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The relationship between historical risk-adjusted 30-day mortality and subsequent hip fracture outcomes: retrospective cohort study

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Abstract

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BACKGROUND—While 30-day risk-adjusted mortality is a performance measure for hip fracture care, it has not been shown to predict long-term outcomes. We assessed whether hospital rankings based on historical 30-day mortality predicted subsequent hip fracture outcomes.

METHODS—Using national Medicare data, we calculated annual hospital performance rankings based on standardized 30-day hip fracture mortality ratios. We used logistic regression to measure the association of patients' survival at 180 days with their hospital's ranking for the year prior to admission. Subgroup analyses assessed whether associations between hospital performance and 180-day outcomes were similar for community-dwelling patients as well as those living in nursing homes prior to fracture.

RESULTS—Out of 378,077 patients hospitalized with hip fractures between January 1, 2007 and June 30, 2009, 81,653 (21.6%) died by 180 days. Worse historical hospital performance was associated with a greater adjusted odds of 30 day mortality (odds ratio (OR), fourth vs. first quartile: 1.24, 95% confidence interval (CI): 1.18, 1.29, $P<0.001$) and 180 day mortality (OR, fourth vs. first quartile: 1.15, 95% CI 1.11, 1.18, $P<0.001$). Past hospital performance was associated with death or new nursing home placement among community dwellers (OR, fourth vs. first quartile: 1.09, 95% CI 1.05, 1.13, $P<0.001$), but was not associated with death or new dependence in locomotion among nursing home residents (OR 1.05, 95% CI 0.97, 1.15, $P=0.229$).

CONCLUSIONS—Better historical hospital hip fracture mortality predicts modest decreases in mortality at 180 days for subsequent patients, but is inconsistently associated with changes in functional outcomes.

LEVEL OF EVIDENCE—Level 3 (Non-randomized controlled cohort study)

INTRODUCTION

Each year, over 300,000 US adults and 1.6 million adults worldwide are hospitalized for an acute hip fracture,^{1, 2} placing them at high risk of excess mortality³ and disability.⁴ 30-day risk-adjusted hip fracture mortality has been proposed as an indicator of the quality of care⁵ for hip fracture patients and is reported by multiple US states^{6–8} as well as major national auditing programs such as the UK National Hip Fracture Database.⁹

Despite this, the validity of 30-day mortality as an indicator of the quality of hip fracture care has been questioned. First, it is unknown whether hospital-level variations in short-term mortality translate into longer-term differences in survival.¹⁰ Second, the relationship between short-term hip fracture mortality and longer-term outcomes may vary across clinical subgroups of hip fracture patients and may only be relevant for some,¹¹ particularly since many patients experience hip fractures as one event within a larger ongoing process of dying.^{3, 12–14} Third, it is unknown to what degree past hospital performance, as measured by short-term mortality, predicts differences in recovery of functional independence after fracture.¹⁵

We sought to answer three questions: first, do patients treated for hip fractures in hospitals that vary in terms of their historical 30-day mortality differ in their short- and long-term survival? Second, does the extent and magnitude of such differences vary across subgroups of hip fracture patients that differ in terms of their prognosis for survival? Third, do

historical mortality rates predict subsequent differences in broader endpoints that capture aspects of functional recovery as well as survival? To accomplish this, we examined the association between hospitals' historical hip fracture mortality and subsequent outcomes among a large sample of U.S. fee-for-service Medicare beneficiaries with hip fractures.

MATERIAL AND METHODS

Data and sample

Our study was approved by the Perelman School of Medicine Institutional Review Board, which waived the requirement for informed consent.

We used data from Medicare Provider Analysis and Review (MedPAR) files, which contain hospital discharge abstracts for fee-for-service Medicare beneficiaries. Additional data came from the Medicare beneficiary summary file, which contains vital status and HMO enrollment information; the Medicare Provider of Services Files, which contains hospital characteristics information; and the Medicare Long-Term Care Minimum Data Set (MDS) which contains clinical assessment data collected at admission and at 92-day intervals for individuals residing in Medicare or Medicaid certified nursing care facilities.^{16–19}

Our cohort included U.S. Medicare fee-for-service patients hospitalized with a hip fracture between January 1, 2007 and June 30, 2009; for patients with more than one admission over this period, only the first admission was used in our analysis. Hip fracture admissions were identified using ICD-9-CM diagnosis codes,^{20–22} which are highly sensitive and specific for hip fractures.²³ We excluded patients transferred from another acute-care hospital. Since risk-adjusted mortality may be unreliable as an indicator of quality at low-volume hospitals,^{24–26} we excluded patients who received treatment at a hospital that had fewer than 50 hip fracture discharges in the year prior to their admission. We based this initial threshold on past research regarding the relationship between surgical case volumes and the reliability of risk-adjusted mortality rates,²⁷ and we conducted supplementary analyses using different minimum case-volume thresholds.

Independent variables

We collected data from MedPAR files on patient age, sex, and race, which was coded as black, white and other.²⁸ We used ICD-9-CM diagnosis codes characterize the anatomic location of the fracture (femoral neck, intertrochanteric, subtrochanteric, or multiple locations),²⁹ and used validated algorithms to identify 16 comorbidities³⁰ based on ICD-9-CM diagnosis codes from the index hospitalization and all hospitalizations occurring in the 180 days preceding the index.^{30, 31} We used diagnosis-related group codes from the index admission to identify patients with multiple trauma.^{20, 21, 29}

We characterized patients with two or more admission or quarterly MDS assessments in the 180 days prior to the hip fracture admission³² as long-term nursing home residents. For these patients, we collected data from the last MDS assessment prior to fracture^{33–36} on self-performance in seven activities of daily living (ADLs; locomotion; dressing; personal hygiene; toilet use; transferring; getting in and out of bed; eating). ADL function over the 7 days preceding the assessment was graded on a five-point scale ranging from

“independence” to “total dependence.” Patients for whom a particular ADL did not occur in the preceding 7 days were classified as being totally dependent in that domain. We also collected data on baseline cognition among long-term nursing home residents from the last MDS assessment prior to the index admission using the MDS Cognitive Performance Scale (CPS),^{37, 38} a validated 7-point scale that rates cognitive status from “intact” to “very severe impairment.”

Dependent variables

Our primary outcomes included death from any cause at 30, 90, and 180 days after admission, as recorded in the Medicare beneficiary summary file.

We examined two composite secondary outcomes that incorporated aspects of functional recovery as well as mortality. Among patients for whom the MDS did not indicate residence in a long-term nursing home prior to fracture (i.e. “community dwellers”), we developed a composite outcome indicating death or new long-term nursing home placement after fracture. This outcome was a binary variable that equaled 1 for all individuals who died by 180 days after admission, or who had one or more admission or quarterly nursing home assessments in the MDS between 90 and 180 days after admission indicating new long-term nursing home resident status.

For patients who we identified as residing in a long-term nursing home prior to fracture and who were not totally dependent in locomotion prior to fracture, we examined an alternate composite endpoint that corresponded to death or new, total dependence in locomotion at 180 days after fracture. This outcome was a binary variable that equaled 1 for all individuals who died by 180 days after admission, or who had evidence of or new total dependence in locomotion at the last available MDS assessment within 180 days after fracture. For both of these composite secondary outcomes, we included death in the composite since failure to account fully for decedents in analyses of post-discharge outcomes can lead to spurious results due to survivorship bias.^{39, 40}

Statistical analysis: Development of the mortality model

We used indirect standardization to develop hospital- and year-specific risk-adjusted measures of 30-day hip fracture mortality.⁴¹ Specifically, we calculated hospital- and year-specific observed-to-expected (O:E) 30 mortality ratios. To calculate these ratios, we first developed a logistic regression model to predict mortality at 30 days after admission among all fee-for-service Medicare beneficiaries discharged from a US acute-care hospital between January 1, 2003 and December 31, 2003 who had a principal or secondary ICD-9-CM discharge diagnosis code indicating a hip fracture. This model contained data on patient age, sex, and race; the anatomic location of the fracture and 16 comorbidities. It included 202,094 patients and had a c-statistic of 0.76.

Development of hospital observed-to-expected mortality ratios

We used this model to predict the probability of death within 30 days of hospital admission for each fee-for-service Medicare beneficiary who was discharged from a US acute-care hospital between January 1, 2006 and December 31, 2008 who had a principal or secondary

ICD-9-CM discharge diagnosis code indicating a hip fracture. Next, for each hospital that had at least 50 hip fracture discharges in a given calendar year (2006, 2007, and 2008), we summed the predicted probabilities for all patients treated in that hospital in that year to obtain the “expected” number of deaths for that hospital for that year. We next divided each hospital’s actual (“observed”) number of deaths within 30 days of admission for that year by this “expected” value to obtain the O:E ratio for that year. For analysis, we grouped hospitals into performance quartiles according to the distribution of O:E mortality ratios across all facilities in a given year.

Outcome analyses

We used hospital-specific identifiers contained in MedPAR data to link each hip fracture admission in the study sample to the lagged (prior-year) O:E ranking for the admitting hospital. Initial analyses used descriptive statistics and simple hypothesis tests to compare predictor and outcome variables across hospital performance quartiles. We generated Kaplan-Meier survival curves to compare unadjusted survival by hospital performance quartile at up to 180 days.

We used multivariate logistic regression to measure the association between the hospital’s performance in the prior year and our study outcomes. We created separate logistic regression models to predict 30-, 90-day and 180-day survival as a function of patient demographics, fracture characteristics, and comorbidities, as well as an indicator of the hospital’s O:E ratio quartile for the year prior year. Regression models used robust standard errors that adjusted for clustering at the level of the hospital.

Subgroup analyses

We created separate regression models to predict these same endpoints only among community-dwelling patients, and only among individuals who were living in a nursing home prior to fracture. Notably, while the model for community-dwellers included the same variables as in our main (all-patients) model, the model for nursing home residents also included additional controls for baseline ADL function and baseline cognitive status.

We developed additional multivariate regression models to investigate the association of past hospital performance with our two subgroup-specific secondary outcomes: (1) death at 180 days or new requirement for long-term nursing care among patients not living in a nursing home prior to fracture; and (2) death at 180 days or new total dependence in locomotion among patients who were long-term nursing home residents prior to fracture and did not have evidence of total dependence in locomotion prior to fracture.

Supplemental analyses

To assess the robustness of our findings, we replicated our analyses within each calendar year. Additionally, we replicated our findings using alternative volume cutoffs (30 cases per year, 100 cases per year) for inclusion of hospitals in our analysis. Additionally, to assess the sensitivity of our results to model specification, we repeated all analyses using linear probability models instead of logistic models. Analyses were carried out using SAS version

9.3 (SAS institute, Cary, NC, 2010). We used a value of $p < 0.05$ to indicate statistical significance.

RESULTS

Primary outcomes

Our sample included 378,077 hip fracture patients, including 140,403 discharges from 1,438 hospitals in 2007, 155,313 discharges from 1,430 hospitals in 2008, and 82,361 discharges from 1,537 hospitals in the first six months of 2009 (Table 1). While the association between hospital characteristics and performance quartile varied from year to year, the highest performance quartile tended to include a greater proportion of teaching hospitals and facilities with 400 or more beds, whereas the lowest performance quartile tended to include more non-teaching hospitals and facilities with less than 200 beds. Overall, 26,618 patients in our sample (7%) were long-term nursing home residents and 351,459 (93%) were community-dwelling patients. 32,511 patients (8.6%) died by 30 days after admission and 81,653 (21.65%) died by 180 days.

Table 2 compares patients treated across hospitals that differed in terms of historical performance. Patients were generally similar across performance quartiles; quantitatively small but statistically significant differences existed between patients treated at facilities with lower historical risk adjusted mortality rates in terms of age and selected comorbidities, including cancer, prior arrhythmias, renal failure, chronic lung disease, dementia. Among the full sample of hip fracture patients, unadjusted mortality rates varied across quartiles of historical hospital performance across all time points assessed ($P < 0.001$). The trend towards lower mortality rates at facilities with better historical performance was present among both community dwelling hip fracture patients as well as long-term nursing home residents (Figure 1)

These differences persisted in our adjusted analyses (Table 3 and Appendix). Among all patients, the adjusted odds of 30-day mortality was 24% greater for patients treated at a hospital in the 4th (worst) quartile of historical risk-adjusted mortality rates compared to patients treated in hospitals in the 1st (best) quartile ($P < 0.001$; model c-statistic 0.786). Smaller but statistically significant associations between historical performance and subsequent outcomes were observed at 90 and 180 days. When data was analyzed separately for nursing home residents and community-dwelling hip fracture patients, we observed a similar pattern, although the association between historical performance and subsequent outcomes was slightly attenuated for nursing home residents.

Subgroup-specific outcomes

351,459 patients in our sample (93.0%) were not residing in a long-term nursing home at the time of fracture. Among these patients, 133,966 (38.1%) either died by 180 days or had evidence of a requirement for prolonged nursing home care. In adjusted analyses, we found a slight association between the odds of death or new long-term nursing home care and historical hospital performance (OR for 4th quartile vs. 1st quartile: 1.09, 95% CI 1.05, 1.13, $P < 0.001$; see Appendix for full model output).

26,618 patients in our sample (7.0%) resided in a long-term nursing home prior to fracture; among the 23,397 (87.9%) of these patients who were not completely dependent in locomotion prior to fracture, 12,313 (52.6%) had either died or developed new complete dependence in locomotion at 180 days after admission. In adjusted analyses, the odds of death or new total dependence in locomotion did not vary according to past hospital performance (OR for 4th quartile vs. 1st quartile: 1.05, 95% CI 0.97, 1.15, P=0.223; see Appendix for full model output).

Supplemental analyses

We repeated our regressions separately by study year, obtaining similar findings as in our main analysis for both the mortality outcomes and the subgroup-specific composite outcomes (full model output appears in the Appendix). Additionally, our findings did not change when we restricted our analysis to patients treated in hospitals with at least 30 hip fracture admissions and at least 100 hip fracture admissions during the year prior to the index. We also obtained similar findings when we repeated our analyses using linear probability models rather than logistic regression.

DISCUSSION

In this study of 387,077 hip fracture patients, we observed a modest but consistent association between better historical hospital performance as measured by risk-adjusted 30-day mortality, and improved post-discharge outcomes. Compared to hip fracture patients treated in hospitals in the lowest quartile of risk-adjusted mortality for the preceding year, the odds of mortality at 180 days after admission were 15% greater for patients treated in hospitals in the highest quartile; we observed similar associations between historical performance measures and survival in subgroup analyses limited to community-dwelling patients and long-term nursing home residents.

Historical risk adjusted mortality was inconsistently associated with composite outcomes that captured selected dimensions of functional recovery. Among community-dwelling patients, receipt of treatment in a hospital in the highest quartile of risk-adjusted mortality was associated with only a 9% greater odds of death by 180 days or requirement for prolonged nursing home care; among long-term residents who were not completely dependent in locomotion prior to fracture, hospital risk-adjusted mortality was not associated with the likelihood of a composite outcome of death or new, total dependence in locomotion at 180 days after hospital admission.

Risk-adjusted short-term mortality is widely reported as an indicator of hospital quality for hip fracture care,⁵ and such data may play a role in guiding care choices by patients and families, and policy-level quality improvement efforts.⁴² Our study provides new insights regarding the value of short-term mortality data for measuring variations in hospital quality for hip fracture care. We found modest but potentially meaningful differences in the odds of mortality between patients treated in hospitals with high versus low past performance at up to 180 days after admission, suggesting a potentially durable impact of hospital-level differences in care on hip fracture outcomes. Moreover, these outcome differences were qualitatively similar among groups of hip fracture patients with markedly different

prognoses for survival, suggesting that differences in hospital quality may contribute to long-term hip fracture outcomes for patients across a spectrum of baseline comorbidity and disability.

At the same time, our findings highlight the limitations of historical risk-adjusted mortality rates for predicting functional outcomes after fracture. Differences in risk-adjusted mortality rates and risk-adjusted functional outcomes have been observed within individual hospitals,¹⁵ suggesting that these endpoints may be influenced by distinct aspects of care. While we did not examine specific inpatient care practices, our findings lend general support to this hypothesis insofar as they characterize hospital risk-adjusted mortality rates as poor predictors of functional recovery after hip fracture. As such, they highlight the need for additional quantitative research to define measures that may be more predictive of functional outcomes after hip fracture. As limited evidence currently exists to identify which specific inpatient care practices may improve mortality after hip fracture,^{14, 43, 44} our work highlights opportunities for additional qualitative research to characterize the approaches that distinguish high-versus low-performing institutions.^{45, 46} Our work has limitations. It is possible that differences could exist between patients treated in hospitals that varied in terms of historical performance beyond those characteristics recorded in the study dataset. If patients treated in hospitals with high historical mortality happened to be sicker than those treated in hospitals with low historical mortality, such differences could lead to a spurious finding of better outcomes at hospitals with lower historical mortality. Nonetheless, our regression analyses adjusted for a wide array of patient-level confounders. Moreover, the difference in the odds of mortality between hospitals with the high versus low historical mortality *increased* after risk adjustment instead of decreasing, suggesting that our results may *underestimate* the association between historical risk-adjusted mortality and subsequent outcomes. At the same time, since the odds ratio tends to be larger than the relative risk for outcomes that are relatively frequent (i.e. an event rate of 10% or greater), the associations we report here would be likely to be smaller in magnitude if considered in terms of relative risk. As our study excluded patients enrolled in Medicare Advantage and patients treated in low-volume hospitals, our results may not be generalizable to these patients.

Since our database did not include information on patient-level finances or the availability of social supports, we were unable to examine whether the association between historical hospital performance and longer-term survival and functional outcomes might have varied according to these factors. Social and economic factors are potentially important determinants of both survival⁴⁷ and functional recovery⁴⁸ after hip fracture; as such, understanding whether the association of past hospital performance with subsequent outcomes might vary among groups of patients with differing levels of financial security or available social supports remains an important topic for future research.

CONCLUSIONS

Our findings have importance for clinical care and health policy. Hip fractures occur over 300,000 times annually in the US^{1, 2} and over 1.6 million times each year worldwide;⁴⁹ given their substantial impact on both survival and functional outcomes, observers have highlighted hip fracture care as a key area for quality improvement in both orthopedic care⁵⁰

and geriatric medicine.^{44, 51} By quantifying the potential difference in mortality that future patients may experience at hospitals with better or worse past performance, our results provide information that may be used to guide choices about care for individual patients, as well as further qualitative and quantitative investigations by quality advocates to identify differences in hospital care characteristic of high- and low-performing institutions. By highlighting the inconsistent association between historical hospital risk-adjusted mortality rates and more global indicators of recovery after hip fracture, our results emphasize the need for additional efforts to define measures of hospital quality for hip fracture care capable of predicting aspects of functional recovery that are likely to be most meaningful to older adults.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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A. All patients

B. Community-dwellers

Figure 1.

Survival at up to 180 days after admission for hip fracture, by quartile of hospital performance for the preceding year among (a) all hip fracture patients (N=387,077; $P<0.001$ for difference by log-rank test); (b) community-dwelling individuals hospitalized with hip fracture (N=351459; $P<0.001$ for difference by log-rank test); (c) long-term nursing home residents hospitalized with hip fracture (N=26,618; $P=0.005$ by log-rank test).

Table 1

Hospital characteristics, by hospital performance quartile and year

2007					
	1 st (best) quartile (N=375)	2 nd quartile (N=400)	3 rd quartile (N=335)	4 th (worst) quartile (N=328)	P
Teaching Status ^a (%)					
Non-teaching	264 (70.4)	270 (67.5)	250 (74.6)	262 (79.9)	<0.001
Minor teaching	59 (15.7)	70 (17.5)	38 (11.3)	29 (8.8)	
Major teaching	14 (3.7)	9 (2.3)	19 (5.7)	13 (4.0)	
Bed count (%)					
< 200 beds	84 (22.4)	100 (25)	81 (24.2)	100 (30.5)	0.036
200 beds < 400	177 (47.2)	173 (43.3)	137 (40.9)	149 (45.4)	
400 beds	114 (30.4)	127 (31.8)	117 (34.9)	79 (24.1)	
Nurse-to-bed ratio, mean (SD)	1.16 (0.5)	1.36 (1.3)	1.23 (0.5)	1.31 (1.2)	0.025
Nurse skill mix ^b , mean (SD)	0.87 (0.1)	0.88 (0.1)	0.87 (0.1)	0.87 (0.1)	0.749

2008					
	1 st (best) quartile (N=353)	2 nd quartile (N=334)	3 rd quartile (N=378)	4 th (worst) quartile (N=365)	P
Teaching Status ^a (%)					
Non-teaching	246 (69.7)	234 (70.1)	279 (73.8)	278 (76.2)	0.160
Minor teaching	53 (15.0)	47 (14.1)	51 (13.5)	40 (11.0)	
Major teaching	16 (4.5)	14 (4.2)	10 (2.7)	19 (5.2)	
Bed count (%)					
< 200 beds	91 (25.8)	76 (22.8)	85 (22.5)	119 (32.6)	0.002
200 beds < 400	156 (44.2)	135 (40.4)	180 (47.6)	157 (43.0)	
400 beds	106 (30.0)	123 (36.8)	113 (29.9)	89 (24.4)	
Nurse-to-bed ratio, mean (SD)	1.25 (0.9)	1.4 (1.6)	1.27 (0.7)	1.22 (0.5)	0.105
Nurse skill mix ^b , mean (SD)	0.88 (0.1)	0.87 (0.1)	0.88 (0.1)	0.87 (0.1)	0.144

2009

	1 st (best) quartile (N=373)	2 nd quartile (N=367)	3 rd quartile (N=389)	4 th (worst) quartile (N=408)	P
Teaching Status ^a (%)					
Non-teaching	255 (68.4)	246 (67.0)	278 (71.5)	311 (76.2)	0.041
Minor teaching	60 (16.1)	66 (18.0)	51 (13.1)	41 (10.1)	
Major teaching	19 (5.1)	20 (5.5)	13 (3.3)	21 (5.2)	
Bed count (%)					
< 200 beds	92 (24.7)	76 (20.7)	103 (26.5)	126 (30.9)	<0.001
200 beds < 400	175 (46.9)	158 (43.1)	158 (40.6)	190 (46.6)	
400 beds	106 (28.4)	133 (36.2)	128 (32.9)	92 (22.6)	
Nurse-to-bed ratio, mean (SD)	1.28 (0.7)	1.32 (1.1)	1.35 (1.2)	1.3 (1.0)	0.784
Nurse skill mix ^b , mean (SD)	0.9 (0.1)	0.88 (0.1)	0.87 (0.1)	0.88 (0.1)	0.117

Notes:

^aTeaching status categories defined according to resident to bed ratio as follows: "Non-teaching;" resident-to-bed ratio = 0; "Minor teaching;" resident-to-bed ratio greater than 0 but less than 0.25; "Major teaching;" resident-to-bed ratio greater than 0.25;

^bNurse skill mix calculated as registered nurses plus licensed practical nurses out of all nurses.

Table 2

Selected patient characteristics, by hospital performance quartile

	1 st (best) quartile N=90,340	2 nd quartile N=102,213	3 rd quartile N=101,908	4 th (worst) quartile N=83,616	P
Male sex (%)	24,598 (27.2)	28,154 (27.5)	27,824 (27.3)	23,294 (27.9)	0.0136
Mean age (SD)	84.25 (7.5)	84.13 (7.5)	84.06 (7.5)	84.02 (7.6)	<0.001
Nursing home resident (%)	6,097 (6.8)	7,487 (7.3)	7,212 (7.1)	5,822 (7.0)	0.012
Comorbidities (%)					
Dementia	23,521 (26.0)	27,308 (26.7)	27,296 (26.8)	22,387 (26.8)	<0.001
Cancer	12,102 (13.4)	13,447 (13.2)	13,332 (13.1)	10,717 (12.8)	0.005
Congestive heart failure	17,892 (19.8)	20,548 (20.1)	19,831 (19.5)	15,994 (19.1)	<0.001
Chronic lung disease	16,750 (18.5)	19,216 (18.8)	19,263 (18.9)	16,078 (19.2)	0.003
Diabetes mellitus	18,211 (20.2)	20,772 (20.3)	20,325 (19.9)	17,019 (20.4)	0.095
Hypertension	58,538 (64.8)	66,352 (64.9)	66,183 (64.9)	54,357 (65.0)	0.825
Electrolyte abnormality	22,004 (24.4)	25,377 (24.8)	24,793 (24.3)	20,012 (23.9)	<0.001
Prior arrhythmia	24,515 (27.1)	27,589 (27.0)	26,806 (26.3)	21,662 (25.9)	<0.001
Renal failure	11,055 (12.2)	12,739 (12.5)	12,220 (12.0)	9,412 (11.3)	<0.001
Valvular disorders	9,698 (10.7)	10,563 (10.3)	10,080 (9.9)	8,194 (9.8)	<0.001
Fracture location (%)					
Femoral neck	43,082 (47.7)	49,099 (48.0)	49,293 (48.4)	40,884 (48.9)	
Intertrochanteric	37,177 (41.2)	42,030 (41.1)	41,725 (40.9)	33,656 (40.3)	
Subtrochanteric	3,686 (4.1)	4,165 (4.1)	4,133 (4.1)	3,457 (4.1)	<0.001
Multiple listed	6,395 (7.1)	6,919 (6.8)	6,757 (6.6)	5,619 (6.7)	
Surgery (%)					
Internal fixation	52,251 (57.8)	59,130 (57.9)	58,608 (57.5)	47,691 (57.0)	<0.001
Hemiarthroplasty	30,206 (33.4)	34,415 (33.7)	34,746 (34.1)	28,423 (34.0)	
Total hip arthroplasty	2,794 (3.1)	3,151 (3.1)	3,071 (3.0)	2,632 (3.2)	
No surgery listed	5,089 (5.6)	5,517 (5.4)	5,483 (5.4)	4,870 (5.8)	

Table 3

Adjusted odds of mortality at 30, 90, and 180 days after admission for hip fracture

	Odds of death at 30 days, worst vs. best quartile (95% CI)		Odds of death at 90 days, worst vs. best quartile (95% CI)		Odds of death at 180 days, worst vs. best quartile (95% CI)	
	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
All patients ^a	1.17 (1.13,1.22)	1.24 (1.18,1.29)	1.12 (1.09,1.16)	1.17 (1.13,1.21)	1.1 (1.07,1.13)	1.15 (1.11, 1.18)
Community dwellers ^a	1.17 (1.12,1.22)	1.24 (1.18,1.3)	1.12 (1.08,1.15)	1.17 (1.13,1.21)	1.1 (1.07,1.13)	1.15 (1.11, 1.19)
Long-term nursing home residents ^b	1.19 (1.07,1.31)	1.22 (1.1,1.36)	1.16 (1.06,1.26)	1.2 (1.09,1.31)	1.07(0.99,1.16) ^c	1.10 (1.01, 1.19) ^d

Notes:

^a Adjusted for gender, race, age, dementia, angina, cancer, congestive heart failure, chronic lung disease, diabetes, hypertension, liver disease, electrolytes, paraplegia, pathological fracture, prior arrhythmia, pulmonary fibrosis, renal failure, presence of multiple trauma, angina, valvular disease, weight loss, fracture type, surgery type; adjustment for pre-fracture nursing home residence carried out in “all patients” model only.

^b Adjusted for gender, race, age, dementia, angina, cancer, congestive heart failure, chronic lung disease, diabetes, hypertension, liver disease, electrolytes, paraplegia, pathological fracture, prior arrhythmia, pulmonary fibrosis, renal failure, presence of multiple trauma, angina, valvular disease, weight loss, fracture type, surgery type, baseline disability in 7 ADLs (dressing, eating, locomotion, getting into and out of bed, transferring, self-hygiene, and toileting), and baseline cognitive performance. c. P=0.026; d. P=0.082; d. P<0.001 for all other comparisons.