion and suggest, when using six-month and twelve-month follow-up, that even fewer patients should be discharged to nursing homes. Based on the ADL functional score for all three follow-up time points, hip fracture patients' outcome would be optimized if more patients received formal home health care and fewer patients were discharged to nursing homes. On the other hand, using the walking score would favor sending patients to rehabilitation facilities for better outcomes at six-week and six-month follow-up. In addition, a better walking score could be achieved at six months and twelve months post-discharge by sending patients home without formal home health care. Furthermore, the results of the 12-month walking score suggested that better walking scores could be achieved by sending fewer patients home with formal home health care or rehabilitation.

Predicted Functional Outcomes at Actual Discharge Locations Versus the Optimal Discharge Location

Table 5 contrasts the case mix–adjusted (predicted) functional outcomes at a patient's actual discharge location and the predicted functional outcomes that would be achieved in the patient's optimal discharge location according to the type of PAC received. As shown in Table 5, discharging patients to their optimal discharge location would result in an additional 0.16 to 30.44 percent of functional improvement depending on patient diagnosis and post-acute care location. Stroke patients would benefit the most, with 3 to 18 percent of additional functional improvement as measured by the ADL scores, if they were discharged to their optimal location. For stroke patients, the functional improvement in optimal discharge location was statistically significantly higher compared to patients' actual discharge location at all three follow-up time periods. The additional benefit of discharging to the optimal post-hospital care location ranged from 0.4 to 13.2 percent for hip procedure and hip fracture patients, and the additional functional improvement in optimal discharge location ranged from 0.16 to 30.44 percent for COPD and CHF patients. Although the optimal discharge locations would yield additional functional improvement compared to patients' actual discharge locations for COPD, CHF, hip procedure, and hip fracture patients, they were not all statistically significant.

DISCUSSION

The findings from this study suggest that better decisions about where older patients should go upon discharge from hospitals can lead to better outcomes. To some extent, the specific recommendations will depend on what point in time after discharge one uses for a follow-up reference and the nature of the measure employed to assess the outcomes of care. Before definitive recommendations can be offered, policy decisions must be made, for example, about whether to consider the implications of a patient population with a high mortality rate in assessing functional benefit.

Nonetheless, it appears that in several instances a better choice of PAC modality could lead to improved functioning. Some of the findings raise important questions. Going home, with and without formal home health services, may be associated with doing better. Some of this difference may be attributed to a failure to account for differences among groups despite the application of sophisticated statistical techniques. Another explanation is the crucial role played by family members who provide informal care.

The pattern of optimal care suggests that nursing homes today are being asked to provide a type of care for which they are not well equipped. The emergence of so-called "subacute care" units is a response to the demand to provide a level of nursing home care formally offered in hospitals. Ironically, this level of care was envisioned by Medicare's designers, who called for extended care facilities in which patients could recuperate. Much remains to be

Table 5: Comparison of Case Mix–adjusted Actual Functional Improvement by Discharge Location Versus Estimated Functional Improvement by Optimal Discharge Location

	6 Weeks			6 Months			12 Months		
	% Actual Functional Improvement	*% Optimal Functional Improvement*	*Additional Gain by Optimal Location*	*% Actual Functional Improvement*	*% Optimal Functional Improvement*	*Additional Gain by Optimal Location*	*% Actual Functional Improvement*	*% Optimal Functional Improvement*	*Additional Gain by Optimal Location*
Stroke									
Home	14.10	20.49**	6.96%	15.44	18.69*	3.25%	6.80	14.27**	7.47%
Home Care	24.26	37.56**	13.30%	20.46	26.84**	6.38%	13.55	24.65**	11.1%
Nursing Home	0.69	17.62**	16.93%	−5.93	12.35**	18.32%	−6.66	9.52**	16.18%
Rehabilitation	23.15	26.27*	3.12%	13.94	29.46**	15.52%	7.76	23.62**	15.86%
COPD									
Home	3.50	6.40*	2.9%	−6.23	−4.62	1.61%	−12.35	−8.93*	3.42%
Home Care	11.05	14.83*	3.78%	3.17	6.45*	3.28%	−11.27	−3.90**	7.37%
CHF									
Home	−0.69†	5.29**	5.98%	−16.94	−16.78	0.16%	−27.92	−23.21*	4.71%
Home Care	11.03	13.15	2.12%	−6.06	4.39**	10.45%	−23.26	−14.69**	8.57%
Nursing Home	−1.63	17.03**	18.66%	−17.87	2.05**	19.92%	−35.58	−5.14**	30.44%
Hip Procedure									
Home	22.62	24.69	2.07%	29.29	30.16	0.87%	30.75	40.35**	9.60%
Home Care	27.95	35.78**	7.83%	32.34	35.39*	3.05%	32.72	39.56**	6.84%
Nursing Home	25.70	26.11	0.41%	27.15	33.24**	6.09%	33.82	41.44**	7.62%
Hip Fracture									
Home	19.26	32.04**	12.78%	21.70	24.91*	3.21%	19.48	31.32**	11.84%
Home Care	29.08	33.60*	4.52%	30.07	33.62*	3.55%	23.63	32.64**	9.01%
Nursing Home	20.19	22.55	2.36%	22.91	24.41	1.5%	17.59	24.36**	6.77%
Rehabilitation	21.80	27.37**	5.57%	26.93	37.26**	10.33%	20.03	33.27**	13.24%

*Significant level < .05 (optimal vs. actual); **significant level < .01 (optimal vs. actual).

†Minus sign indicates that the functional outcomes at follow-up had deteriorated from the time of hospital discharge.

understood about just what aspects of care will distinguish the achievements of this new generation of nursing homes from those of their predecessors. When we compared outcomes in the nursing homes in our data set with more rehabilitative services to the rest, we found only modest advantages for stroke patients and none for hip fracture patients (Kane et al. 1996). Another study, which compared the results of care in so-called subacute facilities with the result in formal rehabilitation and traditional nursing homes, found a benefit from rehabilitation for stroke patients but not for hip fracture patients and a similar advantage when contrasting the results of subacute care over traditional nursing home care (Kramer, Steiner, Schlenker, et al. 1997).

The discrepancies between actual and optimal discharge locations suggest that patients' functional outcomes can be improved significantly if we can obtain and apply the information on functional outcomes to develop a system for hospital discharge decision making. Especially for stroke, hip procedure, and hip fracture patients, a better-targeted discharge could result in substantial functional improvement for these patients. The current pressure to discharge patients quickly and the absence of an empirical database that can assist discharge planners in identifying the most efficacious PAC service combine to limit the options considered at this crucial juncture. Efforts are under way to improve hospital discharge planning. Several years ago the Health Care Financing Administration established a commission to develop standards for assessing patients prior to make a discharge plan. The feasibility of using the Uniform Needs Assessment Instrument (UNAI) developed by that group is just now being tested.

This study can be faulted on several grounds. It did not rely on a randomized allocation design. Rather, it used post hoc statistical techniques to correct for differences among the groups being studied. The sample itself cannot be said to be representative of the nation. The three cities chosen for study had ample supplies of all three of the PAC modalities. Hospitals and patients participated voluntarily. Nonetheless, this study represents a model that will likely be used more often in the future: the application of epidemiological methods to study the outcomes of care. Randomized clinical trials will not suffice to provide all of the information needed as the basis for decisions about appropriate care.

This study suggests that it is possible to do a better job with PAC. Providing more time and better data to make decisions can improve the discharge planning process. Re-examination of the relative merits of PAC alternatives also is necessary. Our study findings support the broader use of home care and raise questions about the role of nursing homes. Decisions about the appropriateness of rehabilitative care need to address both the effectiveness and the duration of benefits. Emerging forms of PAC combine desirable attributes of current PAC modalities, but the efficiency of these new subacute approaches will need to be carefully evaluated.

One way to encourage more effective choices about post-hospital care would be to bundle the payment for hospitals with that for post-hospital care. Setting the rate for such bundling should rely on information such as that presented here. The correct rate should be based not on the average cost of a given care modality, but on the cost of care that produces the optimal results. Too many rate-setting schemes have relied on average costs when they should have used the costs associated with the functional outcomes they wanted to achieve. Obtaining such information, however, can be a labor-intensive process. This study represents a first step along that important path.

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APPENDIX

Table A1: Estimation Results of Functional Outcomes for Stroke Patients at Six Weeks Post-Discharge

Variable	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*
Constant	32.92	(28.81)	.25	−25.34	(22.86)	.27	52.47	(34.97)	.13	51.55	(52.50)	.33
Discharge ADL	−0.16	(0.20)	.44	−0.86	(0.09)	.00	−0.78	(0.27)	.00	−0.29	(0.19)	.12
Expected ADL	0.07	(0.31)	.83	0.30	(0.11)	.01	0.31	(0.27)	.24	0.00	(0.12)	.99
Prior ADL/IADL	0.08	(0.22)	.70	0.52	(0.10)	.00	0.13	(0.16)	.40	−0.11	(0.43)	.80
Lived Alone	−2.55	(5.99)	.67	−11.09	(3.42)	.00	−5.91	(5.74)	.30	−1.54	(4.11)	.71
Age	−0.11	(0.29)	.70	0.00	(0.24)	1.00	−0.09	(0.48)	.85	−0.06	(0.41)	.88
Sex	−1.59	(3.67)	.66	5.12	(3.89)	.19	0.66	(4.85)	.89	−5.51	(4.28)	.20
Race	−6.73	(5.99)	.26	−10.56	(4.77)	.03	−†	–	–	−1.51	(5.40)	.78
Cognitive Status	−0.25	(0.80)	.75	0.38	(0.71)	.59	−2.95	(0.92)	.00	−0.73	(0.82)	.38
Prior Health Status	1.41	(2.44)	.57	4.64	(2.10)	.03	−2.52	(2.62)	.34	4.55	(2.82)	.11
Lives in Houston	−9.93	(4.33)	.02	−21.94	(4.82)	.00	−26.79	(18.22)	.14	3.72	(7.24)	.61
Lives in Pittsburgh	−6.63	(4.00)	.10	−9.40	(4.09)	.02	−6.62	(7.12)	.35	0.78	(7.80)	.92
HMO Member	6.21	(4.14)	.13	4.83	(4.77)	.31	−5.04	(4.42)	.25	−5.62	(12.23)	.65
Admission APS	−1.08	(0.71)	.13	0.82	(0.52)	.12	0.48	(0.31)	.13	−1.27	(0.60)	.03
Comorbidity Score	0.29	(0.37)	.43	−0.20	(0.29)	.49	−0.34	(0.49)	.49	0.86	(0.43)	.04
Instability Score	9.13	(4.84)	.06	20.14	(4.99)	.00	−13.88	(5.57)	.01	−6.62	(4.48)	.14
Stroke-specific Score	−1.23	(1.30)	.34	−0.77	(1.08)	.47	−1.91	(1.74)	.27	−1.31	(2.68)	.62
Probabilities of PAC Type	−22.88	(20.85)	.27	60.87	(14.67)	.00	2.84	(27.92)	.92	8.16	(15.88)	.61
R^2 (Adj R^2)	0.48	(0.41)		0.59	(0.53)		0.44	(0.35)		0.26	(0.22)	

†Did not include this variable in the regression model.

Table A2: Estimation Results of Functional Outcomes for COPD Patients at Six Weeks Post-Discharge

Variable	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*
Constant	−39.26	(44.53)	.38	−4.69	(17.75)	.79
Discharge ADL	−0.40	(0.12)	.00	−0.80	(0.08)	.00
Expected ADL	0.57	(0.40)	.16	0.46	(0.11)	.00
Prior ADL/IADL	0.64	(0.30)	.03	0.33	(0.11)	.00
Lived Alone	−2.65	(4.68)	.57	1.69	(2.97)	.57
Age	0.04	(0.34)	.90	−0.09	(0.19)	.65
Sex	4.20	(4.08)	.30	1.50	(2.47)	.54
Race	0.26	(9.43)	.98	−2.40	(5.03)	.63
Cognitive Status	0.80	(1.23)	.51	−0.84	(0.76)	.27
Prior Health Status	−1.17	(2.05)	.57	4.30	(1.85)	.02
Lives in Houston	4.98	(5.01)	.32	2.96	(4.98)	.55
Lives in Pittsburgh	0.72	(5.50)	.90	−5.20	(3.25)	.11
HMO Member	−6.00	(5.00)	.23	−0.44	(3.81)	.91
Admission APS	−1.25	(0.67)	.06	−0.04	(0.42)	.92
Comorbidity Score	−0.17	(0.43)	.70	−0.14	(0.24)	.55
Instability Score	3.31	(5.15)	.52	−1.84	(2.66)	.49
COPD-specific Score	−0.19	(1.67)	.91	−0.59	(1.05)	.57
Probabilities of PAC Type	−31.80	(26.84)	.24	18.00	(15.26)	.24
R^2 (Adj R^2)	0.42	(0.35)		0.54	(0.48)	

Table A3: Estimation Results of Functional Outcomes for CHF Patients at Six Weeks Post-Discharge

Variable	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*
Constant	20.69	(35.94)	.56	15.18	(19.65)	.44	1.23	(63.88)	.98
Discharge ADL	−0.35	(0.13)	.01	−0.89	(0.06)	.00	−0.79	(0.30)	.01
Expected ADL	0.61	(0.26)	.02	0.42	(0.13)	.00	0.38	(0.48)	.43
Prior ADL/IADL	0.76	(0.33)	.02	0.32	(0.13)	.01	0.06	(0.36)	.86
Lived Alone	−13.81	(6.37)	.03	2.48	(2.59)	.34	6.42	(12.82)	.62
Age	−0.51	(0.32)	.11	−0.02	(0.16)	.88	−0.01	(0.71)	.99
Sex	0.71	(4.49)	.87	0.90	(2.95)	.76	−0.59	(9.80)	.95
Race	0.29	(5.10)	.96	−1.27	(3.26)	.70	–†	–	–
Cognitive Status	−0.60	(1.03)	.56	−0.45	(0.57)	.43	−0.60	(2.00)	.76
Prior Health Status	−2.47	(2.03)	.22	−0.64	(1.37)	.64	3.20	(6.13)	.60
Lives in Houston	16.64	(7.19)	.02	−5.06	(3.71)	.17	23.65	(22.63)	.30
Lives in Pittsburgh	3.01	(5.11)	.56	−3.84	(2.68)	.15	10.48	(12.36)	.40
HMO Member	7.70	(5.26)	.14	0.58	(3.57)	.87	30.07	(13.15)	.02
Admission APS	−0.20	(0.56)	.72	0.06	(0.34)	.85	0.92	(1.57)	.56
Comorbidity Score	−0.82	(0.39)	.04	0.13	(0.21)	.55	0.84	(1.05)	.42
Instability Score	−9.61	(6.10)	.11	1.11	(2.65)	.68	5.27	(9.57)	.58
CHF-specific Score	−2.83	(1.51)	.06	−1.00	(0.91)	.27	−6.50	(4.09)	.11
Probabilities of PAC Type	−92.39	(35.74)	.01	3.05	(11.97)	.80	−30.36	(44.75)	.50
R^2 (Adj R^2)	0.18	(0.15)		0.60	(0.55)		0.31	(0.21)	

†See Table A1.

Table A4: Estimation Results of Functional Outcomes for Hip Procedure Patients at Six Weeks Post-Discharge

Variable	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*
Constant	79.75	(84.71)	.35	75.18	(39.63)	.06	122.39	(123.45)	.32
Discharge ADL	−0.92	(0.09)	.00	−1.05	(0.06)	.00	−0.51	(0.13)	.00
Expected ADL	0.12	(0.35)	.74	0.04	(0.26)	.89	−0.12	(0.43)	.79
Prior ADL/IADL	0.20	(0.58)	.73	0.32	(0.35)	.36	0.17	(0.16)	.30
Lived Alone	2.61	(8.97)	.77	2.33	(5.96)	.70	−1.41	(13.19)	.91
Age	−0.22	(0.65)	.73	0.02	(0.49)	.97	−0.77	(1.27)	.54
Sex	−4.13	(3.63)	.26	−2.39	(1.29)	.06	−4.63	(19.18)	.81
Race	−0.21	(5.00)	.97	−13.64	(4.22)	.00	–†	–	–
Cognitive Status	0.27	(3.50)	.94	−0.25	(1.08)	.81	−2.19	(4.59)	.63
Prior Health Status	−2.08	(2.24)	.35	−2.48	(1.09)	.03	−3.51	(1.50)	.02
Lives in Houston	−0.42	(2.31)	.86	3.39	(10.95)	.76	−11.97	(12.98)	.36
Lives in Pittsburgh	−11.04	(3.85)	.00	−1.98	(7.89)	.80	−6.65	(4.73)	.17
HMO Member	−0.14	(2.02)	.95	−5.11	(9.90)	.61	5.52	(3.65)	.14
Admission APS	0.03	(0.51)	.95	−0.45	(0.84)	.59	0.31	(0.91)	.74
Comorbidity Score	−0.69	(0.99)	.49	−0.01	(0.48)	.98	0.23	(0.30)	.45
Instability Score	1.10	(8.29)	.89	−2.02	(3.13)	.52	−2.61	(3.18)	.42
Probabilities of PAC Type		(35.39)	.95	−21.92	(22.96)	.34	16.34	(10.81)	.14
R^2 (Adj R^2)	0.63	(0.59)		0.47	(0.36)		0.52	(0.38)	

†See Table A1.

Table A5: Estimation Results of Functional Outcomes for Hip Fracture Patients at Six Weeks Post-Discharge

Variable	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*
Constant	64.71	(32.85)	.05	34.59	(20.83)	.10	32.92	(21.94)	.13	7.08	(34.61)	.84
Discharge ADL	−0.74	(0.14)	.00	−0.99	(0.09)	.00	−0.84	(0.10)	.00	−0.73	(0.17)	.00
Expected ADL	0.03	(0.19)	.89	0.15	(0.13)	.24	0.21	(0.09)	.02	0.27	(0.17)	.13
Prior ADL/IADL	0.33	(0.24)	.17	0.36	(0.10)	.00	0.40	(0.11)	.00	0.48	(0.19)	.01
Lived Alone	1.48	(7.49)	.84	5.29	(2.75)	.05	5.03	(2.96)	.09	2.13	(5.25)	.68
Age	−0.77	(0.21)	.00	0.08	(0.22)	.72	−0.25	(0.25)	.33	−0.30	(0.30)	.33
Sex	−3.77	(5.85)	.52	−1.20	(3.53)	.73	4.35	(3.65)	.24	0.58	(6.29)	.93
Cognitive Status	1.27	(1.56)	.42	−2.21	(0.70)	.00	−0.30	(0.58)	.61	−0.15	(1.33)	.91
Prior Health Status	3.20	(3.74)	.39	−2.02	(1.88)	.28	0.45	(1.84)	.81	−1.46	(2.96)	.62
Lives in Houston	5.32	(5.55)	.34	−7.14	(4.49)	.11	–†	–	–	–†	–	–
Lives in Pittsburgh	−6.81	(7.44)	.36	−3.44	(4.04)	.39	−5.25	(3.73)	.16	5.14	(5.18)	.32
HMO Member	16.63	(5.59)	.00	−2.04	(4.85)	.67	2.45	(2.84)	.39	17.60	(12.99)	.18
Admission APS	0.63	(0.61)	.30	−1.20	(0.62)	.05	0.12	(0.94)	.90	–†	–	–
Comorbidity Score	−0.76	(0.64)	.24	−0.47	(0.34)	.16	−0.46	(0.29)	.11	0.03	(0.49)	.94
Instability Score	−0.02	(4.87)	1.00	−0.71	(3.24)	.83	−4.89	(2.83)	.09	−1.79	(6.31)	.78
Hip-specific Score	0.99	(2.73)	.72	0.64	(1.36)	.64	−1.11	(1.18)	.35	1.03	(2.68)	.70
Arthroplasty	11.65	(7.06)	.10	7.59	(4.15)	.07	4.96	(4.20)	.24	2.74	(5.93)	.64
Probabilities of PAC Type	−11.53	(24.47)	.64	11.85	(17.87)	.51	−1.92	(10.97)	.86	25.21	(16.48)	.13
R^2 (Adj R^2)	0.47	(0.38)		0.57	(0.49)		0.40	(0.31)		0.35	(0.22)	

†See Table A1.

Table A6: Estimation Results of Functional Outcomes for Stroke Patients at Six Months Post-Discharge

Variable	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*
Constant	50.14	(28.13)	.08	−3.27	(33.62)	.92	34.95	(37.73)	.35	100.98	(87.68)	.25
Discharge ADL	−0.09	(0.18)	.61	−0.96	(0.13)	.00	−0.87	(0.24)	.00	−0.59	(0.10)	.00
Expected ADL	−0.05	(0.25)	.84	0.19	(0.16)	.21	0.01	(0.24)	.98	−0.31	(0.08)	.00
Prior ADL/IADL	0.49	(0.19)	.01	0.49	(0.16)	.00	0.25	(0.16)	.11	0.55	(0.71)	.44
Lived Alone	3.60	(4.72)	.45	−5.79	(5.38)	.28	0.56	(6.09)	.93	−9.86	(6.42)	.13
Age	−0.56	(0.31)	.08	0.01	(0.34)	.99	0.38	(0.47)	.41	−1.08	(0.59)	.07
Sex	−3.50	(3.66)	.34	4.36	(5.78)	.45	−2.60	(5.46)	.63	−1.68	(2.74)	.54
Race	−7.10	(6.41)	.27	−15.75	(7.54)	.04	−†	–	–	2.82	(8.95)	.75
Cognitive Status	1.76	(0.85)	.04	−0.79	(1.00)	.43	−2.18	(0.92)	.02	−1.67	(0.86)	.06
Prior Health Status	−0.34	(2.63)	.90	4.42	(3.01)	.14	−4.61	(2.80)	.10	8.08	(3.68)	.03
Lives in Houston	−11.35	(5.94)	.06	−7.78	(7.29)	.29	−32.58	(16.10)	.04	−2.29	(8.68)	.79
Lives in Pittsburgh	−12.28	(4.43)	.01	2.99	(5.82)	.61	−4.08	(7.24)	.57	10.47	(6.59)	.12
HMO Member	9.32	(4.11)	.02	−2.36	(6.83)	.73	4.85	(5.80)	.40	−1.16	(10.41)	.91
Admission APS	−1.08	(0.58)	.07	0.19	(0.83)	.82	0.28	(0.58)	.62	−1.16	(0.92)	.21
Comorbidity Score	−0.23	(0.40)	.57	−1.07	(0.47)	.02	−0.29	(0.51)	.57	−0.30	(0.20)	.14
Instability Score	8.95	(4.45)	.05	13.73	(7.03)	.05	−10.59	(6.03)	.08	−6.64	(3.78)	.08
Stroke-specific Score	−2.19	(1.50)	.15	−0.57	(1.80)	.75	−1.65	(1.82)	.37	−1.71	(3.66)	.64
Probabilities of PAC Type	−41.84	(17.76)	.02	53.08	(23.26)	.02	−28.75	(26.26)	.27	15.85	(6.15)	.01
R^2 (Adj R^2)	0.36	(0.30)		0.40	(0.32)		0.34	(0.26)		0.42	(0.27)	

†See Table A1.

Table A7: Estimation Results of Functional Outcomes for COPD Patients at Six Months Post-Discharge

Variable	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*
Constant	−67.04	(62.74)	.29	−31.29	(28.61)	.27
Discharge ADL	−0.46	(0.16)	.00	−0.81	(0.13)	.00
Expected ADL	0.38	(0.59)	.52	0.47	(0.16)	.00
Prior ADL/IADL	0.88	(0.44)	.05	0.72	(0.16)	.00
Lived Alone	1.33	(6.09)	.83	−2.03	(5.53)	.71
Age	0.23	(0.46)	.62	−0.25	(0.35)	.47
Sex	7.23	(5.49)	.19	3.68	(4.42)	.40
Race	18.34	(12.53)	.14	1.11	(8.98)	.90
Cognitive Status	0.32	(1.69)	.85	−0.07	(1.43)	.96
Prior Health Status	−2.58	(2.32)	.27	3.00	(3.73)	.42
Lives in Houston	−3.18	(3.70)	.39	6.79	(10.25)	.51
Lives in Pittsburgh	−6.02	(7.05)	.39	−6.13	(6.43)	.34
HMO Member	−6.62	(5.88)	.26	9.71	(7.56)	.20
Admission APS	−0.52	(0.92)	.57	−1.45	(0.73)	.05
Comorbidity Score	−0.79	(0.57)	.17	−0.31	(0.46)	.50
Instability Score	−12.26	(6.53)	.06	−9.49	(4.94)	.05
COPD-specific Score	−2.41	(2.28)	.29	−0.70	(2.06)	.74
Probabilities of PAC Type	−18.69	(35.61)	.60	40.16	(31.12)	.20
R^2 (Adj R^2)	0.26	(0.21)		0.32	(0.22)	

†See Table A1.

Table A8: Estimation Results of Functional Outcomes for CHF Patients at Six Months Post-Discharge

Variable	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*
Constant	31.40	(46.23)	.50	−38.92	(45.61)	.39	25.11	(73.91)	.73
Discharge ADL	−0.34	(0.17)	.04	−0.76	(0.15)	.00	−1.06	(0.35)	.00
Expected ADL	0.54	(0.33)	.10	0.56	(0.29)	.05	0.27	(0.55)	.62
Prior ADL/IADL	0.74	(0.42)	.08	0.50	(0.30)	.09	0.10	(0.41)	.80
Lived Alone	−15.18	(7.99)	.06	3.87	(6.02)	.52	12.94	(14.75)	.38
Age	−0.78	(0.40)	.05	−0.20	(0.37)	.59	0.09	(0.82)	.91
Sex	0.21	(5.64)	.97	0.06	(6.90)	.99	2.74	(11.26)	.81
Race	8.18	(6.47)	.21	−5.74	(7.58)	.45	–†	–	–
Cognitive Status	−1.40	(1.31)	.29	2.30	(1.33)	.08	1.20	(2.27)	.60
Prior Health Status	−1.84	(2.57)	.47	−0.97	(3.17)	.76	−5.61	(7.06)	.43
Lives in Houston	16.55	(8.94)	.06	−7.28	(8.64)	.40	21.65	(26.09)	.41
Lives in Pittsburgh	4.69	(6.48)	.47	−1.77	(6.22)	.78	−0.33	(14.45)	.98
HMO Member	7.03	(6.66)	.29	12.12	(8.30)	.14	21.87	(14.84)	.14
Admission APS	0.41	(0.70)	.56	−1.53	(0.79)	.05	−3.10	(1.75)	.08
Comorbidity Score	−1.01	(0.50)	.04	0.81	(0.49)	.10	−0.69	(1.21)	.57
Instability Score	−14.89	(7.74)	.05	−6.62	(6.09)	.28	5.46	(10.79)	.61
CHF-specific Score	−2.27	(1.91)	.23	−1.60	(2.11)	.45	4.49	(4.70)	.34
Probabilities of PAC Type	−88.80	(45.12)	.05	40.71	(27.62)	.14	−61.53	(50.97)	.23
R^2 (Adj R^2)	0.22	(0.16)		0.63	(0.52)		0.34	(0.19)	

†See Table A1.

Table A9: Estimation Results of Functional Outcomes for Hip Procedure Patients at Six Months Post-Discharge

Variable	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*
Constant	106.47	(110.62)	.34	66.01	(19.24)	.00	104.38	(112.78)	.35
Discharge ADL	−0.95	(0.05)	.00	66.01	(34.28)	.05	−0.53	(0.30)	.08
Expected ADL	−0.01	(0.47)	.98	0.00	(0.19)	1.00	0.07	(0.14)	.59
Prior ADL/IADL	0.55	(0.77)	.48	0.58	(0.30)	.05	0.27	(0.27)	.33
Lived Alone	−4.21	(11.69)	.72	4.45	(5.18)	.39	−10.15	(9.11)	.27
Age	−0.59	(0.81)	.47	−0.15	(0.40)	.70	−0.86	(1.14)	.45
Sex	2.31	(4.29)	.59	−2.03	(2.68)	.45	8.78	(16.82)	.60
Race	1.75	(3.44)	.61	−6.11	(4.52)	.18	–†	–	–
Cognitive Status	−0.83	(4.63)	.86	−2.45	(1.43)	.09	−4.27	(4.14)	.30
Prior Health Status	−0.88	(2.95)	.76	−2.26	(1.58)	.15	−1.70	(6.89)	.80
Lives in Houston	0.17	(1.66)	.92	−5.55	(9.07)	.54	−18.89	(35.11)	.59
Lives in Pittsburgh	−14.91	(5.40)	.01	−3.17	(6.62)	.63	−22.34	(7.18)	.00
HMO Member	−0.51	(1.85)	.78	−4.87	(9.13)	.59	1.73	(6.57)	.79
Admission APS	−0.22	(0.63)	.73	−0.28	(0.79)	.72	−3.87	(2.81)	.17
Comorbidity Score	−1.24	(1.32)	.35	−0.55	(0.40)	.16	0.23	(1.59)	.88
Instability Score	2.65	(10.81)	.81	1.22	(1.89)	.52	0.81	(4.94)	.87
Probabilities of PAC Type	−20.77	(46.37)	.65	0.91	(9.05)	.92	38.63	(39.93)	.33
R^2 (Adj R^2)	0.63	(0.52)		0.45	(0.38)		0.51	(0.34)	

†See Table A1.

Table A10: Estimation Results of Functional Outcomes for Hip Fracture Patients at Six Months Post-Discharge

Variable	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*
Constant	23.79	(39.17)	.54	1.23	(36.07)	.97	−22.82	(30.20)	.45	42.80	(38.52)	.27
Discharge ADL	−0.91	(0.21)	.00	−1.14	(0.15)	.00	−0.83	(0.15)	.00	−0.97	(0.21)	.00
Expected ADL	0.04	(0.16)	.82	0.09	(0.21)	.69	0.18	(0.14)	.21	0.17	(0.19)	.38
Prior ADL/IADL	0.47	(0.18)	.01	0.47	(0.16)	.00	0.53	(0.15)	.00	0.59	(0.21)	.00
Lived Alone	7.75	(7.69)	.31	−0.80	(4.83)	.87	4.04	(4.11)	.33	8.16	(5.24)	.12
Age	−0.52	(0.41)	.20	0.62	(0.42)	.14	0.36	(0.34)	.29	−0.54	(0.32)	.09
Sex	−3.86	(4.83)	.42	−4.99	(5.55)	.37	12.83	(4.99)	.01	−5.24	(5.87)	.37
Cognitive Status	1.04	(1.15)	.37	−3.29	(1.04)	.00	−0.35	(0.73)	.64	−1.25	(1.67)	.45
Prior Health Status	1.29	(2.71)	.63	−0.31	(2.85)	.91	0.28	(2.33)	.91	5.12	(3.13)	.10
Lives in Houston	7.37	(5.48)	.18	−8.37	(7.09)	.24	−†	–	–	−†	–	–
Lives in Pittsburgh	0.02	(5.71)	1.00	−8.87	(6.18)	.15	−3.55	(5.03)	.48	−1.53	(6.10)	.80
HMO Member	17.42	(5.83)	.00	−4.83	(6.86)	.48	6.65	(3.48)	.06	14.64	(18.03)	.42
Admission APS	−1.08	(1.00)	.28	−0.21	(1.00)	.84	−1.41	(0.81)	.08	−0.05	(1.06)	.96
Comorbidity Score	−0.73	(0.60)	.23	−0.08	(0.54)	.88	−0.84	(0.40)	.04	0.30	(0.50)	.55
Instability Score	−5.03	(4.58)	.27	4.80	(5.22)	.36	−9.42	(3.76)	.01	−4.26	(6.40)	.51
Hip-specific Score	6.26	(2.51)	.01	−0.59	(2.19)	.79	0.74	(1.73)	.67	−1.98	(2.68)	.46
Arthroplasty	8.71	(6.25)	.16	−2.07	(7.19)	.77	6.33	(5.62)	.26	−2.97	(5.93)	.62
Probabilities of PAC Type	31.93	(33.66)	.34	33.31	(35.73)	.35	−16.97	(14.06)	.23	3.81	(17.89)	.83
R^2 (Adj R^2)	0.44	(0.29)		0.53	(0.41)		0.40	(0.29)		0.42	(0.33)	

†See Table A1.

Table A11: Estimation Results of Functional Outcomes for Stroke Patients at Twelve Months Post-Discharge

Variable	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*
Constant	78.72	(55.08)	.15	9.27	(36.52)	.80	70.29	(41.44)	.09	162.12	(129.20)	.21
Discharge ADL	0.08	(0.38)	.84	−0.86	(0.14)	.00	−0.87	(0.34)	.01	−0.94	(0.31)	.00
Expected ADL	0.43	(0.62)	.49	0.11	(0.17)	.50	0.10	(0.33)	.75	−0.17	(0.17)	.33
Prior ADL/IADL	0.24	(0.42)	.57	0.62	(0.18)	.00	0.32	(0.19)	.10	0.00	(0.46)	.99
Lived Alone	−12.38	(11.52)	.28	−6.91	(5.82)	.24	−0.03	(6.84)	1.00	−12.96	(6.77)	.06
Age	−1.19	(0.54)	.03	−0.54	(0.37)	.15	−0.11	(0.59)	.85	−1.25	(0.47)	.01
Sex	−4.40	(5.81)	.45	4.16	(6.27)	.51	−1.86	(5.64)	.74	−11.49	(6.35)	.08
Race	−7.86	(10.78)	.47	−13.97	(8.17)	.09	–†	–	–	−10.36	(8.96)	.25
Cognitive Status	1.83	(1.41)	.20	−0.85	(1.09)	.43	−1.80	(1.13)	.11	−2.72	(1.46)	.06
Prior Health Status	4.84	(4.29)	.26	8.10	(3.27)	.01	−8.46	(3.12)	.01	8.30	(3.78)	.03
Lives in Houston	−17.00	(5.58)	.00	−15.84	(7.91)	.05	−33.40	(23.14)	.15	−3.16	(6.95)	.65
Lives in Pittsburgh	−24.45	(5.93)	.00	−8.29	(6.33)	.19	−6.66	(8.64)	.44	5.49	(15.27)	.72
HMO Member	2.20	(5.37)	.68	−5.55	(7.43)	.46	−0.79	(4.64)	.86	1.54	(32.80)	.96
Admission APS	−1.63	(1.33)	.22	−0.15	(0.89)	.87	0.44	(0.14)	.00	−2.01	(1.12)	.08
Comorbidity Score	−0.17	(0.65)	.79	−0.19	(0.51)	.70	−0.69	(0.58)	.23	0.51	(0.70)	.47
Instability Score	7.54	(8.91)	.40	18.52	(7.65)	.02	−15.85	(6.59)	.02	−6.45	(6.75)	.34
Stroke Specific Score	−1.57	(2.08)	.45	0.30	(1.95)	.88	−0.28	(2.09)	.89	0.29	(4.81)	.95
Probabilities of PAC Type	−86.34	(38.52)	.02	58.75	(25.19)	.02	−31.44	(34.82)	.37	−19.85	(27.91)	.48
R^2 (Adj R^2)	0.56	(0.36)		0.39	(0.32)		0.34	(0.26)		0.42	(0.27)	

†See Table A1.

Table A12: Estimation Results of Functional Outcomes for COPD Patients at Twelve Months Post-Discharge

Variable	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*
Constant	−58.46	(63.96)	.36	−36.32	(38.46)	.34
Discharge ADL	−0.43	(0.18)	.02	−0.72	(0.17)	.00
Expected ADL	0.29	(0.59)	.62	0.19	(0.22)	.39
Prior ADL/IADL	1.01	(0.44)	.02	0.62	(0.23)	.01
Lived Alone	−1.17	(6.86)	.86	0.99	(8.09)	.90
Age	−0.01	(0.49)	.98	−0.08	(0.45)	.86
Sex	13.85	(6.00)	.02	8.33	(5.70)	.14
Race	−9.11	(13.83)	.51	−0.99	(13.73)	.94
Cognitive Status	−0.31	(1.81)	.86	−1.02	(1.77)	.57
Prior Health Status	4.04	(3.01)	.18	−1.37	(4.85)	.78
Lives in Houston	5.63	(7.09)	.43	12.25	(13.53)	.37
Lives in Pittsburgh	−8.99	(7.88)	.25	0.11	(8.07)	.99
HMO Member	−6.38	(7.33)	.38	10.61	(9.35)	.26
Admission APS	−0.53	(0.99)	.59	−1.16	(1.01)	.25
Comorbidity Score	−0.75	(0.64)	.24	−0.22	(0.57)	.70
Instability Score	−10.53	(7.01)	.13	−8.26	(6.11)	.18
COPD-specific Score	−2.07	(2.46)	.40	−1.82	(2.54)	.47
Probabilities of PAC Type	−42.23	(39.35)	.28	29.09	(45.49)	.52
R^2 (Adj R^2)	0.49	(0.36)		0.42	(0.31)	

†See Table A1.

Table A13: Estimation Results of Functional Outcomes for CHF Patients at Twelve Months Post-Discharge

Variable	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*
Constant	31.15	(47.39)	.51	14.53	(53.97)	.79	−8.90	(73.07)	.90
Discharge ADL	−0.34	(0.17)	.05	−0.81	(0.18)	.00	−1.43	(0.35)	.00
Expected ADL	0.82	(0.34)	.02	0.48	(0.36)	.18	0.43	(0.55)	.44
Prior ADL/IADL	1.17	(0.43)	.01	0.26	(0.35)	.47	0.17	(0.41)	.68
Lived Alone	−27.34	(8.24)	.00	5.60	(7.01)	.42	16.26	(14.66)	.27
Age	−1.35	(0.41)	.00	−0.60	(0.44)	.17	0.54	(0.81)	.50
Sex	0.30	(5.81)	.96	1.46	(7.82)	.85	9.09	(11.20)	.42
Race	8.15	(6.65)	.22	−5.50	(8.95)	.54	–†	–	–
Cognitive Status	−1.88	(1.35)	.16	0.57	(1.56)	.71	0.49	(2.29)	.83
Prior Health Status	3.00	(2.64)	.26	1.11	(3.78)	.77	−5.52	(7.01)	.43
Lives in Houston	20.45	(9.24)	.03	−4.08	(10.05)	.68	11.69	(25.87)	.65
Lives in Pittsburgh	6.21	(6.66)	.35	−6.79	(7.36)	.36	1.55	(14.15)	.91
HMO Member	5.01	(6.85)	.46	7.86	(9.79)	.42	5.81	(14.99)	.70
Admission APS	0.66	(0.72)	.36	−1.57	(0.94)	.10	−2.53	(1.79)	.16
Comorbidity Score	−1.17	(0.51)	.02	0.17	(0.58)	.77	−0.96	(1.20)	.42
Instability Score	−26.36	(7.96)	.00	−12.39	(7.56)	.10	−6.18	(10.91)	.57
CHF-specific Score	−3.36	(1.97)	.09	−1.53	(2.49)	.54	0.90	(4.67)	.85
Probabilities of PAC Type	−141.53	(46.45)	.00	48.65	(33.68)	.15	−44.69	(51.09)	.38
R^2 (Adj R^2)	0.20	(0.13)		0.29	(0.25)		0.38	(0.32)	

†See Table A1.

Table A14: Estimation Results of Functional Outcomes for Hip Procedure Patients at Twelve Months Post-Discharge

Variable	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*
Constant	84.38	(93.33)	.37	81.64	(52.68)	.12	169.55	(178.11)	.34
Discharge ADL	−0.95	(0.08)	.00	−1.04	(0.07)	.00	−0.19	(0.21)	.35
Expected ADL	0.12	(0.39)	.75	0.07	(0.27)	.78	−0.17	(0.14)	.21
Prior ADL/IADL	0.36	(0.62)	.56	0.34	(0.38)	.38	0.38	(0.27)	.16
Lived Alone	−5.20	(9.59)	.59	2.43	(6.53)	.71	−26.57	(9.54)	.01
Age	−0.26	(0.76)	.74	0.00	(0.65)	1.00	−1.87	(1.70)	.27
Sex	−0.03	(3.92)	.99	−4.07	(1.92)	.03	10.22	(27.18)	.71
Race	0.03	(5.20)	.99	–†	–	–	–†	–	–
Cognitive Status	0.46	(3.83)	.91	−5.21	(1.32)	.00	−4.78	(8.07)	.55
Prior Health Status	−1.95	(2.71)	.47	−1.53	(1.22)	.21	−1.94	(11.12)	.86
Lives in Houston	−0.95	(1.67)	.57	−4.20	(12.88)	.74	4.63	(55.12)	.93
Lives in Pittsburgh	−8.49	(5.83)	.15	−4.62	(7.92)	.56	−24.16	(10.28)	.02
HMO Member	2.40	(2.31)	.30	−4.20	(10.90)	.70	8.46	(8.24)	.30
Admission APS	0.96	(0.74)	.19	0.42	(1.06)	.69	−1.70	(2.78)	.54
Comorbidity Score	−1.41	(1.09)	.20	−0.80	(0.49)	.10	−0.99	(2.61)	.71
Instability Score	−5.10	(9.11)	.58	0.84	(2.47)	.74	−4.36	(4.89)	.38
Probabilities of PAC Type	−18.89	(40.25)	.64	5.08	(24.92)	.84	66.02	(65.90)	.32
R^2 (Adj R^2)	0.70	(0.67)		0.78	(0.73)		0.53	(0.40)	

†See Table A1.

Table A15: Estimation Results of Functional Outcomes for Hip Fracture Patients at Twelve Months Post-Discharge

Variable	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*	*Coeff*	*(Std Err)*	p-*Value*
Constant	49.68	(41.99)	.24	−54.11	(40.38)	.18	−5.71	(29.43)	.85	21.59	(43.04)	.62
Discharge ADL	−0.81	(0.23)	.00	−0.91	(0.17)	.00	−0.86	(0.15)	.00	−1.00	(0.22)	.00
Expected ADL	−0.04	(0.19)	.84	−0.07	(0.25)	.79	0.13	(0.13)	.34	0.14	(0.22)	.50
Prior ADL/IADL	0.50	(0.22)	.02	0.37	(0.19)	.05	0.45	(0.16)	.00	0.76	(0.23)	.00
Lived Alone	11.90	(8.91)	.18	−1.57	(5.36)	.77	1.24	(4.00)	.76	7.08	(6.42)	.27
Age	−0.80	(0.41)	.05	0.92	(0.45)	.04	0.18	(0.32)	.57	−0.40	(0.37)	.28
Sex	−10.82	(5.55)	.05	2.70	(6.64)	.68	19.38	(4.93)	.00	−5.03	(7.62)	.51
Cognitive Status	1.25	(1.41)	.37	−3.53	(1.30)	.01	−1.63	(0.69)	.02	−1.46	(1.69)	.39
Prior Health Status	2.09	(3.32)	.53	4.41	(3.50)	.21	0.85	(2.32)	.71	4.59	(3.65)	.21
Lives in Houston	11.67	(5.99)	.05	−3.05	(8.44)	.72	–†	–	–	–†	–	–
Lives in Pittsburgh	4.95	(6.94)	.48	−15.14	(7.53)	.04	−8.21	(4.75)	.08	0.87	(6.51)	.89
HMO Member	24.85	(6.06)	.00	−1.10	(8.85)	.90	5.82	(3.97)	.14	20.14	(16.93)	.23
Admission APS	−0.81	(1.13)	.47	0.36	(1.17)	.76	−0.86	(0.80)	.28	−1.69	(1.17)	.15
Comorbidity Score	−1.60	(0.71)	.02	−0.84	(0.64)	.19	−1.12	(0.38)	.00	−0.15	(0.60)	.80
Instability Score	−4.80	(5.14)	.35	2.65	(6.14)	.67	−8.01	(3.71)	.03	−4.03	(7.73)	.60
Hip-specific Score	5.13	(2.97)	.08	2.82	(2.57)	.27	2.59	(1.68)	.12	−3.02	(3.28)	.36
Arthroplasty	10.30	(7.12)	.15	1.60	(8.04)	.84	7.98	(5.38)	.14	−1.28	(7.25)	.86
Probabilities of PAC Type	25.14	(31.61)	.43	93.30	(36.61)	.01	−21.85	(12.65)	.08	12.40	(20.40)	.54
R^2 (Adj R^2)	0.47	(0.39)		0.38	(0.30)		0.24	(0.19)		0.53	(0.43)	

†See Table A1.