Variations in Cost and Readmissions of Patients in the Bundled Payment for Care Improvement Bundle for Hip and Femur Fractures

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Abstract

Introduction: The Bundled Payment for Care Improvement (BPCI) for hip and femur fractures is an effort to increase care quality and coordination at a lower cost. The bundle includes all patients undergoing an operative fixation of a hip or femur fracture (diagnosis-related group codes 480-482). This study aims to investigate variance in the hospital cost and readmission rates for patients within the bundle. **Materials and Methods:** The study is a retrospective analysis of patients ≥65 years old billed for a diagnosis-related groups 480-482 in 2016 in the National Readmission Database. Cost of admission and length of stay were compared between patients who were or were not readmitted. Regression analysis was used to determine the effects of the primary procedure code and anatomical location of the femur fracture on costs, length of stay, and readmission rates. **Results:** Patients that were readmitted within 90 days of surgery had an increased cost on initial admission ($18,427 vs $16,844, $P < .0001$), and an increased length of stay (6.24 vs 5.42, $P < .0001$). When stratified by procedure, patients varied in readmission rates (20.7% vs 19.6% vs 21.8%), initial cost, and length of stay (LOS). Stratification by anatomical location also led to variation in readmission rates (20.7% vs 18.3% vs 20.6%), initial cost, and LOS. **Conclusion:** The hip and femur fractures bundle includes a great number of procedures with variance in cost, readmission, and length of stay. This amount of variation may make standardization difficult and may put the hospital at potential financial risk.

Keywords

bundled payment, hip fracture, femur fracture, hospital cost, readmission rate

Introduction

The Centers for Medicare and Medicaid Services (CMS) has attempted to mitigate rising healthcare costs by implementing Bundled Payment Initiatives as a new billing method. This provides a single comprehensive payment to cover all aspects of patient care from initial admission to the completion of the 90-day global period, as opposed to the previous Fee For Service (FFS) method that reimbursed providers and facilities segmentally for each individual service provided. Bundled reimbursements have

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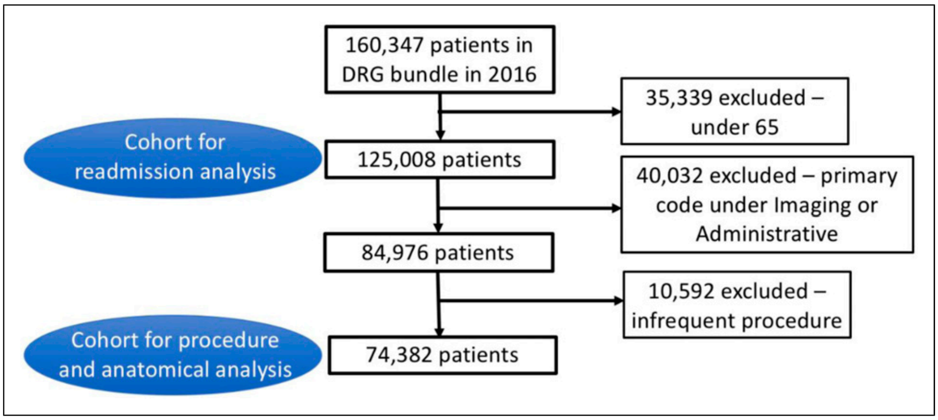

Figure 1. Study population.

become a flagship of CMS cost reduction efforts in recent years, and have increased in number to span multiple domains of patient care both medical and surgical.[1]

Although some Bundled Reimbursements in general have shown promise, more recent systemic reviews have raised concerns on the utilization and cost effectiveness of specific bundles, particularly those with significant patient population heterogeneity that require more in-depth risk stratification for accurate reimbursement.[2,3] A new Bundled Payment for Care Improvement-Advanced (BPCI-A) for surgical hip and femur fractures was initiated in 2016.[4] This particular bundle includes 393 unique ICD-10 primary procedure codes at multiple anatomic locations, without specific considerations for potential variance in costs.[5-7]

This large amount of procedures could potentially lead to variance in costs associated with differences in lengths of stay and readmission rates. This uncertainty and lack of consistent appropriate reimbursements could discourage care facilities from utilizing a method that could potentially reduce costs and improve care due to a bundle that is insufficiently stratified. This study aims to explore the variability of procedures in this femur bundle and determine the effect of both procedure and fracture location on cost and readmission rates within the bundle.

Methods

This study was deemed non-human subjects research by our IRB. This study is a retrospective evaluation of data from the National Readmissions Database (NRD). The NRD is a Health Cost and Utilization Project (HCUP) affiliated set of inpatient databases for readmissions within 90 days of initial admission.[8] Diagnosis-Related Groups (DRG) 480-482 correspond to hip and femur procedures excluding a major joint with major complications, with minor complications, and without any complications, respectively.[6] We examined the DRGs used in the BPCI hip and femur bundle for the year 2016. Patients under 65 years old were excluded in an attempt to restrict our study to those with Medicare as their primary payer.

Our initial patient population consisted of 160,347 patients (Figure 1). Our follow-up analyses that were procedure and anatomically based further excluded 40,032 that had ICD-10 PCS primary procedure codes listed as imaging or administrative rather than a code classified as surgical or medical. 10,592 patients were excluded who had an infrequent primary procedure code that corresponded to <2 patients each in the entire dataset. The final cohort for the analysis of root procedure and anatomical location of the procedure includes 74,382 as our cohort.

Data were collected from the NRD using de-identified patients based on their ICD-10 PCS primary procedure codes. Variables evaluated include total cost on admission, length of stay, comorbidities, number of concurrent ICD-10 diagnoses, and readmission rates within 90 days. The "cost on admission" data element only includes the US dollar amount related to the inpatient care episode related to the primary surgical encounter.[9] The NRD does not include information on the cost of patient care after discharge including readmissions, home care, and post-acute care facilities such as nursing homes and inpatient rehab.The NRD design uses patient level weighted data to provide population estimates. The weighted data do not allow for cost summation of patient observations from the initial visit and any subsequent readmissions. The NRD does record other metrics that have been established to correlate with overall costs such as initial cost, readmission rate, and length of stay.

A bivariate statistical analysis was performed comparing those who were readmitted vs those who were not, and identified differences in variables related to cost including total cost on admission, length of stay, comorbidities, and number of concurrent ICD-10 diagnoses.

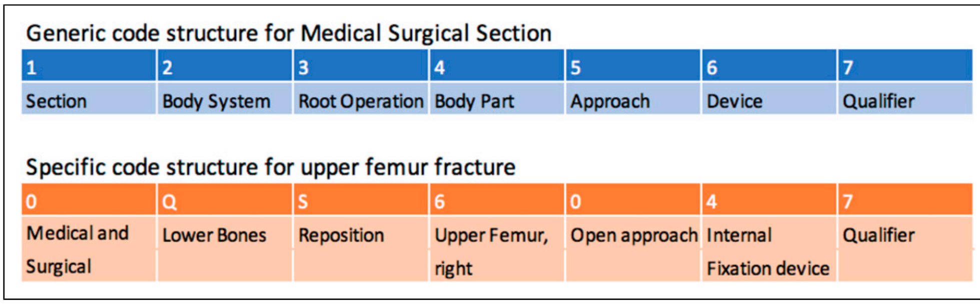

Figure 2. ICD-10 PCS coding format with an example procedure (0QS6047).

Continuous variables were compared with t-test and categorical variables were compared using the chi-squared test. Statistical significance was set at $\alpha < .05$. Statistical analysis was completed using Stata 14.0.[10]

Additional empirical analyses were conducted in order to assess the relationship between patient and hospital characteristics on patient clinical and administrative outcomes within the bundle.

Descriptive statistics by root procedure was conducted. This was determined from the ICD-10 PCS codes, corresponding to the third character[11] in the primary procedure code (Figure 2). The hip and femur bundle consists of 393 unique procedure codes. The corresponding root procedure code gave an umbrella category irrespective of more specific qualifiers such as body part, type of approach, and specific device used. The cohort was divided in to 3 categories: patients with a reposition code, an insertion code, and a third group that had multiple primary procedure codes. Multiple regression analyses based off of the root procedure were employed in order to further analyze association of readmission, initial cost, and LOS. Age, gender, hospital size, teaching status, and number of comorbidities were used as control variables. A multiple logistic regression was performed for the readmission outcome and is reported as odds ratios. An ordinary least squares regression was used for the continuous outcomes of initial cost. Cost was transformed using a natural log transformation and coefficients are interpreted as percent changes in costs. A negative binomial regression was used for the length of stay outcome and coefficients are presented as incidence rate ratios.

The second follow-up analysis stratified the same cohort by the anatomical location of the procedure. This corresponds to the fourth character[11] in the ICD-10 PCS primary procedure code (Figure 2). The cohort was divided into 3 categories consisting of procedures performed on the upper femur, the shaft of the femur, and the lower femur. Differences in the same variables related to cost were compared including readmission rate, initial cost, length of stay, comorbidities, and chronic diagnoses. Similar regressions with identical controls for age, gender, hospital size, teaching status, and number of comorbidities were conducted for this analysis, but the same cohort was stratified by anatomical location irrespective of root procedure, again focusing on key cost determining variables: readmission, initial cost, and LOS (Table 1). A logit regression for readmission is presented as odds ratios, and the ordinary least squares regressions for initial cost and LOS is presented as the coefficients % change and incidence rate ratios, respectively. The initial cost values were transformed to a normal distribution using the natural log transformation.

Results

The initial readmission study consisted of 125,008 patients, of whom 25,958 (21%) were readmitted within 90 days of initial admission. The overall mean age was 81.5 ± 7.6 years and 91,501 (73.2%) were female. On average, the entire population had 3.32 ± 1.88 comorbidities, 13.3 ± 5.94 chronic ICD-10 diagnoses, and 116,895 (93.58%) used Medicare as their primary payer. The most common procedure was a reposition (53,317) (Table 2) and most procedures occurred at the upper femur (53,475) (Table 3).

Patients who were readmitted had an increased cost on initial admission ($18,427 vs $16,844, $P < .01$) (Table 4) and an increased length of stay on initial admission (6.24 days vs 5.42, $P < .01$). Patients who were readmitted also had more comorbidities (3.8 vs 3.2, $P < .01$) and a higher number of chronic diagnoses (6.0 vs 5.9, $P < .01$) on initial admission. Readmitted patients also had a higher predicted Elixhauser mortality score (8.98 vs 6.54, $P < .01$) and readmit score (21.8 vs 15.2, $P < .01$) on their initial visit.

Our cohort included patients coded under reposition (54,317), insertion (9387), and those with multiple primary codes (2528). The patients varied in readmission rates based off of their root procedure (20.7% vs 19.6% vs 21.8%) (Table 2), cost on initial admission ($17,374 vs $15,300, vs $19,190), length of stay (13.37 vs 12.77), comorbidities (3.34 vs 3.23 vs 3.42), chronic diagnoses

Table 1. Regressions Based on Anatomical Location.

Model	Readmit (Odds Ratio)	Initial Cost (ln)	LOS (IRR)
Anatomical location[a]			
Upper feur	—	—	—
Shaft of femur	.94	.17**	1.05**
Lower femur	1.02	.22**	1.10**
Age	1.01**	2.8×10^{-4}**	1.00**
Sex[b]	.78**	−-0.04**	.93**
Comorbidities	1.18**	.06**	1.09**
Bed size[c]			
Small	—	—	—
Medium	.99	−.07*	1.01
Large	1.01	−.05*	1.08**
Hosp teaching status[d]			
Metro non-teaching	—	—	—
Metro teaching	.97	.01	1.04**
Non-metro	.86**	.08**	.99

A summary of regression models when cohort divided based off anatomical location of procedure analyzing differences in readmission, cost, and length of Stay.
*denotes *P*-value <.05 **denotes *P*-value <.01.
Readmission data presented as odds ratio, initial cost presented as coefficient of % change, and length of stay (LOS) presented as incidence rate ratios. Referents noted as a (−) value.
[a] Upper femur is the referent.
[b] Female is the referent.
[c] Small bed size is the referent.
[d] Metropolitan non-teaching is the referent.

Table 2. Patients Stratified by Root Procedure.

Variable	Reposition (54,317)	Insertion (9,387)	Multiple procedures (2,528)	*P*-value
Cost on initial admission	$17,374	$15,300	$19,190	<.01
Length of stay	13.37	12.77	13.94	<.01
Comorbidities	3.34	3.23	3.42	<.01
Chronic diagnoses	13.37	12.77	13.93	<.01
Mortality score	7.04	7.11	7.56	<.01
% readmitted	20.7%	19.6%	21.8%	<.01

Table 3. Patients Stratified by Anatomical Location of Procedure.

Variable	Upper femur (53,475)	Shaft of femur (4380)	Lower femur (5844)	*P*-value
Cost on initial admission	$16,473	$19,498	$20,589	<.01
Length of stay (days)	5.48	5.77	6.09	<.01
Comorbidities	3.30	3.33	3.48	<.01
Chronic diagnoses	13.18	13.54	14.05	<.01
Mortality score	7.21	6.55	5.95	<.01
% readmitted	20.7%	18.3%	20.6%	<.01

(13.37 vs 12.77 vs 19.93), and mortality score (7.04 vs 7.11 vs 7.56).

Regression results based off the root procedure yielded similar results. Although the specific root procedure performed did not significantly relate to readmission rates, it did show varied relationships with initial cost and LOS (Table 5). When compared to reposition procedures, insertion procedures had a decreased initial cost (−13%) ($P < .01$) as well as a decreased LOS (5% shorter) ($P < .01$). Patients with multiple primary procedures in contrast had

Table 4. Patients Readmitted vs Not Readmitted.

Variable	Not readmitted (99,050)	Readmitted (25,959)	*P*-value
Cost on initial admission	$16,844	$18,427	<.01
Length of stay	5.42	6.24	<.01
Comorbidities	3.19	3.83	<.01
Chronic diagnoses	12.92	14.77	<.01
Mortality score	6.54	8.98	<.01

Table 5. Regressions Based on Root Procedure.

Model	Readmit (Odds Ratio)	Initial cost (ln)	LOS (IRR)
Root procedure[a]			
Reposition	—	—	—
Insertion	1.02	−.13**	.95**
Multiple procedures	1.07	.06**	1.09**
Age	1.01**	2.9×10^{-4}**	1.01*
Sex[b]	.78**	−.03	.94**
Comorbidities	1.18**	.06	1.09**
Bed size[c]			
Small	—	—	—
Medium	1.01	−.06**	1.01
Large	1.01	−.35	1.08**
Hosp teaching status[d]			
Metro no-teaching	—	—	—
Metro teaching	.97	.02	1.04**
Non-metro	.85**	.08**	.99

A summary of 3 regression models when cohort divided based off root procedure analyzing differences in readmission, initial cost, and length of stay. *denotes *P*-value < .05 **denotes *P*-value < .01.
Readmission data presented as odds ratio, initial cost presented as coefficient of % change, and length of stay (LOS) presented as incidence rate ratios.
[a] Reposition is the referent.
[b] Female is he referent.
[c] Small bed size is the referent.
[d] Metropolitan non-teaching is the referent.

an increased initial cost (+6%) ($P < .01$) as well as an increased LOS (9% longer) ($P < .01$) when using the same reposition values as a reference.

Anatomical location for the procedures included the upper femur (53,475), shaft of femur (4380), and lower femur (5844). These 3 groups differed in readmission rates (20.7% vs 18.3% vs 20.6%) (Table 3), cost on initial admission ($16,473 vs $19,498 vs $20,589), length of stay (5.48 days vs 5.77 vs 6.09), comorbidities (3.30 vs 3.33 vs 3.48), chronic diagnoses (13.18 vs 13.54 vs 14.05), and mortality score (7.21 vs 6.55 vs 5.95). Regression results based off of anatomical location did not show any correlation between readmission and the location on the femur, but again showed an increasingly positive relationship with initial cost and LOS with more distal fractures (Table 1). When compared to the upper femur, the patients undergoing procedures related to the shaft of their femur had a 17% increased initial cost ($P < .01$) as well as 5% increased LOS ($P < .01$). Patients undergoing procedures at their lower femur had even greater values related to cost, exhibiting a 22% increase in initial cost ($P < .01$) and 10% increased LOS ($P < .01$) when compared to those undergoing procedures on their upper femur.

Discussion

The hip and femur bundle within the BPCI initiative covers a large number of disparate CPT codes. Our study shows that these procedures have variation in potential for cost to the hospital and surgeon. Patients that are subsequently readmitted also have increased cost on initial admission and length of stay, as well as having more comorbidities, chronic diagnoses, and mortality score than their non-readmitted counterparts. These potential bundle buster patients are not only more expensive to care for up front but are also more likely to be readmitted with 90 days. Our study cannot examine the cost of the readmission, but is well established that readmission episodes are costly to hospitals following any procedure, with some estimates approximating $26 billion annually in costs to Medicare patients alone.[12-14] Although the National Readmissions Database does not record a total cost for a patient care episode in its entirety, these variables serve as a proxy for estimating increased cost to the care facility. It has previously been shown that length of stay is a strong correlative measure for inpatient cost care ($R^2 = .77$)[1] supporting our hypothesis of variance in cost within this bundle.

We further hypothesized that the root procedure billed for could also affect readmission rates, as well as other variables associated with variance in costs that are unaccounted for in bundle reimbursement. Common root procedures determined by ICD-10 PCS codes also lead to differences in costs. Patients undergoing a reposition procedure differ in readmission rates, initial costs, length of stay, comorbidities, and chronic diagnoses from those patients undergoing an insertion procedure or multiple procedures that fall under this same bundle. Although our regression results do not demonstrate a direct relationship between root procedure and readmission, they do indicate a relationship between the procedure performed and the initial cost as well as LOS. Of note our study removed codes which were only included 1 or 2 times throughout the year. This included an additional 393 unique procedure codes that were not included within our study.

Another potential hurdle in appropriate and accurate coding and reimbursement is effective and synchronized communication between the surgeon and the coder.[15] Coding for the bundle uses ICD-10 procedural codes and not physician driven CPT codes. The two most common coding areas in the hip and femur bundle are reposition and insertion. The reposition root procedure represents moving a body part to a new location.[16] For the femur, this would include open and closed reductions of displaced fractures with or without internal fixation. The insertion category of root procedures on the other hand is generally defined as putting in a non-biological device that assists physiologic function, but does not physically take the place of a body part.[16] In this bundle that includes insertion of orthopedic screws or rods in non-displaced fractures. Multiple ICD-10 primary procedures may be coded if the same root operation is performed on different body parts, or if multiple root operations are performed with distinct objectives.[17,18] It is the coders responsibility to determine what the documentation in the medical record or operative report equates to in the ICD-10 procedure definitions.[19] The coder is not required to query the physician when the defined ICD-10 terms are clear in the note, even if the physician notes a particular procedure that the coder deems more appropriate in another category. This potential discrepancy between procedure codes decided on in the operating room and the procedure codes that end up being billed further complicates appropriate reimbursement, as well as accurate retrospective analysis when certain procedures are not identifiable to the surgeon when converted into ICD-10 PCS language.

The hip and femur bundle includes procedures performed on the entire femur bone. We also found significant variation in cost, and length of stay when examining the patients by location within the femur. Initial cost, length of stay, comorbidities, and chronic diagnoses all increase as you progress distally from upper to lower portions of the femur. Perhaps the distal femur intra-articular fractures are a driver of this cost as these potentially include more difficult periprosthetic fractures requiring fixation.[20] Replacement surgeries of the hip are excluded from the hip and femur bundle and are classified separately under DRGs 469-470[21,22] along with major joint replacements or reattachments. Variables that are not recorded in the NRD such as time to weightbearing and distal joint involvement could also have effects on LOS as well as other variables related to overall cost. Future studies that are more specific and utilize chart review of individual cases could help illuminate this cost variance.

There are several limitations to this study. While this study is focused on the potential financial discrepancies between services provided and reimbursement, the National Readmission Database that was used for this dataset does not measure the true total cost of a bundle of care. Other data elements that have been shown to be accurate surrogates for cost such as readmission rate[8] and length of stay ($R^2 = .77$),[1,23] as well as others such as comorbidities and chronic diagnoses, were used to approximate expenses and the variety of costs when stratified with different approaches. Although the NRD lacks data from the post-acute perspective such as outpatient, home care, and skilled nursing facilities, this study focused on the hospital cost and readmission numbers. These factors have been shown to identify variance in the amount of bundle busters, or patients that have a higher risk of a discrepancy between services provided and CMS reimbursement. Furthermore, the pre-determined bundled reimbursement from Medicare does not individually include the cost of these post-acute care facilities, which also bear significant expenses to the care providers, totaling $59.2 billion in 2014 for all Medicare reimbursements.[24] This study excluded patients under 65 years of age with the intention of corresponding with Medicare more accurately, and it is likely that this excluded a healthier group of patients that were less of a financial burden. Our final patient cohort also excluded a significant portion of the initial population that had rare procedure codes in order to analyze large scale variance. This likely excluded additional variance within the bundle that this study does not account for. This retrospective study utilized a large and inclusive sample size to analyze big picture trends in variables related to costs. Although this strategy allowed for more valid statistical conclusions and illuminated potential future studies that can be more targeted, more studies consisting of individual chart review to more accurately assess costs and outcomes at varying institutions that participate in the bundle. For example, Kelley et al.[25] demonstrated this by doing a cost analysis on 278 individual patients that all had a similar intertrochanteric femur fracture at a single level 1 trauma center. They found that there indeed was a problematic and non-sustainable financial imbalance between the cost of highly comorbid patients and CMS reimbursements. Wodowski et al.[26] demonstrated similar results at a different institution participating in the BPCI bundle, classifying up to 30% of their patients as bundle busters who as a group had a median loss of $11,797 per patient. Further studies that analyze change in readmission rates as well as other metrics of continuity and quality of care are necessary to fully elucidate bundle success before the first rendition of the initiative expires at the end of 2021.

Conclusion

This study suggests that there is significant variance in cost, readmission, and length of stay in the hip and femur fractures bundle. The one-size-fits-all model of reimbursement is potentially powerful,[27] but may be too rigid for this bundle that encompasses such a heterogenous group of procedures. Further stratification and specific billing bundles that ensure appropriate reimbursement for providers and facilities could help mitigate these concerns and increase bundle participation, reducing overall costs to all parties involved.

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Declaration of Conflicting Interests

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