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Admitting Service Affects Cost and Length of Stay of Hip Fracture Patients

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Abstract

Introduction: The purpose of this study was to analyze the effect of the admitting service on cost of care for hip fracture patients by comparing the cost difference between patients admitted to the medicine service versus those admitted to a surgical service. **Methods:** A 2-year cohort of patients 55 years or older who were admitted to a single level 1 trauma center with an operative hip fracture were included. Patient demographics, comorbidities, admitting service, complications, and hospital length of stay were recorded for each patient. Cost of hospitalization, discharge disposition, and 30-day readmissions were collected. Patients who were admitted to the medicine service (medicine cohort) were compared to those admitted to a surgery service (surgery cohort). Multivariate regression models controlling for age, Charlson comorbidity index (CCI), and American Society of Anesthesiology (ASA) scores were used to evaluate hospitalization costs with a *P* value of <.05 as significant. **Results:** Two hundred twenty-five hip fracture patients were included; 143 (63.6%) patients were admitted to a surgical service, while 82 (36.4%) were admitted to the medicine service. Patients admitted to medicine service had greater CCI and ASA scores, longer lengths of stay, and more complications than those patients admitted to surgery service. Linear regression model controlling for age, CCI, ASA score, and time to surgery demonstrates that patients admitted to a surgical service will have 2.0-day (95% confidence interval [CI]: 0.561-3.503; $P = .007$) shorter admissions with a US$4215 reduction in cost (95% CI: US$314-US$8116; $P = .034$) compared to patients admitted to the medicine service. **Discussions:** In our urban safety net hospital, hip fracture patients admitted to medicine service had longer lengths of stay and higher total hospitalization costs than patients who were admitted to surgery service. **Conclusions:** This study highlights that the admitting service should be an area of focus for hospitals when developing programs to provide effective and cost-conscious care to hip fracture patients.

Keywords
hip fracture, admitting service, length of stay, cost of care, complications

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Introduction

There are more than 300 000 hip fracture admissions annually among older adults in the United States with estimated annual hospitalization costs of US$9.2 billion.[1-3] With the aging population, these numbers are only expected to rise. With this increasing incidence and the growing focus on providing quality, cost-effective care, the current management of hip fracture patients is being reevaluated. This has been compounded by the Center for Medicare and Medicaid Services' introduction of bundle payment programs for these fracture patients. Hip fractures treated with arthroplasty procedures are currently incorporated into the Comprehensive Joint Replacement bundle, and there are plans to include all other operative, nonarthroplasty hip fracture patients into an optional surgical hip and femur fracture treatment bundle.[4,5] These 2 bundles will thereby incorporate all operative hip fracture care into a bundle payment reimbursement model. As such, further analysis of the cost of care for hip fracture patients has become imperative in order to reduce cost without diluting patient care in this evolving reimbursement environment.

In analyzing the cost of treating hip fracture patients, several groups have noted risk factors that increase the cost of care for hip fracture patients, including comorbidities, American

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Society of Anesthesiology (ASA) score, and complications.[6-8] However, such patient-specific risk factors are beyond the control of the provider, and aside from awareness and triaging such patients, tangible cost-reducing modification for their care is largely inviable. As such, in this study, we sought to analyze a component of hip fracture management that is within direct provider control, specifically the admitting service. As a component of care coordination, the admitting service is one such initiative that hospitals are establishing to provide more cost-effective yet high-quality care to patients. Although there has been an increasing push to establish comanagement services with the implementation of geriatric hip fracture programs, such programs require both additional personnel and changes to traditional care management practices, making them difficult to establish in all hospitals, particularly nonacademic medical institutions. Therefore, in these institutions, hip fracture patients are admitted and primarily managed by either a medicine or a surgical service. Previously, there have been 2 studies evaluating the effect of admitting hip fracture patients to medicine versus orthopedic services with respect to length of stay, with each study providing conflicting evidence.[9,10] To our knowledge, no such study has directly investigated the impact of service of admission (admitting to the medicine vs the surgical service) on cost. As such, the purpose of this study was to analyze the cost difference between hip fracture patients admitted to the medicine service versus those admitted to a surgical service.

Methods

Patients aged 55 years and older who were admitted to a single level 1 trauma center with a primary diagnosis of hip fracture over a 2-year period (October 2014 to September 2016) were analyzed in this study. Exclusion criteria included any patient who did not receive operative treatment for their hip fracture. Patient demographics, comorbidities, admitting service, hospital length of stay, and complications were recorded for each patient. Comorbidities were analyzed using the Charlson comorbidity index (CCI), and physical health status was analyzed using ASA scores. Patients were divided into 2 cohorts based on which service they were admitted to: medicine or surgery. Patients in the medicine cohort were admitted directly to the medicine service due to an acute exacerbation of a preexisting condition or if a new medical diagnosis possibly contributed to the injury. The surgery cohort included patients who were admitted to the orthopedic service and those who were admitted to the trauma surgery service. Patients were admitted to the trauma surgery service if they had other traumatic nonorthopedic injuries that required general surgery care or monitoring including head or abdominal injuries. Inpatient complications were recorded, including acute renal failure, surgical site infection, decubitus ulcer, urinary tract infections, acute anemia, sepsis, pneumonia, acute respiratory failure, acute myocardial infarction, deep vein thrombus, pulmonary embolism, cardiac arrest, stroke, and death. Direct variable costs of care were obtained from the hospital finance department. Total costs of these hospitalizations were collected and categorized into the following groups: room/board, emergency department, pharmacy, laboratory/pathology, radiology, dialysis, cardiology, procedural, allied health, other (eg, blood products). Discharge disposition and 30-day readmission events were also recorded. Patients in the medicine cohort were compared to patients in the surgery cohort using independent t test and χ^2 analyses.

In order to isolate the effect of admitting service on hospital quality measures, analyses were performed to remove the effects of the following possibly confounding variables: age, CCI, ASA score, and time to surgery. This was performed using both multivariate hierarchical linear and logistic regression models. For the continuous variables (total cost of hospitalization, length of stay, and number of complications), multivariate hierarchical linear regression models were performed. The variables age, CCI, ASA score, and time to surgery were placed into the model prior to the variable of admitting service, allowing for isolation of the effect of the admitting service. For the dichotomous outcomes, postacute care facility utilization, and 30-day readmission, multivariate binomial logistic regression models were used, which allows for the analysis of the contribution of each independent variable to the model. A P value of $<.05$ was considered significant.

Results

A total of 238 hip fracture patients were treated during this period. Two hundred twenty-five (94.5%) were treated operatively and were included in this analysis. One hundred forty-three (63.6%) patients were admitted to a surgical service (surgery cohort), while 82 (36.4%) were admitted to the medicine service (medicine cohort). In the surgery cohort, 127 (88.8%) were admitted to orthopedics and 16 (11.2%) patients were admitted to the trauma surgery service. The mean age was no different between the medicine and surgery cohorts (81.3 [10.8] years vs 78.9 [11.3] years, $P = .116$, respectively). Although there was a slight difference in fracture pattern between the 2 cohorts, there was no difference in procedure performed (Table 1). In addition, patients admitted to medicine had a greater number of comorbidities than the patients admitted to surgery (1.8 [1.5] vs 1.1 [1.3], $P = .001$) and had greater ASA scores (3.5 [0.5] vs 3.2 [0.6], $P < .001$; Table 1).

Patients admitted to medicine service had longer lengths of stay compared to those patients admitted to a surgery service (10.4 [6.2] vs 8.0 [4.5] days, $P = .002$). However, the time to surgery did not differ between the 2 cohorts (2.2 [1.3] days in medicine cohort vs 2.0 [4.3] days in surgery cohort, $P = .667$; Table 2). This relationship of longer lengths of stay in the medicine cohort was maintained even when controlling for age, CCI, ASA score, and time to surgery. After controlling for these variables, the length of stay for these patients in the surgery cohort was 2.0 days less than those admitted to the medicine service (95% confidence interval [CI]: 0.561-3.503, $P = .007$; Table 3).

Table 1. Demographics and Procedure Information for Medicine and Surgery Cohorts.

Patient Characteristics	Medicine (n = 82)	Surgery (n = 143)	*P* Value
Age (years), mean (SD)	81.3 (10.8)	78.9 (11.3)	.116
Sex, n (%)			.807
Female	52 (63.4%)	93 (65.0%)	
Male	30 (36.6%)	50 (35.0%)	
CCI, mean (SD)	1.8 (1.5)	1.1 (1.3)	.001
ASA score, mean (SD)	3.5 (0.5)	3.2 (0.6)	<.001
Fracture type, n (%)			.048
Intertrochanteric	48 (58.5%)	73 (51.0%)	
Femoral neck	32 (39.0%)	53 (37.1%)	
Subtrochanteric	2 (2.4%)	17 (11.9%)	
Procedure choice, n (%)			.238
CRPP	6 (7.3%)	7 (4.9%)	
ORIF	50 (60.9%)	105 (73.4%)	
Hemiarthroplasty	21 (25.6%)	27 (18.9%)	
Total hip arthroplasty	5 (6.1%)	4 (2.8%)	

Abbreviations: ASA, American Society of Anesthesiology; CCI, Charlson comorbidity index; CRPP, closed reduction percutaneous fixation; ORIF, open reduction internal fixation; SD, standard deviation.

The mean cost of care for patients admitted to medicine was more than US$5000 greater than that of patients admitted to surgery (US$31 977 [US$12 558] vs US$26 653 [US$14 673], $P = .006$; Table 2). A subanalysis of cost data revealed differences between the cohorts in the following cost buckets: room/board, pharmacy, laboratory/pathology, cardiology, and allied health (Table 4). There was no difference in total cost per day between patients admitted to the medicine service and those admitted to a surgical service. When the cost of admission analysis was controlled for age, CCI, ASA score, and time between presentation and surgery, patients admitted to the surgical service maintained a US$4215 cost reduction compared to those admitted to medicine (95% CI: US$314-US$8116, $P = .003$; Table 3).

Univariate analysis suggested that patients in the medicine cohort had more complications (1.3 [1.3] in the medicine cohort compared to 1.0 [0.9] in the surgery cohort, $P = .020$), were more likely to be readmitted to the hospital within 30 days of discharge (14.6% in the medicine cohort compared to 6.3% in the surgery cohort, $P = .038$), and were more likely to be discharged to a postacute care facility (92.7% in the medicine compared to 81.1% in the surgery cohort, $P = .018$; Table 2). However, after controlling for age, CCI, ASA score, and time between presentation and surgery, there was no difference in mean number of complications, postacute care facility utilization, or 30-day readmission risk (Table 3).

Discussion

This study demonstrates that hip fracture patients admitted to the medicine service have longer and more costly admissions than those patients admitted to a surgical service. Although patients who were admitted to the medicine service had more comorbidities and greater ASA scores, when controlling for age, CCI, and ASA score, patients admitted to the medicine service had admissions that were more than US$4000 more costly.

To our knowledge, this is the first study to demonstrate a difference in index admission costs comparing hip fracture patients who are admitted to medicine service versus those admitted to surgery service. In addition to the total cost of care, there were several subdivisions of care that were significantly costlier in the medicine cohort compared to the surgery cohort including room/board, cardiology, laboratory/pathology, and pharmacy. However, notably there was no difference in total cost per day. As such, given the increased length of stay in the medicine group, it is reasonable to assume that most of the observed cost differential is due to length of stay. Furthermore, room/board, laboratory/pathology, and pharmacy costs are all recurring costs and therefore will be greater for patients with longer lengths of stay compared to onetime costs such as procedure costs.

The impact of admitting service on length of stay has been analyzed by 2 previous studies. The first by Chuang et al had a cohort of 98 patients and demonstrated that after adjusting for patient characteristics and comorbidities, there was no difference in the number of complications or length of stay between patients admitted to the medicine service and those admitted to the orthopedic service.[9] A more recent and larger study by Greenberg et al analyzed over 600 patients at a level 1 trauma center and found that patients admitted to the medicine service had 1.5 times longer hospitalizations than those admitted directly to orthopedics. This group however did not analyze complications or time to surgery to ascertain whether the increased length of stay was preoperative or postoperative.[10]

In our analysis, patients admitted to the medicine service had more patient comorbidities and had greater ASA scores than those admitted to the surgical service, which is consistent with the literature.[9,10] Although our result that patients admitted to the surgical service have greater lengths of stay and higher cost is consistent with Greenberg et al, it is notable that half of patients in their cohort were admitted to medicine service compared to our cohort of patients in which 36% were admitted to the medicine service.[10] Therefore, given that both studies included patients from an urban level 1 trauma center with a presumably similar distribution of case severity, even with a possibly more stringent criteria for admission to the medicine service in our cohort, both a cost and length of stay differential is observed.

There are possible explanations for longer lengths of stay and therefore greater index admission costs. One is that patients who are admitted to the medicine service require a longer preoperative optimization period given their preexisting comorbidities. However, as the time to surgery in our cohort was no different between the 2 groups, this was likely not the case in our study. Instead, the longer length of stay was likely due to factors affecting postoperative length of stay, such as less coordination of care between the surgical and medical services after surgical procedures were performed or stricter criteria for

Table 2. Hospital Quality Measures and Costs of Care for Medicine and Surgery Cohorts.

Quality Measure	Medicine (n = 82)	Surgery (n = 143)	*P* Value
Length of stay (days), mean (SD)	10.4 (6.2)	8.0 (4.5)	.003
Time to surgery (days), mean (SD)	2.2 (1.3)	2.0 (4.3)	.667
Total complications, mean (SD)	1.3 (1.3)	1.0 (0.9)	.020
Readmitted within 30 days, n (%)	12 (14.6%)	6 (6.3%)	.038
Discharged to postacute care facility, n (%)	116 (81.1%)	76 (92.7%)	.018
Total cost of care, mean (SD)	US$31,977 (US$12,558)	US$26,653 (US$14,673)	.006
Cost of care/day, mean (SD)	US$3466 (US$1118)	US$3592 (US$1121)	.418

Abbreviation: SD, standard deviation.

Table 3. Hospital Quality Measures and Cost of Care for Medicine and Surgery Cohorts (Controlling for Age, CCI, ASA Score, and Time to Surgery).

Quality Measure	B Coefficient[a]	95% CI	*P* Value
Length of stay (days)	2.032	0.561 to 3.503	.007
Total cost of care	US$4215	US$314 to US$8116	.034
Total complications	0.229	−0.074 to 0.533	.138
	Odds Ratio[a]	95% CI	*P* Value
Postacute care facility utilization	2.721	0.948 to 7.806	.063
30-day readmission risk	1.708	0.643 to 4.542	.283

Abbreviations: ASA, American Society of Anesthesiology; CCI, Charlson comorbidity index; CI, confidence interval.
[a]Medicine cohort relative to surgery cohort.

Table 4. Subdivisions of Cost of Care for Medicine and Surgery Cohorts.

Subdivision of Cost of Care	Medicine (n = 82)	Surgery (n = 143)	*P* Value
Room/board, mean (SD)	US$13,105 (US$7319)	US$9662 (US$8121)	.002
Emergency department, mean (SD)	US$516 (US$241)	US$540 (US$272)	.437
Pharmacy, mean (SD)	US$1555 (US$2064)	US$905 (US$864)	.008
Laboratory/pathology, mean (SD)	US$561 (US$329)	US$366 (US$239)	<.001
Radiology, mean (SD)	US$1542 (US$689)	US$1450 (US$642)	.313
Dialysis, mean (SD)	US$101 (US$667)	US$30 (US$319)	.373
Cardiology, mean (SD)	US$489 (US$1475)	US$179 (US$241)	.016
Procedure, mean (SD)	US$11,268 (US$5543)	US$11,188 (US$5979)	.808
Allied health, mean (SD)	US$1272 (US$1179)	US$972 (US$742)	.044
Other (eg, blood), mean (SD)	US$1569 (US$1031)	US$1446 (US$1221)	.337

Abbreviation: SD, standard deviation.

discharge on the medicine service. Further analysis of these factors should be performed, particularly care coordination and the increased responsibility that orthopedic surgeons need to have in the postoperative care of their patients.

Although it is not our recommendation that all hip fracture patients be solely managed by orthopedics, this study should encourage further study to refine guidelines for admitting service for hip fracture patients. As highlighted in this study, it is the older patients with more comorbidities and health issues (as demonstrated by increased CCI and ASA scores) that tend to be admitted to the Medicine service. Instead of surgical services leaving the medical and postoperative management of their more complicated patients solely to the medicine service, this study may further the argument for more orthopedic-hospitalist comanagement of patients, particularly for patients who would traditionally be admitted to the medicine service. The utility and success of such services is well-documented in the literature.[11-14] After implementation of an orthopedic-hospitalist comanagement service for patients who were traditionally admitted to the general medicine service, Bracey et al cites a reduction in length of stay by 1.6 days without an increase in 30-day readmission or mortality. This is consistent with the study by Phy et al who noted a reduction in length of stay from 10.6 to 8.4 days and a reduction in time to surgery from 38 to 25 hours under a similar coordination initiaitive.[12,13] For institutions that do not have the resources to develop such comanagement programs, this analysis suggests that increased resources and attention should be devoted to discharge planning for hip fracture patients admitted to the medicine service. This could be either

through the use of social work or clinical care coordinators. Through early discharge planning, both length of stay and cost of care would decrease. As all of these hip fracture patients are orthopedic surgical patients, orthopedic surgeons should assume the responsibility of ensuring the highest quality care for their patients which includes decreasing hospital length of stay and safe discharge planning.

Limitations to this study include its retrospective nature and all inherent disadvantages of such an analysis. Further, the data were collected from one urban level 1 trauma center. As such, these results, particularly the cost data, may not be directly applicable to other hospitals with patient populations different from our own. Furthermore, hospitals may utilize different preexisting protocols regarding admitting service for hip fracture patients, which may limit the generalizability of this study. Lastly, socioeconomic factors were not analyzed in this study. Further analysis of these factors is necessary to determine whether they are confounding risk factors for length of stay and admission costs.

Conclusion

In conclusion, hip fracture patients admitted to medicine service had longer lengths of stay and higher total hospitalization costs than patients who were admitted to surgical services. This relationship was significant even when controlling for age, patient comorbidities, and physical health status. Both surgical and medical services should be aware of this information so that they can together develop strategies to counter this effect. This study highlights that the admitting service should be an area of focus for hospitals when developing programs to provide effective and cost-conscious care to hip fracture patients, particularly with the incorporation of hip fracture patients into bundle payment of care programs.

Declaration of Conflicting Interests

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References

1. HCUPnet. Healthcare Cost and Utilization Project (HCUP). *Agency for Healthcare Research and Quality*. Rockville, MD: Centers for Medicare and Medicaid Services; 2012. http://hcupnet.ahrq.gov. Accessed June 5, 2017.
2. Burge R, Dawson-Hughes B, Solomon DH, et al. Incidence and economic burden of osteoporosis-related fractures in the United States, 2005-2025. *J Bone Miner Res*. 2007;22(3):465-475.
3. Braithwaite RS, Cos NF, Wong JB. Estimating hip fracture morbidity, mortality, and costs. *J Am Geriatr Soc*. 2003;51(3):364-370.
4. Centers for Medicare and Medicaid Services. Comprehensive care for joint replacement (CJR) model. 2017. https://innovation.cms.gov/Files/fact-sheet/cjr-providerfs-finalrule.pdf. Accessed September 20, 2018.
5. Centers for Medicare and Medicaid Services. Surgical hip and femur fracture treatment (SHFFT) model. 2017. https://innovation.cms.gov/initiatives/shfft-model/. Accessed September 10, 2018.
6. Brown CA, Olson S, Zura R. Predictors of length of hospital stay in elderly hip fracture patients. *J Surg Orthop Adv*. 2013;22(2):160-163.
7. Garcia AE, Bonnaig JV, Yoneda ZT, et al. Patient variables which may predict length of stay and hospital costs in elderly patients with hip fracture. *J Orthop Trauma*. 2012;26(11):620-623.
8. Aigner R, Meier Fedeler T, Eschbach D, et al. Patient factors associated with increased acute care costs of hip fractures: a detailed analysis of 402 patients. *Arch Osteoporos*. 2016;11(1):38.
9. Chuang CH, Pinkowsky GJ, Hollenbeak CS, et al. Medicine versus orthopaedic service for hospital management of hip fractures. *Clin Orthop Relat Res*. 2010;468(8):2218-2223.
10. Greenberg SE, VanHouten JP, Lakomkin N, et al. Does admission to medicine or orthopaedics impact a geriatric hip patient's hospital length of stay? *J Orthop Trauma*. 2016;30(2):95-99.
11. Ling SN, Kleimeryer C, Lynch G, et al. Can geriatric hip fractures be managed effectively within a level 1 trauma center? *J Orthop Trauma*. 2015;29(3):160-164.
12. Phy MP, Vanness DJ, Melton LJ III, et al. Effects of a hospitalist model on elderly patients with hip fracture. *Arch Intern Med*. 2005;165(7):796-801.
13. Bracey DN, Kiymaz TC, Holst DC, et al. An orthopedic-hospitalist comanaged hip fracture service reduces inpatient length of stay. *Geriatr Orthop Surg Rehabil*. 2016;7(4):171-177.
14. Swart E, Vasudeva E, Makhni EC, et al. Dedicated perioperative hip fracture comanagement programs are cost-effective in high-volume centers: an economic analysis. *Clin Orthop Relat Res*. 2016;474(1):222-233.