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Effect of Inpatient Quality of Care on Functional Outcomes in Patients With Hip Fracture

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Abstract

Objectives—We sought to examine the relationship between functional outcome and process of care for patients with hip fracture.

Research Design and Participants—We undertook a prospective cohort study in 4 hospitals of 554 patients treated with surgery for hip fracture.

Measurements—Information on patient characteristics and processes of hospital care collected from the medical record, interviews, and bedside observations. Follow-up information obtained at 6 months on function (using the Functional Independence Measure [FIM]), survival, and readmission.

Results—Individual processes of care were generally not associated with adjusted outcomes. A scale of 9 processes related to mobilization was associated with improved adjusted locomotion ($P = 0.006$), self care ($P = 0.022$), and transferring ($P = 0.007$) at 2 months, but the benefits were smaller and not significant by 6 months. These processes were not associated with mortality. The predicted value for the FIM locomotion measure (range, 2–14) at 2 months was 5.9 (95% confidence interval 5.4–6.4) for patients at the 10th percentile of performance on these processes compared with 7.1 (95% confidence interval 6.6, 7.6) at the 90th percentile. Patients who experienced no hospital complications and no readmissions retained the benefits in locomotion at 6 months. Anticoagulation processes were associated with improved transferring at 2 months ($P = 0.046$) but anticoagulation and other processes of care were not otherwise associated with improved function.

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Discussion—Our findings indicate the need to attend to all steps in the care of patients with hip fracture. Additionally, functional outcomes were more sensitive markers of improved process of care, compared with 6-month mortality, in the case of hip fracture.

Keywords

quality; process; function; hip fracture

Hip fracture is one of the most common acute medical problems in older persons, with more than 340,000 occurring annually in the United States[1] and 1.6 million worldwide.[2] Mortality associated with hip fracture in older persons ranges from 13% to 37%,[3] and only 60% of surviving patients eventually return to their baseline or prefracture level of walking.[4,5] Indeed, the care and functional consequences of a hip fracture are a cause of concern for older persons and their families.[6,7] Unfortunately, studies of interventions during hospitalization to improve the functional outcomes in patients with hip fracture have been few, and they have had mixed or disappointing results. For example, early surgery has been shown to have no effect on function,[8] and early physical therapy[9] is associated with improved early mobility, but this effect is not sustained.[10]

The hospital care of patients with hip fractures spans a variety of clinical issues (evaluation of surgical risk and stability, prevention of common complications, pain control, mobilization and physical therapy among them) over the course of a several day hospital episode. A possible explanation for why functional outcomes have been difficult to improve in patients with hip fracture by modifying any one of these is that the benefit of any single intervention is relatively small or short-lived without also attending to the other clinical issues. For example, the benefit from early surgery may be short-lived if it is not followed up by timely mobilization, early initiation of rehabilitation, and attention to postoperative care.

In this article, we used a prospective cohort to examine the relationship between functional outcome and process of care measures of quality for patients with hip fracture. We focused on the combination of interventions that span the course of the hospital episode of care for patients with hip fracture and that have been shown to have some effect on a clinical outcome (eg, reduced complications or mortality) that could be associated with improved function. Our intent in this report is to provide evidence for the role that combined acute care processes have on functional outcomes after hip fracture. This information has implications for identifying processes that can be used to characterize and measure the quality of acute care for hip fracture patients. By providing a link between acute care processes and functional outcomes, we also provide further evidence to support the use of function as a quality indicator—an issue of considerable interest[11] but about which there is limited experience.12

METHODS

Admissions to 4 hospitals in the New York metropolitan area were screened for cases of hip fracture for a 12-month period in 1997–1998. We excluded patients younger than 50 years of age, fractures that occurred as an inpatient, transfers from another hospital, multiple trauma, pathologic fractures, femoral shaft fractures, bilateral hip fractures, or previous fracture or surgery on the currently fractured hip. The Institutional Review Board at each of the sites approved the protocol, and the guidelines for investigation with human subjects were followed. Informed consent was obtained from subjects. A total of 804 patients presented with hip fracture. Of these patients, 650 (81%) met the eligibility criteria, and 571 (88%) of those patients gave informed consent for participation in the study. Additional

information on the study and patient population has been previously reported.[13] This analysis focuses on the patients who were treated with surgery (n = 554).

Data Collection and Study Outcomes

We collected information on patient characteristics, the processes of inpatient care, and mortality and functional outcomes. The primary source of information was the medical record. This was supplemented with interviews with the patient or proxy (if the patient was delirious or cognitively impaired), bedside observations, and conversations with the hospital staff to obtain information that could not be reliably obtained from the medical record.

Trained research associates collected information on pre-fracture function, residential location, use of services, and history of dementia from patients or their proxies. Each patient was seen 5 days a week, and the medical record was reviewed to collect additional information on the hospital course. We collected information during hospital visits on hospital arrival time, date and time of surgical intervention, patient mobility and physical therapy by day, patient ratings of pain, complications, and the presence of an indwelling urinary catheter or restraints. The medical record was reviewed in its entirety after discharge. Information was collected on diagnostic studies and physical findings, chronic medical conditions, fracture characteristics (femoral neck/displaced, femoral neck/nondisplaced, intertrochanteric), type of surgery, and medications.

All patients were followed and information on functional status, mortality, and readmissions was obtained by telephone at 2 and 6 months. Additional readmissions were obtained from hospital reports and from administrative data.[14] Additional deaths were identified from hospital records and from vital statistics. Ascertainment of death or functional outcome was available for 93% of subjects at 6 months.

Information on each patient's functional status was obtained by interview using items from the motor scale of the Functional Independence Measure (FIM)[15] on admission (from 2 weeks before fracture) and by telephone (for current status) 2 and 6 months after hospital discharge. The FIM includes 3 subscales of physical functioning: (1) locomotion (a 2-item subscale [range, 2–14] focusing on walking and climbing stairs), (2) self care (a 6-item scale [range, 6–42] of self-care activities, including bathing and dressing), and (3) transferring (a 3-item scale [range, 3–21] focusing on transfers from the bed, toilet, and tub). Each item was scored between 1 (for complete dependence) and 7 (for complete independence) using specific criteria.

Deriving Processes Measures of the Quality of Care

We reviewed the literature on various aspects of the clinical management of patients with hip fracture.[16] We additionally included information from recently completed studies from our group.[8,10,17-19] We found that extensive randomized trial evidence was available for only 3 issues at best—antibiotic prophylaxis,[20-22] prevention of thromboembolism,23-26 and nutritional support.27-30 For several issues (urinary tract care and collaborative rehabilitation), the randomized trials were fewer and smaller.[31] Similarly, there were few randomized trials available for a number of important clinical topics including timing of surgery, early mobilization, and intensity of physical therapy, although some well-conducted observational studies were available.

On the basis of this review, we constructed 13 items (see Table 2) that described the process of care for the following aspects of the management of patients with hip fracture: (a) timing of surgery,8·9·32 (b) clinical stability before surgery, (eg, whether electrolytes and other laboratory tests were normal)18 (c) use of anticoagulants to prevent thromboembolism (2 items)23-26; (d) use of prophylactic antibiotics to prevent wound infection33; (e) removal of

urinary catheters34,35; (f) mobilization after surgery (2 items)19; (g) timely physical therapy9,10,36; (h) pain management17 (2 items); (i) avoidance of restraints37,38; and (j) stability at discharge (eg, whether there were unresolved clinical issues at discharge).39 We limited our consideration to processes of care that had been shown to have some effect on a clinical outcome of interest in either well-conducted randomized trials or cohort studies. Performance on each process was categorized into 2 or 4 categories (eg, surgery performed 24 hours or less after admission; 24–48 hours, etc.). In each case, we selected cutpoints for the categories using evidence from the relevant research studies where possible. Additionally, for some items, a "not applicable" category was designated (eg, the mobilization items were not applicable if the patient was nonambulatory at baseline).

We conducted a series of analyses with the intent of combining the individual process of care items into a more robust measure. To determine how many components were represented by the 13 items, we began by performing exploratory principal components analyses, followed by confirma-tory factor analyses with oblique rotation, to determine the grouping of the items. Because both dichotomous and ordinal response options were included, we computed tetrachoric and polychoric correlations. We identified 2 factors that cumulatively explained 40.0% of the total variance. Rotated loadings ranged from 0.25 to 0.80, and 9 items had loadings exceeding 0.40. The adequacy of the resulting 2 scales in terms of internal consistency reliability was examined using Cronbach's alpha and corrected item-total correlations (the correlation of the item with the remaining items after removing that item from the sum created by the remainder). For all subjects that had "not applicable" items, the scale score was computed with "not applicable" items assigned a value equal to the mean of the applicable items. The reliability analyses indicated that the first scale (9 items) had a reliability coefficient alpha of 0.70. The 9 items related to timing of surgery, clinical stability before surgery, removal of urinary catheters, mobilization, physical therapy, pain management, and restraints. A second set of 4 items had 2 items (prophylactic antibiotics and stability at discharge) with low corrected item-total correlations. The elimination of these 2 items increased alpha from 0.30 to 0.71 for the remaining 2 items on use of anticoagulant medications. Hence, we used the 9-item set as a scale of process of care (range 9–32) which measured an underlying attribute of mobilization and avoidance of restrictions to mobility and a 2-item set on anticoagulation (range 2–7). The remaining 2 items (prophylactic antibiotics and stability at discharge) were treated as single items in the analysis.

Data Analysis

Data were analyzed using STATA (STATA Corp., College Station, TX). We examined the effect of quality of care on the following outcomes: (1) 6-month survival and readmissions; (2) FIM locomotion at 2 and 6 months; (3) FIM self care at 2 and 6 months; and (4) FIM transferring at 2 and 6 months. We first examined the unadjusted relationship between each of the 13 items (with each process item considered as a categorical variable) and outcomes using analysis of variance for the functional outcomes and Cox proportional hazards for survival and readmissions. For the functional outcomes, analyses were restricted to survivors.

In adjusted analyses, we controlled for variables shown to be predictors of hip fracture functional outcomes and mortality13: age, gender, prefracture FIM locomotion, prefracture nursing home residence, reliance on paid help from others if not in a nursing home before fracture, dementia diagnosis (from the medical record or patient/proxy report), and comorbidity.13,40 Additionally, we controlled for hospital site, abnormal clinical findings on admission (which might lead to delay in surgery),18 and fracture characteristics (which might lead to delay in weight bearing and mobilization).

To examine how the process of care scales affected outcome, we used a Cox proportional hazards model for survival and readmissions and ordinary least squares regression for other outcomes. To account for clustering of observations within hospitals, we performed a set of analyses using a robust cluster variance estimator. For the main independent variable (ie, the quality measure), the estimated standard errors became smaller due to negative intracluster correlation; hence, we present the more conservative estimates without clustering. To facilitate interpretation of the regression coefficients, we used the regressions to compute predicted values and confidence intervals for each of the dependent variables. Predicated outcomes were estimated for values for the duration of immobility set at the 10th, 50th, and 90th percentiles while holding all other variables constant at their weighted means.

RESULTS

Eighty-two percent of the subjects were women, and the median age was 83. Only 12.1% resided in nursing homes at baseline (Table 1). The mean FIM locomotion score was 9.8; 24.5% of patients were independent and needed neither personal assistance nor equipment, and patients at the median of this measure required supervision but no personal assistance to walk and climb stairs. The mean FIM self-care score was 35.3, and 46.2% of patients were independent in all self-care tasks. The mean FIM transfer score was 16.7, and 37.5% were independent in the 3 transferring activities.

Table 2 summarizes the frequency distribution on the 13 process of care items. One-fifth of the patients had surgery more than 48 hours after admission, and 15% had markedly abnormal clinical findings before going to surgery. Almost two-thirds of patients received some form of heparin and timely prophylactic antibiotics. Half the patients had urinary catheters removed by the end of the second postoperative day. Half were mobilized beyond a chair by the end of the second postoperative day, and just more than half had 2 or more physical therapy treatments in the first 3 postoperative days. Restraints were used in 13% of patients, and 40.2% of patients reported 2 or more days of moderate or severe pain. At the time of discharge, 16.8% had active clinical issues to be addressed.

The unadjusted relationship was examined between each of the 13 items and mortality and readmissions (using Cox proportional hazards) and function (using analysis of variance). Improved unadjusted outcomes were most consistently and significantly associated with only selected processes: a) early removal of urinary catheters was associated with reduced mortality and readmissions and with improved locomotion (2 and 6 months), self care (2 months), and transfers (2 months); b) early mobilization beyond a chair was associated with improvement in all outcomes; c) early physical therapy was associated with improvement in all outcomes, excepting readmissions; and d) not using restraints was associated with improvements in all the functional outcomes examined. For the other processes of care, associations were less consistent; however, there was a trend for better process to be associated with better outcomes. Most of the significant unadjusted associations, however, were not significant after adjusting for age, gender, nursing home residence, receiving paid help to live in the community, baseline locomotion, dementia, comorbidity, fracture type, clinical abnormalities on admission, and hospital. In the case of early mobilization beyond a chair and early physical therapy, only the associations with improved transferring at 2 months remained significant.

For the 9-item summary scale of process (Tables 3 and 4), better process of care was associated in adjusted analyses with improvement on all 3 scales of function (locomotion [$P = 0.006$], self-care [$P = 0.022$], and transferring [$P = 0.007$]) at 2 months and with reduced readmissions. For example, the predicted values for the FIM locomotion, self-care, and transfer measures at 2 months were 5.9 (95% confidence interval [CI] 5.4, 6.4), 27.4 (25.9–

28.8), and 12.0 (11.3–12.9), respectively, at the 10th percentile of the 9-item measure compared with 7.1 (95% CI 6.6–7.6), 30.3 (28.8–31.8), and 13.6 (12.9–14.3), respectively, at the 90th percentile. In the range of FIM locomotion scores observed at 2 months, a 1-point difference in scores translates to the difference between a patient needing moderate personal assistance versus needing just minimal contact assistance in walking or climbing. By 6 months, gains associated with improved process on the 9-item scale substantially diminished and became nonsignificant. For example, the predicted value for the FIM locomotion measure at 6 months was 7.7 (95% CI 7.1–8.2) at the 10th percentile of the 9-item measure compared with 8.3 (95% CI 7.8–8.8) at the 90th percentile. The 9-item summary scale was not associated with survival.

After adjustment, the anticoagulation 2-item scale was significantly associated with improved transferring at 2 months ($P = 0.046$) but was otherwise not associated with any other outcome (Table 4). The single item on active clinical issues was significantly associated with improved adjusted survival ($P = 0.012$) and readmissions through 2 months. The single items on antibiotic use and active clinical issues were not associated with function at either 2 or 6 months in adjusted analyses.

To explore the possible mechanism and dynamics of how process was associated with function, we examined the association of process and function in a subgroup of patients that experienced no inpatient complications and no rehospitalizations through 6 months—experiences that themselves are likely to overpower any beneficial effect of better initial inpatient quality of care. As in the main analysis involving all patients, 2-month adjusted locomotion outcomes were similar in magnitude and significant for this subgroup (n = 361) for the 9-item summary scale (Table 4). However, better process was also associated with improved 6-month adjusted locomotion in the subgroup (n = 309). For the other functional outcomes, effects in the subgroup were similar in direction and magnitude to those found in the entire group but were not statistically significant.

DISCUSSION

We found that process of care was variable and that opportunities exist to improve various processes in the inpatient care of patients with hip fracture. These processes include mobilization, avoidance of various impediments to mobilization, pharmacologic prophylaxis of selected complications, and timeliness and consideration of clinical problems before surgery and discharge. The individual processes were not strongly associated with functional outcomes after adjusting for baseline patient and other characteristics. In contrast, we found that better a combination of processes related to patient mobilization were associated with improved locomotion, self care and transferring at 2 months. These improvements diminished and were not significant by 6 months for the average patient. Further, for the subgroup of patients who experienced no hospital complications and no readmissions, the benefits in improved mobility persisted through 6 months. The other processes of care did not have a consistent effect on functional outcomes.

The analysis examines survival and functional outcomes for 6 months. Notably, the study examined functional outcome rather than intermediate or surrogate outcomes that might be associated with function. Additionally, instead of discharge outcomes, the focus of the study was on 6-month outcomes—a timeframe during which most of the recovery in function is observed.[4,5]

Improved function was associated with the 9-item quality measure, but the individual process items were not associated with improved function, which suggests that the effect of an individual item is small and that the effect of any single process may be dependent on other care processes. For example, early surgery may have little effect on subsequent

function[8] unless it is also followed by timely mobilization and rehabilitation. It is also possible that the composite studied includes some processes that have no effect and are therefore irrelevant. Although the factor analyses indicate that the 9 items can be conceptualized as an underlying latent construct, validation of the results with a different sample would strengthen the findings and indicate whether or not some of the processes of care could be omitted. Additional studies are also needed to develop and test new processes that would allow us to identify even more strongly linked processes of care that could be used to improve outcomes.

It is not surprising that the observed effect of inpatient process diminishes between 2 and 6 months for the average patient. In previous studies, we found that 13% of the patients experienced major hospital complications[18] and a third of the patients were readmitted to the hospital within 6 months. Many were readmitted more than once.[14] Most of these complications and readmissions are for reasons not directly related to hip fracture. These events may well negate any beneficial effect of better hip fracture related processes of care during the initial hospital stay, thereby limiting the beneficial effect to those who did not experience complications or readmissions.

Our study was limited to data on process of care in the initial hospital stay, and outcomes 6 months later may be affected by health events and medical care received after the initial hospital stay. Having additional information on the care received after hospital discharge41 could perhaps have amplified the effects observed. Nevertheless, we believe that a focus on the early portion of the episode of care is appropriate and important. Most of the medical and rehabilitative care received by these patients is concentrated in the first 2 months after fracture and particularly in the index hospitalization.[42] Similarly, the physiologic changes (eg, loss of muscle mass) after a hip fracture occur early in the episode of care and stabilize by 2 months.[43] Thus, the early portion of the episode of care and especially the index hospitalization present fertile opportunities for improving the process of care as a means to improve outcome.

The study was limited by its use of observational data; however, our analysis adjusted for a large variety of clinical variables that could have biased the results. These variables go well beyond the administrative and medical record data available in many other studies and include clinical variables obtained from interviews (eg, baseline function) and observations (eg, of restraints or catheters). Because we recorded complications as we followed the patients through the hospital course (and not from retrospective record review or administrative data), we believe that we were able to ascertain significant complications and to account for unanticipated complications that might have interfered with performance of an indicated process. We had only limited information on surgical processes of care, but characteristics of the fracture and type of surgical procedure have not been found to be major predictors of functional outcomes.[13]

For those who design and provide healthcare for patients with hip fracture, our results indicate the need to carefully attend to all steps in the care of these patients. The 9-item quality measure included several different and specific care interventions ranging from early surgery, early mobilization, pain management, and removal of catheters and other impediments to mobilization. Our findings suggest that the benefits of better process are not sustained if complications and hospital readmission occur. However, the opportunity to fully realize the benefits in functional outcome may exist given that modifiable risk factors have been described for hip fracture complications[18] and interventions have been developed to reduce readmissions in elderly patients.[44]

In addition, our findings have important implications for research on and applications of quality measures in healthcare. Our process measures were most strongly associated with functional outcomes. Hence, functional outcomes were more sensitive markers of improved process of care, compared with mortality, in the case of hip fracture and perhaps other clinical conditions where the focus of clinical care may be improved function. Failure to measure functional outcomes for certain conditions may overlook an important aspect of the quality of care.

Medicare has moved to implement pay for performance as a means of improving the quality of care through the payment system. The Centers for Medicaid and Medicare Services has identified and collected data on quality measures, published performance on some providers, and fielded demonstrations of pay for performance. However, functional outcomes are not a major focus of Medicare's current pay for performance initiative. Focusing on isolated processes of care (eg, prescribing of beta blockers) or on the more easily ascertainable outcomes of mortality would not only ignore an important set of functional outcomes, but it could also mask important differences in the processes of care related to functional improvement. Our study indicates the need to address this shortcoming in these efforts.

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TABLE 1

Baseline Characteristics of Patients With Hip Fracture

	n = 554
Mean age (SD)	82 (8.7)
Male	18.4%
Nursing home resident before admission	12.1%
Receiving paid help to live in the community	35.7%
Mean FIM locomotion score, range 2–14 (SD)	9.8 (3.9)
Mean FIM self care score, range 6–42 (SD)	35.3 (8.7)
Mean FIM transfer score, range 3–21 (SD)	16.7 (4.8)
History of dementia	24.9%
Comorbidity Score, range 0–15 (SD)	3.0 (2.6)
Intertrochanteric fracture	51.1%
Femoral neck fracture, nondisplaced	15.9%
Femoral neck fracture, displaced	33.0%
Abnormal clinical findings on admission*	34.5%

*Abnormal laboratory and/or physical examination findings on admission included the following: Abnormal blood pressure (systolic blood pressure over 180 or less than 91 or diastolic blood pressure over 110); Abnormal heart rhythm (electrocardiogram that included atrial fibrillation or a supraventricular tachycardia at a rate over 100; a sinus rhythm with a rate over 120 or 50 or less; ventricular tachycardia, or third-degree heart block); chest pain or any new myocardial infarction on the electrocardiogram; heart failure (chest radiograph finding of congestive heart failure, interstitial edema, pleural effusion, or pulmonary edema; or a normal chest radiograph in the setting of dyspnea, an abnormal lung exam, or the presence of an S3); respiratory compromise (arterial blood gas findings of a pCO_2 greater than 45 mm Hg, a pO_2 less than 60 mm Hg, or oxygen saturation of less than 90%); coagulation disorder (INR of greater than 1.3); electrolyte abnormality (serum sodium less than 129 or greater than 150, serum potassium less than 3.0 or greater than 5.5, or serum bicarbonate less than 20 or greater than 34); hyperglycemia (serum glucose over 450); fluid imbalance (a serum blood urea nitrogen greater than 40 or a serum creatinine over 2.0 in the absence of dialysis dependent renal disease); anemia (hemoglobin less than 8); Fever or pneumonia (temperature greater than 38.5 or less than 35°C or pneumonia or infiltrate on chest radiograph).

TABLE 2

Quality Criteria, Scoring Options, and Their Frequency (n = 554)

Criteria	Scoring Options	Frequency (%)					
		1	2	3	4	NA	Missing
Time from admission to surgery[8,9,32]	1 if >72 h; 2 if >48 but ≤72 h; 3 if >24 but ≤48 h; 4 if ≤24	10.1	12.6	48.7	28.5	—	0
Abnormal clinical findings before surgery[18]	1 if patient had markedly abnormal clinical findings; 2 if patient had no or minimally abnormal findings	15.0	85.0	—	—	—	0
Anticoagulation[23-26]	1 if none; 2 if initiated day after surgery; 3 if initiated day of surgery or before; NA if contraindicated	2.4	15.9	77.6	—	1.8	2.4
Anticoagulation regimen[23-26]	1 if other than an indicated regimen; 2 if aspirin; 3 if warfarin; 4 if heparin combination; NA if contraindicated	2.4	2.0	25.8	65.7	1.8	2.4
Use of prophylactic antibiotics[33]	1 if not initiated within indicated timeframes; 2 if initiated within 2 h after surgery; 3 if initiated 1—2 h before surgery; 4 if initiated ≤1 h before surgery	26.7	7.8	5.1	60.5	0	0
Removal of urinary catheter postoperatively[34,35]	1 if not removed by day 3; 2 if removed day 3; 3 if removed day 2; 4 if removed day 1; NA if incontinent at baseline	20.0	18.1	24.9	25.6	10.8	0.5
Mobilization to a chair in first 3 postoperative days[19]	1 if not done by day 3; 2 if initiated on day 3; 3 if initiated on day 2; 4 if initiated by day 1; NA if nonambulatory at baseline	2.4	5.2	17.0	64.1	10.5	0.9
Mobilization beyond chair in first 3 postoperative days[19]	1 if not done by day 3; 2 if initiated on day 3; 3 if initiated on day 2; 4 if initiated by day 1; NA if nonambulatory at baseline	26.2	11.7	21.7	30.0	10.5	0
Physical therapy (PT) in first 3 postoperative days[9,10,36]	1 if no PT; 2 if 1 session; 3 if 2 sessions; 4 if 3 sessions; NA if nonambulatory at baseline	16.8	19.3	29.4	24.0	10.5	0
Days of moderate or severe pain over first 5 hospital days[17]	1 if 3 or more days; 2 if 2 d; 3 if 1 d; 4 if none; missing if no response	17.5	22.7	30.3	17.3	—	12.1
Number of days of severe pain with no or only slight relief[17]	1 if 3 or more days; 2 if 2 d; 3 if 1 d; 4 if none; NA if no severe pain; missing if no response	1.4	3.4	7.4	62.6	16.1	9.0
Restraints[37,38]	1 if any restraints used; 2 if no restraints	13.0	86.8	—	—	—	0.2
Active clinical issues at discharge[39]	1 if ≥2 issues; 2 if 1 issue; 3 if none	1.8	15.0	82.7	—	—	0.5

NA indicates not applicable.

TABLE 3

Regression Models Predicting Outcomes at 2 and 6 Months

	Mortality Hazard Ratio†	Readmission Hazard Ratio†	2-Month Outcomes			6-Month Outcomes		
			Locomotion (Range, 2 – 14)	Self-Care (Range, 6 – 42)	Transferring (Range, 3 – 21)	Locomotion (Range, 2 – 14)	Self-Care (Range, 6 – 42)	Transferring (Range, 3 – 21)
9-item quality measure (range, 9–32)	0.95	0.95†	0.10†	0.27*	0.15†	0.06	0.01	0.04
Prefracture locomotion (range, 2–14)	0.87‡	0.97	0.35‡	1.01‡	0.49‡	0.46‡	1.28‡	0.67‡
Comorbidity (range, 0–15)	1.06	1.01	0.04	−0.16	−0.02	−0.09	−0.36*	−0.15
Age	1.01	1.00	−0.06‡	−0.14*	−0.08†	−0.04*	−0.09†	−0.06*
Male§	1.61	1.45*	−0.11	−1.83	−1.02	−0.26	−0.04	−0.27
Nursing home residence§	1.24	1.67	−1.40*	−5.50†	−2.72†	−1.60*	−5.02†	−2.04*
Community with paid help§	2.00*	1.64†	−0.90*	−2.52*	−1.04*	−0.67	−1.86	−0.34
Dementia diagnosis	1.40	0.60*	−0.86*	−6.53‡	−2.32‡	−0.66	−6.16‡	−1.83†
Abnormal clinical findings§	1.24	1.37	−0.36	−0.72	−0.76	−0.12	−0.73	−0.29
Femoral neck displaced fracture§	1.64	1.05	−0.03	−0.21	−0.21	−0.26	−0.58	−0.22
Femoral neck nondisplaced fracture§	0.59	0.75	0.61	1.28	0.11	0.35	−0.27	−0.28
Hospital 2§	1.79*	1.52*	−0.07	1.22	0.58	0.42	2.75†	0.71
Hospital 3§	2.00	2.19†	0.45	1.74	0.60	0.90	1.03	−0.24
Hospital 4§	0.64	1.16	0.63	0.53	0.85	1.12*	3.07*	1.09
Constant			5.93	26.58	12.0	5.65	27.97	12.68
n	554	545	464	447	454	444	424	431
R^2	—	—	0.36	0.42	0.41	0.39	0.48	0.43

*$P < 0.05$.

†$P < 0.01$.

‡$P < 0.001$.

§Reference categories were female, community-dwelling without paid help, no abnormal clinical finding, intertrochanteric fractures, and Hospital 1.

TABLE 4

Adjusted Associations Between Quality Measures and Outcomes[‡]

			2-Month Outcomes			6-Month Outcomes		
	Mortality Hazard Ratio	**Readmission Hazard Ratio**	**Locomotion (Range, 2 – 14)**	**Self-Care (Range, 6 – 42)**	**Transferring (Range, 3 – 21)**	**Locomotion (Range, 2 – 14)**	**Self-Care (Range, 6 – 42)**	**Transferring (Range, 3 – 21)**
9-item quality measure (range, 9–32)	0.95 (0.90, 1.00)	0.95[†] (0.91, 0.98)	0.10[†] (0.03, 0.18)	0.26[*] (0.04, 0.49)	0.14[†] (0.04, 0.25)	0.06 (−0.02. 0.14)	0.01 (−0.20, 0.22)	0.04 (−0.06, 0.15)
2-item anti-coagulation measure (range, 2–7)	1.25 (0.92, 1.70)	0.92 (0.78, 1.09)	0.24 (−0.08, 0.57)	0.81 (−0.17, 1.79)	0.47[*] (0.01, 0.92)	0.22 (−0.12, 0.56)	0.39 (−0.54, 1.32)	0.18 (−0.28, 0.65)
Single-item on antibiotic use (range, 1–4)	0.92 (0.77, 1.09)	0.99 (0.89, 1.12)	0.01 (−0.21, 0.22)	−0.54 (−1.21, 0.13)	−0.08 (−0.39, 0.23)	0.17 (−0.06, 0.40)	0.51 (−0.09, 1.12)	−0.08 (−0.39, 0.23)
Single item on active clinical issues (range, 1–3)	0.50[*] (0.31, 0.81)	0.74[§] (0.54, 1.02)	−0.08 (−0.81, 0.65)	1.34 (−0.85, 3.54)	0.68 (−0.35, 1.71)	−0.12 (−0.87, 0.63)	0.46 (−1.51, 2.44)	0.68 (−0.35, 1.71)
Subgroup analysis								
9-item quality measure (range, 9–32) excluding patients with major inpatient complications and/or readmissions before the follow-up interval	0.96 (0.86, 1.08)	—	0.10[*] (0.01, 0.20)	0.22 (−0.05, 0.50)	0.12 (−0.01, 0.25)	0.13[*] (0.02, 0.23)	0.003 (−0.26, 0.27)	0.08 (−0.05, 0.22)

[*] $P < 05$.

[†] $P < 0.01$.

[‡] Adjusting for age, gender, nursing home residence, receiving paid help to live in the community, baseline locomotion, dementia, comorbidity, fracture type, clinical abnormalities on admission, and hospital site.

[§] Hazard ratio is 0.66 (0.45, 0.97) for readmission through 2 months.

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