RESEARCH ARTICLE

Factors for Increased Hospital Stay and Utilization of Post -Acute Care Facilities in Geriatric Orthopaedic Fracture Patients

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Abstract

Background: This study aims to determine the extent of utilization of health care resources in the geriatric fracture population and to identify factors associated with burden on resources.

Methods: This is a retrospective study of 1074 patients ≥65 years admitted to an orthopaedic service for a long bone fracture between July 2014 - June 2015. Outcomes were hospital length of stay (LOS), discharge disposition, and post-acute care facility LOS. Secondarily, readmission rates and mortality were assessed. Multivariable regression was performed to identify factors associated with utilization.

Results: Prior to injury, 96% of patients lived at home and 50% ambulated independently. Median hospital LOS was 5 days (IQR 3 – 7). 878 patients were discharged to a rehabilitation facility, with 45% being discharged <20 days. Ten percent of patients (n = 108) were re-admitted <90 days of their discharge. 924 patients were still alive one year after the injury. Higher Charlson Comorbidity Index (CCI) (*P=0.048*), male sex (*P<0.001*), pre-injury use of an ambulatory device (*P = 0.006*), and undergoing surgical treatment (*P<0.001*) were associated with longer hospital LOS. Older age (*P<0.001*), pre-injury ambulatory device (*P=0.001*), and surgery (*P=0.012*) were risk factors for requiring discharge to another inpatient facility. Older age (*P<0.001*), pre-injury ambulatory aid (*P<0.001*), and pre-existing immobility (*P<0.001*) were independent risk factors for LOS >20 days in a rehabilitation facility. Discharge home was not found to be associated with an increase in 1-year mortality after adjusting for age, CCI, sex, fracture location, and surgery (*P=0.727*). Shorter LOS in rehabilitation facilities (<20 days) was also not associated with an increase in 1-year mortality (*P=0.520*).

Conclusion: Elderly fracture patients utilize a significant amount of post-acute care resources and age, CCI, surgery, fracture location, pre-injury ambulatory status, and pre-injury living status were found to be associated with the use of these resources.

Level of evidence: III

Keywords: Bundled payments, Fracture, Geriatric, Healthcare utilization, Length of stay, Post-acute care, Rehabilitation

Introduction

The population of 65 years and older in the United States increased by 15.1 percent between 2000 and 2010 and is expected to continue growing (1). As the population ages, the incidence of orthopaedic trauma in the elderly is increasing. The treatment of geriatric fractures requires a considerable amount of both hospital

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and post-acute care resources (2). Accurate appraisal and containment of health care costs is becoming increasingly important as healthcare systems strive to provide high quality patient care with good value (3-5). With the continued evolution of healthcare reform and increased use of bundled payment models, an understanding of the utilization of resources in this group of patients will be beneficial to target opportunities for improvement. To date, there is a paucity of data regarding factors affecting increased use of healthcare resources in geriatric orthopaedic trauma patients.

Presently, the largest experience in orthopaedic surgery with bundled payments is with total joint arthroplasty (TJA). In the most common Medicare Bundled Payments for Care Improvement (BPCI) model, the episode of care is defined as the period including the surgical procedure, the acute hospital admission, and all post-acute care up to 90 days following surgery (6). Healthcare providers in a bundled payment program receive a single payment for each TJA covering the episode of care and are responsible for all related costs during that timeframe (7). There is risk to the providers as they can lose money if total costs during the episode of care exceed the payment amount; however there is the potential for greater reward if they can manage costs more efficiently. By 2018, 90% of Medicare payments will reward value, per the Centers for Medicare & Medicaid Services (CMS), and commercial payers are leaning towards similar reimbursement (8). Since bundled payments directly reward lower cost and better outcomes, it is expected that this model of reimbursement will be expanded to other procedures. In fact, the CMS has finalized the rule regarding the implementation for the Surgical Hip and Femur Fracture Treatment (SHFFT) model that will shift reimbursement for surgery for these fractures to a bundled payment model (9).

Post-acute care resources represent a significant portion of healthcare episode costs. Chandra et al. identified spending on post-acute care, comprising long-term hospital care, rehabilitation care, and skilled nursing facility care as the major cause for rising healthcare expenditures for hip fracture care during the period from 1994 to 2004. During this period, the cost of post-acute care for hip fracture doubled in the Medicare population (10).

This study aims to determine the extent of utilization of health care resources in a geriatric fracture population initially admitted to an acute care hospital and to identify factors associated with either an increased or decreased burden on resources.

Materials and Methods

We conducted a retrospective review of all patients aged 65 years or older admitted to an orthopaedic service at two urban academic level 1 trauma centers for a long bone or hip/pelvis fracture between July 2014 and June 2015. Institutional Review Board approval was obtained; the requirement for patient informed consent was waived.

Table 1 outlines the AO/OTA Classifications of fractures included in the study. Patients with pathologic fractures were excluded. The primary outcome measures of resource utilization were defined as hospital length of stay (LOS), hospital discharge disposition, and LOS at a post-acute care facility. As secondary outcomes, readmission within 90 days after discharge and 30-day and 1-year mortality were assessed.

Data on all eligible patients were extracted from medical records. Collected data included age at presentation, gender, Charlson Comorbidity Index (CCI), Injury Severity Score (ISS), American Society of Anesthesiologists (ASA) grade, service of admission, Intensive Care Unit (ICU) stay, mechanism of injury, fracture location, fracture treatment, pre-injury living status, pre-injury ambulatory status, concomitant cerebral injury, albumin, hemoglobin, and creatinine levels at admission. For all patients discharged to a rehabilitation facility, information on LOS at the facility, discharge disposition, and readmission to a hospital, was requested from this facility.

Continuous variables were presented as medians with interquartile ranges (IQR) and categorical variables as frequencies with percentages. The Shapiro-Wilk test was performed to determine if continuous variables were normally distributed. Correlations between the continuous outcome and explanatory variables were analyzed using the Mann-Whitney-U, Kruskal-Wallis, and Spearman's rank test, as appropriate. For dichotomous outcome measures the $\chi 2$ and Mann-Whitney-U tests were used. We applied multiple chained imputation (forty times) to estimate missing values for variables with missing values. With multiple imputation, the dataset is recreated multiple times and plausible values for the missing values are estimated based on the remaining variables accounting for uncertainty. To identify factors independently associated with greater utilization, multivariable linear and logistic regression

Table 1. Included Fracture Types

Variable	AO/OTA Classification code	Anatomical Location
Upper Extremity Fracture	23 ,22 ,21 ,13 ,12 ,11	Humerus, Forearm
Pelvis Fracture	62 ,61	Pelvis, Acetabulum
Hip Fracture	31	Proximal Femur
Lower Extremity Fracture	32,33,41,42,43,44	Femoral Shaft, Distal Femur, Tibia, Ankle

AO = Arbeitsgemeinschaft für Osteostynthesefragen; OTA = Orthopaedic Trauma Association.

analyses were conducted using explanatory values with *P <0.10* in bivariate analysis. The relationships between the use of resources and mortality were adjusted for age at presentation, CCI, sex, fracture location, and surgery. All analyses were performed using STATA version 13 (StataCorp); 2-sided *P <0.05* was considered statistically significant.

Results

During the 1 year study period, 1074 geriatric patients with non-pathological fractures from Table 1 were admitted to the orthopaedic services of our hospitals. The median age of the cohort was 81 years (IQR 73 – 88) and 73% were female [Table 2]. Most patients had sustained a fracture secondary to an injury of low energy mechanism (920/1074, 86%). Figure 1 illustrates that the greatest portion of fracture types was hip fractures – 43%. Seventy-five percent (803/1074) of patients underwent surgery for their fracture while the rest were treated non-operatively. Prior to their fracture and hospital admission, a clear majority of patients were living in the community (1034/1074, 96%), half of all patients were independently mobile (532/1074, 50%), 46% required the use of an ambulatory assistive device (493/1074), and 4% of patients were immobile/wheelchair dependent (48/1074).

The median LOS in hospital for our cohort was 5 days (IQR 3 – 7). Eight percent of patients were admitted to the ICU (89/1074) and their median number of ICU days was 4 (IQR 3 – 7). Only 16% of patients could be discharged to a home environment [Table 3; Figure 2a]. The in-hospital mortality rate was 2% (22/1074). Thus, 878 patients were discharged to a rehabilitation facility (acute rehabilitation or subacute rehabilitation/skilled nursing facility).

Table 2. Baseline Characteristics (n = 1074)

	Median	IQR
Age at presentation (years)	81	73 – 88
Charlson Comorbidity Index	1	0 – 2
Injury Severity Score*	9	9 – 9
	n	**%**
Male sex	293	27
ASA Score		
1	2	0
2	263	24
3	498	46
4	40	4
Mechanism of injury		
Low energy	920	86
High energy	108	10
Fracture location		
Hip fracture	459	43
Lower extremity fracture	251	23
Upper extremity fracture	126	12
Pelvic fracture	95	9
Multiple fractures	143	13
Pre-injury living status		
Home	1034	96
Not home	39	4
Pre-injury ambulatory status		
Independent	532	50
Using device	493	46
Immobile	48	4
Cerebral injury		
Yes	36	3
No	1038	97
Surgery		
Yes	803	75
No	270	25
Hemoglobin		
≤12 g/dL	551	51
>12 g/dL	512	48
Creatinine		
≤1.5 mg/dL	932	87
>1.5 mg/dL	132	12
Albumin		
≤3.5 g/dL	166	15
>3.5 g/dL	388	36

*Injury Severity Score (ISS) available for 314 patients (29%).
IQR = interquartile range; n = number; ASA = American Society of Anesthesiologists.

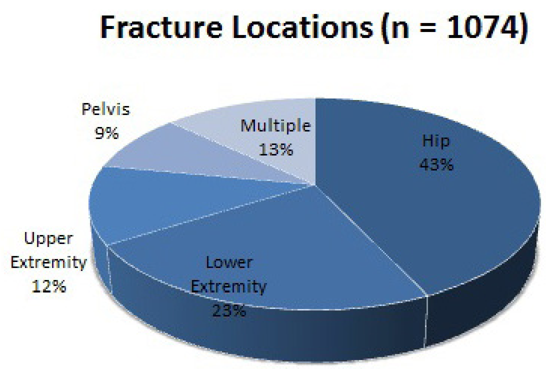

Figure 1. Fracture locations.

The median LOS in a rehabilitation facility was 19 days (IQR 13 – 33). Patients were discharged to a total of 207 different rehabilitation facilities and we obtained the discharge disposition from the rehabilitation facilities for 754 patients (86%); 60% of patients were discharged home, 14% were transitioned to a long-term care facility, 8% ended up back in an acute care hospital, 4% deceased prior to discharge, and disposition for 14% was unknown [Table 3; Figure 2b].

Intermediate outcomes revealed that 10% of patients (108/1052) were re-admitted to an acute care hospital within 90 days of their discharge. 30-day mortality for the cohort was 4% (48/1074); mortality at 1 year post fracture was 14% (150/1074).

We analyzed our primary utilization outcomes as hospital LOS in days, hospital discharge home or to another facility, and rehabilitation LOS less than 20 days versus 20 or more days. In a multivariable regression analysis [Table 4], independent risk factors for longer hospital LOS were a higher CCI (*P=0.048*), male sex (*P<0.001*), the use of an ambulatory assistive device prior to injury (*P=0.006*), and undergoing surgical treatment

Table 3. Outcomes

	Median	IQR
Hospital LOS (days) (n = 1074)	5	3 – 7
ICU LOS for patients admitted to ICU (days) (n = 89)	4	3 – 5
Rehabilitation LOS for patients admitted to rehabilitation facility (n = 764)*	19	13 – 33
	n	**%**
ICU admission		
Yes	89	8
No	985	92
Hospital discharge disposition		
Home	168	16
Rehabilitation facility	878	82
Subacute rehabilitation	664	62
Acute rehabilitation	214	20
Hospital	6	1
Deceased	22	2
Rehabilitation discharge disposition		
Home	526	60
Subacute care	121	14
Hospital	71	8
Deceased	36	4
Unknown	124	14
Rehabilitation LOS		
<20 days	398	45
≥20	392	45
Unknown	88	10
Hospital readmission <90 days		
Yes	108	10
No	944	88
N/A (deceased during initial admission)	22	2
30-day mortality		
Deceased	48	4
Alive	1026	96
1-year mortality		
Deceased	150	14
Alive	924	86

*Rehabilitation LOS available for 764 patients admitted to rehabilitation facility (87%), categorized rehabilitation LOS for 790 (90%).

IQR = interquartile range; LOS = length of stay; ICU = intensive care unit; n = number; N/A = not applicable.

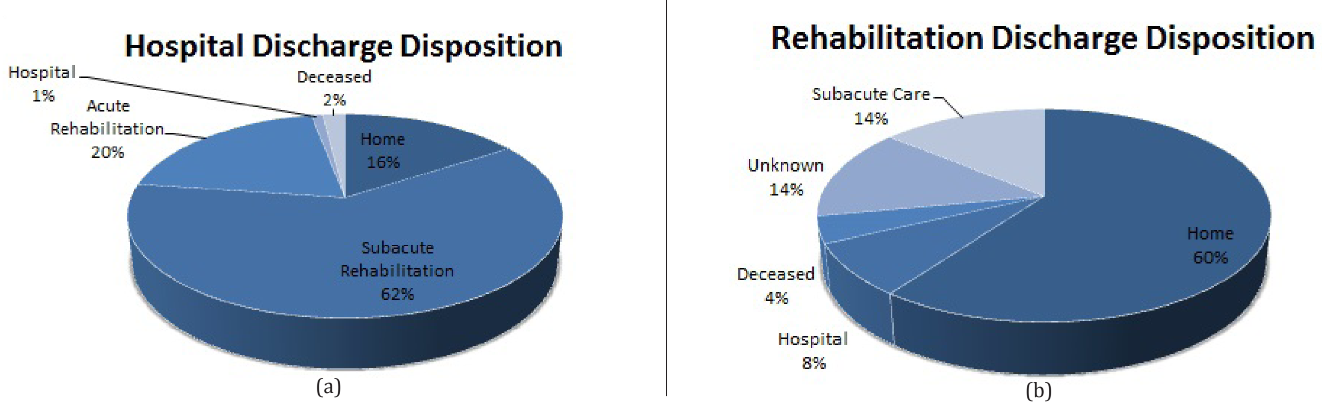

Figure 2. a) Hospital discharge disposition, b) Rehabilitation discharge disposition.

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Table 4. Multivariable regression analyses for primary outcomes

	Regression coefficient	95% confidence interval	*p*-value
Hospital LOS (n = 1074)			
Age at presentation	0.02	-0.01 – 0.05	0.223
Charlson Comorbidity Index	0.15	0.00 – 0.30	0.048
Male sex	1.09	0.49 – 1.68	<0.001
Low energy trauma	-1.66	-2.61 – -0.71	0.001
Fracture location			
Hip		reference value	
Lower extremity	-0.16	-0.83 – 0.51	0.664
Upper extremity	-1.49	-2.36 – -0.62	0.001
Pelvis	-0.01	-1.09 – 1.06	0.983
Multiple	0.69	-0.20 – 1.58	0.128
Pre-injury ambulatory status			
Independent		reference value	
Using device	0.77	0.22 – 1.32	0.006
Immobile	0.50	-0.76 – 1.75	0.436
Surgery	2.01	1.32 – 2.69	<0.001
Hemoglobin ≤12 g/dL	0.42	-0.11 – 0.95	0.124
Creatinine ≤1.5 mg/dL	-0.47	-1.31 – 0.36	0.264
	Odds ratio	**95% confidence interval**	***P-value***
Hospital discharge to home (n = 1052)			
Age at presentation	0.91	0.89 – 0.93	<0.001
Charlson Comorbidity Index	0.98	0.86 – 1.11	0.729
Low energy trauma	0.80	0.44 – 1.45	0.454
Fracture location			
Hip		reference value	
Lower extremity	1.68	0.97 – 2.89	0.064
Upper extremity	10.19	5.71 – 18.18	<0.001
Pelvis	1.77	0.79 – 3.96	0.169
Multiple	0.87	0.40 – 1.86	0.717
Pre-injury ambulatory status			
Independent		reference value	
Using device	0.45	0.28 – 0.72	0.001
Immobile	1.45	0.58 – 3.65	0.430
Surgery	0.54	0.33 – 0.87	0.012
Hemoglobin ≤12 g/dL	0.67	0.43 – 1.02	0.062
Creatinine ≤1.5 mg/dL	1.60	0.69 – 3.70	0.274
Rehab LOS <20 days (n = 790)			
Age at presentation	0.96	0.95 – 0.98	<0.001
Charlson Comorbidity Index	1.00	0.92 – 1.09	>0.999
Male sex	1.27	0.91 – 1.77	0.166

Table 4. Continued

Pre-injury living status			
Home		reference value	
Not home	0.47	0.19 – 1.15	0.099
Pre-injury ambulatory status			
Independent		reference value	
Using device	0.54	0.40 – 0.74	<0.001
Immobile	0.16	0.06 – 0.44	<0.001

LOS = length of stay.

Table 5. Multivariable regression analyses for intermediate outcomes.

	Odds ratio	95% confidence interval	*P-value*
30-day mortality			
Hospital LOS	1.07	1.01 – 1.12	0.012
Hospital discharge to home	1.59	0.44 – 5.77	0.480
Rehab LOS <20 days		omitted	
1-year mortality			
Hospital LOS	1.05	1.01 – 1.09	0.006
Hospital discharge to home	0.87	0.40 – 1.89	0.727
Rehab LOS <20 days	1.17	0.73 – 1.86	0.520
Readmission <90 days			
Hospital LOS	1.02	0.97 – 1.06	0.500
Hospital discharge to home	0.40	0.18 – 0.89	0.025
Rehab LOS <20 days	1.10	0.70 – 1.71	0.688

All analyses adjusted for age at presentation, Charlson Comorbidity Index, sex, fracture location, surgery.
LOS = length of stay.

(*P<0.001*). Low energy mechanism of injury (*P=0.001*), and having a fracture of the upper extremity (*P=0.001*) were associated with shorter LOS in hospital. An upper extremity fracture was the one factor associated with an increased odds ratio (OR) of being discharged home (OR 10.2, 95%CI 5.7-18.2, *P<0.001*), whereas older age (*P<0.001*), pre-injury use of an ambulatory assistive device (*P=0.001*), and having surgery (*P=0.012*) were risk factors for requiring discharge to another inpatient facility.

In the 790 patients (90%) for whom we could obtain rehabilitation length of stay data, older age (*P<0.001*), pre-existing use of an ambulatory aid (*P<0.001*), and pre-existing level of immobility (*P<0.001*) were independent risk factors for LOS in a rehabilitation facility greater than 20 days.

To investigate whether utilization of resources had an impact on secondary outcomes of readmission and mortality, we also analyzed our utilization outcomes as predictors [Table 5]. In those analyses, we adjusted for age, CCI, sex, fracture location, and surgery. Hospital discharge to home was independently associated with a decreased odds ratio of readmission (OR 0.4, 95%CI 0.2 – 0.9, *P=0.025*). Longer hospital LOS was identified as an independent risk factor for both 30-day and 1-year mortality (*P=0.012*, *P=0.006* respectively), but was not associated with increased odds for readmission (*P=0.500*). Discharge to home from hospital was not associated with an increase in 1-year mortality (*P=0.727*). Shorter LOS in rehabilitation facilities (less than 20 days) was also not associated with an increase in 1-year mortality (*P=0.520*) nor readmission to an acute care facility (*P=0.688*).

Discussion

The shift in healthcare payment models from fee-for-service to bundled payments necessitates an understanding of resource utilization to set targets for improvement in efficiency and costs. Our study demonstrates that high use of post-acute care hospital resources occurs in our geriatric fracture population aged 65 and older who require hospital admission. This was despite 96% of patients coming from a living situation within the community. Ultimately, 22% of our cohort were known not to have returned to the community after their fracture (14% entered a long-term care facility and 8% ended up back in an acute care hospital; we were unable to ascertain the ultimate disposition in 14% of patients so even these numbers may be underestimates). This information is useful even simply for having conversations with patients and their families regarding expectations for recovery. Most patients, 82%, were discharged from the acute care hospital to a rehabilitation facility. In our system, most of these patients go to a skilled nursing facility (SNF) as opposed to an inpatient rehabilitation facility (IRF), 62% vs 20%. This is comparable to a national Medicare sample of patients with hip fractures treated with hemiarthroplasty or total hip arthroplasty that demonstrated discharge rates to SNF and IRF from 77.5% to 86.9% (11).

Our LOS in the acute care hospital (median 5 days) and in rehabilitation facilities (median 19 days) are comparable to previously published reports in similar samples. Harada et al. examined a sample from the 1995 Medicare Provider Analysis and Review (PAR) File to investigate different patterns for physical therapy use for hospitalized hip fracture patients and found acute hospital median lengths of stay from 5 to 7 days and median SNF LOS from 15 to 28 days among groups receiving different types of physical therapy (12). Recently, Nichols et al. observed median hospital LOS of 5 days for arthroplasty-treated hip fracture patients without major complications or comorbidity (i.e. diagnosis-related group (DRG) 470), and 8 days for those with major complications or comorbidity (DRG 469). Their rehabilitation LOS were 22 to 26 days for SNF and 11 to 25 days for IRF (11). Interestingly, our cohort was found to have a lower rate of readmission back to acute hospital within 90 days of discharge (10%) compared to the Nichols' et al. cohort (14-26%). This finding may be explained by the slight differences in cohort since ours included all geriatric major fractures and Nichols' et al. were only examining hip fracture patients. Additionally, our study was limited in not having complete Medicare billing data; we could only ascertain readmissions that were either readmissions to our hospital network or reported to us by patients/caregivers/rehab facilities, potentially leading to an underestimation of the readmission rate.

Our analyses establish associated risk factors for higher utilization of healthcare resources. Patients who sustained upper extremity fractures were more likely to be discharged home, whereas older patients and those who used an assistive ambulatory device prior to injury were more often discharged elsewhere. Similarly, Salar et al. identified younger age and no use of walking aids to be independent variables associated with a higher likelihood of direct home discharge.13 Lower energy trauma and fractures of the upper extremity were associated with decreased LOS in hospital. Looking specifically at the DRG 536 for fracture of the hip and pelvis, Samuel et al. have highlighted that not all fractures are equal and that there are significant differences in resource utilization such as acute hospital LOS between low energy non-operative pelvic fractures and hip fractures compared to presumably high energy operative pelvic fractures (14). In our study, male sex, higher Charlson Comorbidity Index, prior use of an ambulatory aid, and undergoing surgery were factors associated with increased LOS in hospital. Using the ASA score, Garcia et al. found comorbidities to increase hospital LOS too (15). Having surgery was the strongest factor associated with LOS identified in our study, with a mean increase in hospital LOS by 2 days. Lübbeke and colleagues found surgical treatment to be also associated with increased utilization of rehabilitation care in a study on upper extremity fractures in the elderly (16). Time required for pre-operative investigation and clearance, waiting time for OR availability, and the actual day used to complete the surgery likely explain some of the difference; however, one should not discount these time periods from being areas to target efficiency. Strategies from elective surgeries such as total joint arthroplasty and general surgery laparoscopic procedures should be investigated for applicability to the geriatric fracture surgery population. Enhanced Recovery After Surgery (ERAS) programs, developed to prepare patients for surgery and decrease duration of recovery, have shown to decrease LOS after hip and knee arthroplasties (17-19). Tessier et al. demonstrated that clearly defined care pathways in total joint arthroplasty surgery promote better discharge disposition and lower cost (20). Elements of a care pathway that can be applied to the geriatric fracture population include early case management evaluation on hospital day 1 as opposed to after surgery and prognostication for discharge disposition based on factors that we have identified in this study (age, lower extremity versus upper extremity fracture, prior use of an ambulatory aid, energy of trauma, and need for surgery). Another example would be to hire a dedicated mid-level provider who interacts with patients and caregivers pre-, peri-, and post-op, and after discharge to liaise with patients/caregivers and post-discharge providers at SNF or homecare.

For our regression analysis of factors associated with rehab LOS, we selected 20 days in rehab as our dichotomous variable cut-off because 20 days in rehab is the Medicare limit after which patients admitted to a SNF must start to pay a co-pay ($164.50 in 2017) (21). The CMS rules for IRF stays are different (Medicare covers all costs up to 60 days); however, the majority of our patients went to a SNF (22). We did not find a relationship between LOS at a rehabilitation facility and mortality and readmission. This finding may be beneficial in attempts to safely reduce (expensive) post-discharge utilization of resources. We did adjust this analysis for age at presentation, comorbidity, sex, fracture location, and surgery. However, there may be other factors associated with survival in this population as well and we do not have data regarding patients' mobility or progress with physical therapy programs. We were not able to find literature with which to compare our results. Therefore, we would like to emphasize the need for more research in this field.

Interestingly, we found that our 878 patients discharged to a rehabilitation facility were admitted to a total of 207 different post-acute care facilities during this 1-year period. This seems to be an exceedingly high number – a 2014 study of post-acute referral patterns using 2008 Medicare PAR claims calculated the mean post-acute care network size for U.S. hospitals at 37.5 SNFs (23). This finding itself can be identified as a target for improvement, particularly for our institutions but also recognizing that the mean U.S. size of 37.5 SNFs is still a large amount of post-discharge providers to interact with. It is our hypothesis that acute care hospitals with a smaller network of post-acute facilities potentially may find it easier to liaise and interact with post-acute providers to influence efficient and better quality care. Being knowledgeable about their post-acute network and developing a strategy for liaison with post-acute care is expected to be a key pre-requisite for care transformation for surgeons and acute care providers treating geriatric fracture patients (24).

Our study is limited as a retrospective review in a single urban area. This limited our ability to retrieve complete data regarding patients in the post-acute care phase. However, we obtained complete information on 86% of our cohort by directly calling SNFs and IRFs for LOS, readmission, and discharge disposition data. Furthermore, we had few missing data of our explanatory variables and accounted for that using multiple imputation.

Study strengths include our large sample and that our data is relatively recent, including only patients admitted between 2014 and 2015. Also, we could assess the pre-injury patient living status and ambulatory status. This is beneficial as most studies use administrative data and focus on medical and demographic factors only.

The use of post-acute care inpatient facilities contributes significantly to the total cost of a care episode. We demonstrated that elderly orthopaedic fracture patients utilize a significant amount of post-acute care resources and that age, energy of trauma, fracture location, pre-injury ambulatory status, and undergoing surgery are associated with the use of these resources. Early identification of patients at risk for increased use of resources may be useful to accurately anticipate patients' needs and to set expectations regarding discharge disposition and LOS. Further, this data can be used to help properly risk stratify patients when developing bundled payment plans. Longer LOS in a post-acute care facility was not found to be associated with a difference in mortality at 1 year from injury. This finding is encouraging as it suggests that efforts to reduce post-discharge utilization of acute care resources is likely not detrimental to survival and readmission.

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