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The Coming Hip and Femur Fracture Bundle: A New Inpatient Risk Stratification Tool for Care Providers

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Abstract

Introduction: In response to increasing health-care costs, Centers for Medicare & Medicaid Services has initiated several programs to transition from a fee-for-service model to a value-based care model. One such voluntary program is Bundled Payments for Care Improvement Advanced (BPCI Advanced) which includes all hip and femur fractures that undergo operative fixation. The purpose of this study was to analyze the current cost and resource utilization of operatively fixed (nonarthroplasty) hip and femur fracture procedure bundle patients at a single level 1 trauma center within the framework of a risk stratification tool (Score for Trauma Triage in the Geriatric and Middle-Aged [STTGMA]) to identify areas of high utilization before our hospitals transition to bundle period. **Materials and Methods:** A cohort of Medicare-eligible patients discharged with the Diagnosis-Related Group (DRG) codes 480 to 482 (hip and femur fractures requiring surgical fixation) from a level 1 trauma center between October 2014 and September 2016 was evaluated and assigned a trauma triage risk score (STTGMA score). Patients were stratified into groups based on these scores to create a minimal-, low-, moderate-, and high-risk cohort. Length of stay (LOS), discharge location, need for Intensive Care Unit (ICU)/Step Down Unit (SDU) care, inpatient complications, readmission within 90 days, and inpatient admission costs were recorded. **Results:** One hundred seventy-three patients with a mean age of 81.5 (10.1) years met inclusion criteria. The mean LOS was 8.0 (4.2) days, with high-risk patients having 4 days greater LOS than lower risk patients. The mean number of total complications was 0.9 (0.8) with a significant difference between risk groups ($P = .029$). The mean total cost of admission for the entire cohort of patients was US$25,446 (US$9725), with a nearly US$9000 greater cost for high-risk patients compared to the low-risk patients. High-cost areas of care included room/board, procedure, and radiology. **Discussion:** High-risk patients were more likely to have longer and more costly admissions with average index admission costs nearly US$9000 more than the lower risk patient cohorts. These high-risk patients were also more likely to develop inpatient complications and require higher levels of care. **Conclusion:** This analysis of a 2-year cohort of patients who would qualify for the BPCI Advanced hip and femur procedure bundle demonstrates that the STTGMA tool can be used to identify high-risk patients who fall outside the bundle.

Keywords

hip fracture, femur fracture, cost of care, bundle payment, length of stay

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Introduction

Each year, the United States spends nearly US$3 billion on the hospital admission care of Medicare patients undergoing non-joint replacement procedures for hip and femur fractures.[1] With the annual incidence of hip fractures in the United States estimated to be more than 250,000 and expected to increase given the aging population,[2] the cost of caring for these patients is only expected to rise in the next decade. In an attempt to combat these rising health-care costs, the Centers for Medicare & Medicaid Services (CMS) has developed several bundle payment programs to both reduce these rising health-care costs and improve patient outcomes and satisfaction. In January 2018, CMS announced a new voluntary program termed Bundled Payments for Care Improvement Advanced (BPCI

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Advanced).[3] One of the 29 inpatient clinical episodes included as part of BPCI Advanced is hip and femur procedures except major joint arthroplasty. This includes all operatively fixed hip and femur fractures. This specific hip and femur fracture BPCI Advanced program is scheduled to start on October 1, 2018. Whether or not hospitals decide that participating in the new hip and femur fracture bundle program is in their best economic interest, the fact remains that it is in society's best interest for hospitals to provide better value-based care for these hip and femur fracture patients. In addition, many private companies may proceed with a similar program in the future.[4]

Several groups have demonstrated success with programs initiated to aid in this transition to a bundle payment model of care.[5-8] These programs have included initiatives focusing on care coordination, pathway implementation, and attempts to reduce post-acute care inpatient facility use. However, these programs have all been utilized in the joint arthroplasty population as part of the comprehensive joint replacement (CJR) model, which is a largely elective population. Compared to the trauma patients that will comprise the majority of the new hip and femur procedure bundle, most patients included in the CJR bundle have been medically optimized for surgery. The differences in cost of care among hip fracture patients have been demonstrated in the literature, with studies demonstrating that patients with greater American Society of Anaesthesiologist (ASA) and Charlson Comorbidity Index (CCI) scores are more likely to have longer and more costly hospital admissions.[9-11] Garcia et al for example demonstrated that with each increase in ASA score, there was an average increase of US$9300 in index hospital admission costs.[9] Given the heterogeneity of hip and femur fracture patients, it is essential to have an effective risk stratification tool to provide targeted resource-conscious and high-value care to both prototypical and outlier patients within the new nonarthroplasty hip and femur procedure bundle. This group has previously published on the development of a novel inpatient mortality risk tool, the Score for Trauma Triage in the Geriatric and Middle-Aged (STTGMA). This score, which evaluates a patient's age, comorbidities, vital signs, and anatomic injuries, has been validated in the National Trauma Databank as well as prospectively at our academic medical center and level 1 trauma center as a reliable tool for triage analysis.[12,13] The purpose of this study is 2-fold: (1) to analyze the inpatient cost and resource utilization of patients who fall into the new hip and femur fracture BPCI Advanced bundle at a single level 1 trauma center in order to identify areas of high resource utilization and (2) to determine whether a validated middle-aged and geriatric trauma risk assessment tool (STTGMA) can identify patients who fall outside the expected bundle.

Materials and Methods

A cohort of Medicare-eligible patients discharged with the DRG codes 480 to 482 (hip and femur fractures requiring surgical fixation) from an urban level 1 trauma center between October 2014 and September 2016 were evaluated. Each patient was assigned a trauma triage risk score (STTGMA score) at presentation to the emergency department using information collected by second- or third-year orthopedic surgery consult residents who had been trained in STTGMA score calculation via a standardized online 20-minute tutorial. The STTGMA score captures a patient's injury, health, and functional status using the variables in Table 1.[12] This STTGMA score provides a predicted percentage inpatient mortality risk for each patient. Patients were stratified into 4 groups based on these scores to create a minimal-risk, low-risk, moderate-risk, and high-risk cohort indicating a risk of inpatient mortality of <0.4%, 0.4% to 1.5%, 1.5% to 4%, and >4.0%, respectively. Patient length of stay (LOS), location of discharge, need for ICU/SDU care, inpatient complications, and readmission within 90 days were recorded. Complications included septic shock, pneumonia, acute respiratory failure, acute myocardial infarction, deep vein thrombus, pulmonary embolism, cardiac arrest, stroke, and death. Total direct variable costs of these hospitalizations were obtained from the hospital finance department from their cost accounting system (EPSI, New York, New York). Cost data were divided into the following cost buckets: room, emergency department, pharmacy, laboratory/pathology, radiology, dialysis, cardiology, procedure, allied health, and other (eg, blood). χ^2 analysis and analysis of variance were used to determine differences between the different risk cohorts with $P < .05$ considered significant.

Table 1. Variables Included in the STTGMA Score.

Injury Status	Health Status	Functional Status
Low/high energy	CCI[a]	Ambulatory capacity[a]
GCS[a,b]	Albumin level[b]	Age[a,b]
AIS head/neck[a,b]		
AIS chest[a,b]		
AIS extremity/pelvis[b]		

Abbreviation: STTGMA, Score for Trauma Triage in the Geriatric and Middle-Aged; GCS, Glasgow Coma Scale; CCI, Charlson Comorbidity Index; AIS, Abbreviated Injury Score.
[a]Variable is included in the low-energy score.
[b]Variable is included in the high-energy score.

Results

One hundred seventy-three hip and femur fracture patients with DRG codes 480 to 482 were included in this study with an average age of 81.5 (10.1) years. Eighty-five (49.1%) patients were considered minimal risk with STTGMA scores less than 0.4%, 53 (30.6%) patients were considered low risk with STTGMA scores between 0.4% and 1.5%, 26 (15.0%) patients were considered moderate risk with STTGMA scores between 1.5% and 4%, and 9 (5.2%) patients were considered high risk. The majority of patients had a Glasgow Coma Scale (GCS) of 15 (158, 91.3%), with a mean GCS of 14.8 (1.0). The mean Abbreviated Injury Scale (AIS) scores were as follows: 0.09 (0.35) for AIS head/neck, 0.08 (0.29) for AIS chest, and 3.02 (0.36) for AIS extremity. The average CCI score for the

Table 2. Baseline Study Characteristics for Minimal-, Low-, Moderate- and High-Risk Patients With Hip and Femur Fracture.

Baseline Characteristics	Minimal Risk (n = 85)	Low Risk (n = 53)	Moderate Risk (n = 26)	High Risk (n = 9)	Total Cohort (N = 173)
Age (years), mean (SD)	78.2 (9.5)	85.8 (9.0)	83.7 (10.7)	80.6 (10.1)	81.5 (10.1)
GCS, mean (SD)	15.0 (0.1)	14.9 (0.5)	14.1 (2.3)	14.3 (1.3)	14.8 (1.0)
AIS head/neck, mean (SD)	0.40 (0.19)	0.13 (0.48)	0.19 (0.40)	0.11 (0.33)	0.09 (0.35)
AIS chest, mean (SD)	0.05 (0.26)	0.08 (0.27)	0.15 (0.37)	0.11 (0.33)	0.08 (0.29)
AIS extremity, mean (SD)	3.05 (0.31)	3.00 (0.52)	3.00 (0.00)	3.00 (0.00)	3.02 (0.36)
CCI, mean (SD)	0.53 (0.38)	0.98 (1.15)	2.12 (1.03)	4.56 (1.75)	1.12 (1.37)
On anticoagulation?, n (%)	17 (20.0%)	21 (39.6%)	12 (46.2%)	5 (55.6%)	55 (31.8%)
Ambulation, n (%)					
Community	83 (97.6%)	21 (39.6%)	4 (15.4%)	1 (11.1%)	109 (63.0%)
Household	1 (1.2%)	32 (60.4%)	19 (73.1%)	6 (66.7%)	58 (33.5%)
Minimal/nonambulatory	1 (1.2%)	0 (0.0%)	3 (11.5%)	2 (22.2%)	6 (3.5%)
Assistive device?, n (%)	30 (35.3%)	30 (56.6%)	20 (76.9%)	9 (100.0%)	89 (51.4%)
Albumin (g/mL), mean (SD)	3.9 (0.4)	3.7 (0.5)	3.6 (0.4)	3.6 (0.6)	3.8 (0.5)

Abbreviation: GCS, Glasgow Coma Scale; AIS, Abbreviated injury Score; CCI, Charlson Comorbidity Index.

Table 3. Cost Data for Minimal-, Low-, Moderate-, and High-Risk Patients With Hip and Femur Fracture.

Cost	Minimal Risk (n = 85)	Low Risk (n = 53)	Moderate Risk (n = 26)	High Risk (n = 9)	Total Cohort (N = 173)	*P* Value
Total cost, mean (SD)	US$24,872 (US$10,826)	US$25,483 (US$8432)	US$24,471 (US$7101)	US$33,473 (US$10,202)	US$25,446 (US$9725)	.081
Cost/day, mean (SD)	US$3704 (US$1673)	US$3439 (US$925)	US$3515 (US$1250)	US$2917 (US$291)	US$3554 (US$1376)	.345
Room/board, mean (SD)	US$9018 (US$7642)	US$9703 (US$4821)	US$9817 (US$5131)	US$14,540 (US$5812)	US$9635 (US$6511)	.116
Emergency department, mean (SD)	US$560 (US$350)	US$525 (US$174)	US$594 (US$334)	US$664 (US$509)	US$559 (US$313)	.657
Pharmacy, mean (SD)	US$884 (US$1508)	US$1066 (US$1767)	US$878 (US$818)	US$2044 (US$1510)	US$999 (US$1525)	.174
Laboratory/ pathology, mean (SD)	US$333 (US$222)	US$438 (US$265)	US$384 (US$216)	US$490 (US$273)	US$381 (US$241)	.040
Radiology, mean (SD)	US$1503 (US$647)	US$1573 (US$510)	US$1512 (US$602)	US$1979 (US$588)	US$1550 (US$602)	.154
Dialysis, mean (SD)	US$7 (US$61)	US$180 (US$1076)	US$24 (US$125)	US$778 (US$1552)	US$103 (US$705)	.012
Cardiology, mean (SD)	US$185 (US$211)	US$282 (US$200)	US$239 (US$167)	US$416 (US$244)	US$235 (US$211)	.002
Procedure, mean (SD)	US$9986 (US$3281)	US$9047 (US$2432)	US$8812 (US$2449)	US$9485 (US$3743)	US$9496 (US$2970)	.179
Allied health, mean (SD)	US$856 (US$660)	US$981 (US$847)	US$981 (US$904)	US$1535 (US$970)	US$948 (US$784)	.095
Other (eg, blood), mean (SD)	US$1541 (US$1054)	US$1690 (US$1048)	US$1227 (US$631)	US$1562 (US$505)	US$1541 (US$983)	.277

cohort was 1.1 (1.4). Of this, 31.8% of patients were taking anticoagulant medications and 63.0% were community ambulators; 51.4% used assistive devices for ambulation, and average albumin levels were 3.8 (0.5) g/dL. Using these variables, the mean STTGMA score was 1.2%. Baseline study characteristics for each risk group are summarized in Table 2.

The mean LOS for the cohort of patients was 8.0 (4.2) days with a significant difference among the different risk groups ($P = .045$). For example, patients in the high-risk cohort group had a 4-day increase in their mean LOS compared to the minimal-risk cohort group (7.5 [4.2] vs 11.7 [4.0] days). The mean total cost of admission for the entire cohort of patients was US$25,446 (US$9725) with much greater costs in the high-risk cohort group. The mean index cost of admission for patients in the high-risk cohort was nearly US$9000 more than that of the minimal-risk cohort (US$24,872 [US$10,826] vs US$33,473 [US$10,202]). The top 5 high-cost areas of care in these patients were room/board, procedure, radiology, other (eg, blood products and nonsterile supplies), and pharmacy costs. For example, room/board costs and procedure costs

Table 4. Hospital Quality Measures for Minimal-, Low-, Moderate-, and High-Risk Patients With Hip and Femur Fracture.

Hospital Quality Measures	Minimal Risk (n = 85)	Low Risk (n = 53)	Moderate Risk (n = 26)	High Risk (n = 9)	Total cohort (N = 173)	*P* Value
Mean, length of stay (days), n (%)	7.5 (4.2)	8.0 (3.7)	8.2 (5.0)	11.7 (4.0)	8.0 (4.2)	.045
Need for ICU/SDU level care, n (%)	2 (2.4%)	5 (9.4%)	1 (3.8%)	3 (33.3%)	11 (6.4%)	.002
Mean number of total complications, mean (SD)	0.79 (0.69)	0.96 (0.78)	0.73 (0.87)	1.56 (1.30)	0.87 (0.80)	.029
Discharged home?, n (%)	11 (12.9%)	1 (1.9%)	3 (11.5%)	1 (11.1%)	16 (9.2%)	.172
Readmitted within 90 days, n(%)	5 (5.6%)	8 (15.1%)	1 (3.8%)	1 (11.1%)	15 (8.7%)	.219

Abbreviation: SD, standard deviation.

comprised 37.9% and 37.3% of the total index admission costs for these patients, respectively. Just as patients in the high-risk group had longer lengths of stay, high-risk cohort patients had much greater room/board costs compared to the mean room and board cost of care for the entire cohort (US$14,540 [US$5812] vs US$9635 [US$6511]). Procedure costs were relatively uniform across the different risk cohort groups. Radiology was the third most costly bucket of care; mean radiology costs for the total cohort of patients were US$1550 (US$602; 6.1% of the total cost of care). Radiology costs differed between the different risk groups with high-risk patients having radiology costs more than US$400 greater than the other risk cohort groups. Other category costs, which includes blood and nonsterile supplies, contributed 6.1% of the mean total costs of care (US$1541). There was little variation between the risk groups for these costs ($P = .277$). Pharmacy costs accounted for 3.9% of total index admission costs (US$999 [US$1525]) with nearly a doubling of pharmacy costs in the high-risk patients compared to the other risk cohorts (US$2044 [US$1525] vs US$884 [US$1508]; Table 3).

The average number of total complications in the cohort was 0.9 (0.8) with a significant difference between the different risk groups (high risk: 1.6 [1.3] vs low risk: 0.8 [0.7]; $P = .029$). This increased number of complications was associated with a higher rate of need for ICU/SDU care in the high-risk cohort: 33% of high-risk patients required advanced levels of care compared to 2.4% of the minimal-risk cohort patients. With respect to discharge, only 16 (9.2%) patients in the entire cohort were discharged home with a high utilization of post-acute care facility needs in all risk groups. Lastly, there was an 8.7% readmission rate within 90 days with no statistically significant difference between the risk groups ($P = .172$; Table 4).

Discussion

This study demonstrates the ability of a middle-aged and geriatric trauma triage tool to risk stratify hip and femur fracture patients and identify those patients who are outliers with regard to cost and resource utilization. High-risk patients were more likely to have longer and more costly admissions with average index admission costs nearly US$9000 more than the lower risk patient cohorts. These high-risk patients were also more likely to develop inpatient complications and require higher levels of care. As such, this study provides hospitals with a tool that they can use to prepare if they do choose to participate in the bundle payment program. We see the use of this analysis as 2-fold. First, hospitals can use this tool to identify high-risk patients and devote more resources to these patients in a *proactive rather than reactive fashion*. Example bundle payment programs suggested in the literature require many resources and often have large start-up costs. One such tool that has been shown to be effective in the joint arthroplasty population involves hiring clinical care coordinators to contact each patient included in the bundle throughout the 90-day post discharge period. They anticipate any complications and organize ways to solve any problems if they arise.[5] Using the STTGMA tool, hospital systems that may have limited resources can identify where they should initially focus their efforts when initiating such programs.

Second, hospitals can use this tool to develop pathways as part of a larger bundle payment initiative. The standard deviation of the mean total admission costs in the minimal-risk cohort was much greater than that of the low- and moderate-risk patients. This is indicative of the variability of care that exists in the minimal-risk cohort group. Given that this group of patients has a low complication rate and little advanced care use, this group of patients would benefit from a standardized pathway of care. Hip fracture protocols and pathways of care have been shown to not only reduce the cost but to also reduce the LOS and complications.[14,15] One such study by Morrison et al estimated that the introduction of the pathway resulted in a cost reduction of about US$3800 per case with an estimated 871 complications prevented for every 1000 patients treated.[16]

Other groups have analyzed hip fracture patients and factors that influence LOS, complications, and cost. The relationship between ASA, LOS, and cost has been well established.[9,17,18] Garcia et al reported that with each increase in ASA score, there was an average increase in LOS of 2 days which corresponded to a US$9300 increase in cost. This increase in LOS is thought to be in part due to increased time between admission and surgery.[9] A study by the same group also reported on the relationship between CCI and LOS and hospital costs. Compared to patients with a CCI of 0, patients with CCI of 2 stayed an additional 2 extra days in the hospital and had nearly US$9000 of added expense.[10] However, these studies provide no guidance on which patients should be considered high risk and to our knowledge, no study has looked at the nonarthroplasty hip and femur procedure bundle patient population specifically.

This study also identifies high-cost areas of inpatient care in these patients that can be targeted through new initiatives in anticipation of the expansion of bundle patients. Room and board and procedure costs together comprised more than 75% of the total index hospitalization costs. These results are consistent with the limited studies that present cost data for subcategories of care. One such study at a large regional trauma referral center cites that for hip fracture patients, 30% of direct variable expenses come from LOS costs, 27% from supply costs (including implants), and 16% from operating room expenses. The figures for femur fractures were similar with 26% of direct variable expenses from LOS costs, 29% from supply costs (including implants), and 16% from operating room expenses.[19] A second study from Germany also highlights the effect of room/board costs in these hip fracture patients citing that 68.5% of total costs are from ward costs with 22.3% of costs associated with surgical expenses.[20] Along with room and board costs, the effect of implant costs on the total cost of care has been well demonstrated in the literature with many studies citing the large range of implant costs.[21,22] In a study by Egol et al, they were able to save 18% (US$550) per case simply by changing implant choice for patients with intertrochanteric hip fractures with no decrease in hospital quality measures.[23]

It should be noted that the costs presented in this study are from patients treated at a single level 1 trauma center and therefore, may not be reflective of costs at other institutions. Second, this study only addresses costs that are incurred during the index admission, which is only part of the 90-day bundle payment cost. Post-acute care costs are not included in this article. Future studies will focus on this important aspect of the bundle. Third, while this study includes patients from a 2-year cohort, it includes a limited number of high-risk patients. Fourth, additional factors such has early mobilization, nutritional support, and caregiver support that have been shown to affect patient and financial outcomes were not included in this study. Future studies are planned to evaluate the relationship of the STTGMA tool to these factors. Lastly, while all patients were Medicare eligible, patient socioeconomic factors were not collected in this analysis. Further analysis of these factors may reveal confounding factors.

Conclusions

This analysis of a 2-year cohort of patients who would qualify for the upcoming hip and femur procedure bundle demonstrates that the STTGMA tool can be used to identify outlier patients at risk for high cost and resource utilization. A risk-stratified analysis of index admission direct variable cost data highlights areas of care that should be targeted in the effort to provide more cost-conscious care, particularly in the realm of LOS and procedural costs.

Authors' Note

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Declaration of Conflicting Interests

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