

Incidence and Economic Burden of Intertrochanteric Fracture

A Medicare Claims Database Analysis

Ayoade Adeyemi, PhD, and Gary Delhougne, MS

Investigation performed at Smith & Nephew, Andover, Massachusetts

Background: There is limited information on current cost estimates associated with intertrochanteric hip fractures in the United States. The purpose of the present study was to estimate the incidence and economic burden of both intertrochanteric and all hip fracture types in the Medicare patient population to the U.S. health-care system.

Methods: This retrospective database analysis of the 2014 Medicare database involved Standard Analytic File (SAF) 5% sample claims and total enrollment files. Patients ≥ 65 years of age with a new principal diagnosis of hip fracture (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] code 820.xy) who were continuously enrolled for 18 months were included; those with intertrochanteric hip fracture were further identified with use of ICD-9-CM code 820.21. The total direct medical costs associated with hip fracture in the 90-day and 12-month post-fracture periods were estimated. The relevant costs were estimated on the basis of a propensity-score-matched analysis. The health-care services responsible for major expenses within the 90-day episode-of-care period were also identified.

Results: The total annual direct medical costs associated with all hip fractures was \$50,508 per patient, resulting in a yearly estimate of \$5.96 billion to the U.S. health-care system. Intertrochanteric hip fractures accounted for an annual estimate of \$52,512 per patient, corresponding to an overall annual economic burden of \$2.63 billion to the U.S. health-care system and representing 44% of all hip fracture costs. Inpatient hospitalization and skilled nursing facility services jointly accounted for 76.3% of the \$44,135 estimated cost per patient and 75.6% of the \$42,388 estimated cost per patient within the 90-day post-acute care period for intertrochanteric and all hip fractures, respectively.

Conclusions: Hip fracture represents a substantial economic burden to the U.S. health-care system, accounting for \$5.96 billion per year, with intertrochanteric hip fracture accounting for 44% of total costs.

Level of Evidence: Economic and decision analysis, Level IV. See Instructions for Authors for a complete description of levels of evidence.

Clinical Relevance: The present study provides a comprehensive and updated annual estimate of the economic burden of all hip fracture types and estimates the economic burden of intertrochanteric hip fractures in the Medicare population; to our knowledge, prior availability of this information in the literature is limited.

With an increasingly aging population, the prevalence of osteoporosis continues to rise, with a corresponding increase in the risk of fracture. As of 2014, the National Osteoporosis Foundation (NOF) estimated that 54 million American adults ≥ 50 years of age present with osteoporosis and low bone mass, making this a high-risk population for hip fracture¹.

By the year 2025, osteoporosis is projected to account for 3 million fractures and a corresponding \$25.3 billion in annual costs in the U.S.^{2,3}. Of all fractures, hip fracture has been most strongly associated with high morbidity and mortality rates⁴. Even though the incidence of hip fractures is relatively low, accounting for 14% of fractures, it has been estimated to account for 72% of total fracture costs³. Moreover, hip fracture

Disclosure: The authors indicated that no external funding was received for any aspect of this work. On the **Disclosure of Potential Conflicts of Interest** forms, which are provided with the online version of the article, one or more of the authors checked "yes" to indicate that the author had a relevant financial relationship in the biomedical arena outside the submitted work (<http://links.lww.com/JBJSOA/A86>).

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represents a substantial health-care burden (reported to be responsible for 37% of total incremental costs of all moderate trauma fractures) and has been associated with a mortality rate of 27% in the first postoperative year^{4,5}. In addition, Shi et al. reported an average incremental health-care cost of almost \$17,000 in 2006 USD during the first year following hip fracture in a cohort of patients who were ≥ 65 years old⁶. Nikitovic et al. also estimated that a total of \$1.1 billion in health-care costs in Canada were directly attributable to hip fractures in patients who were ≥ 65 years of age in the first year after fracture⁷. While these estimates indicate substantial health-care resource utilization within the first year following hip fractures, they do not reflect the current economic burden of hip fracture as the latest estimates in the U.S. are a decade old^{6,8,9}.

Intertrochanteric hip fracture has been reported to be a common type of hip fracture and is known to be associated with older age and multiple comorbidities, suggesting substantial direct health-care costs¹⁰. However, there is limited information regarding the direct economic burden of intertrochanteric fracture and there are no recent direct cost estimates of all hip fractures in the U.S. patient population mostly at risk (i.e., patients ≥ 65 years old). The purposes of the present study were (1) to estimate the incidence and economic burden associated with intertrochanteric hip fractures and all hip fracture types, using the Medicare database, a nationally representative health-care database that covers $>96\%$ of U.S. patients ≥ 65 years of age¹¹ and (2) to identify cost drivers within the 90-day episode-of-care period.

Materials and Methods

Study Design, Data Sources, and Patient Population

This retrospective database analysis involved the use of the 2014 Medicare limited data set (LDS) standard analytic file (SAF) 5% sample claims and enrollment files. To ensure the representativeness of the sample, the 5% Medicare SAF data file is made up of a randomly selected fraction of the Medicare population. Eligible patients were required to meet the following inclusion criteria: be ≥ 65 years of age, be continuously enrolled in parts A and/or B for 6 months before and 12 months after discharge, and have no evidence of hip fracture in the preceding year. A principal diagnosis of hip fracture was defined as any fracture on the proximal end of the femur (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] code 820.xy), based on the Agency for Healthcare Research and Quality (AHRQ) Clinical Classification System (CCS) hip fracture definition. From this population, intertrochanteric hip fractures were further identified with use of ICD-9-CM code 820.21. A control group consisting of a cohort of patients who met all of the inclusion criteria except a diagnosis of hip fracture was also created; thereafter, the hip fracture cohort was propensity-score-matched to the control group. A greedy (nearest-neighbor) matching technique was used to pair-match both cohorts by age category, sex, race, geographic region, and Charlson Comorbidity Index (CCI) score at baseline.

Based on the propensity-score pair-matched cohorts, the incremental costs attributed to hip fracture (intertrochanteric and all hip fractures) were estimated as the difference in post-fracture period costs between the matched cohorts. All costs

Attrition Table – Incidence of hip fracture in the Medicare patient population ≥ 65 years

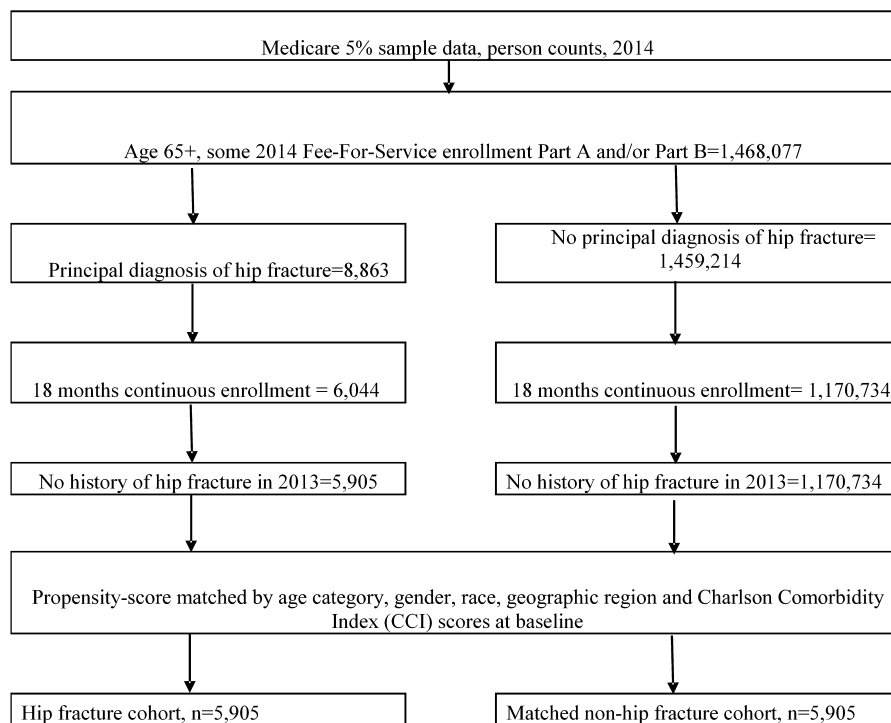


Fig. 1

Sample selection flowchart.

TABLE I Demographic Characteristics of Hip Fracture and Non-Hip Fracture Cohorts*

Characteristic	Before Propensity Score Matching			After Propensity Score Matching		
	Hip Fracture Cohort (N = 5,905)	Non-Hip Fracture Cohort (N = 1,170,734)	P Value	Hip Fracture Cohort (N = 5,905)	Non-Hip Fracture Cohort (N = 5,905)	P Value
Age† (yr)	82.7 ± 8.0	75.6 ± 7.6	<0.0001	82.7 ± 8.0	82.3 ± 8.2	0.0137
CCI score† (points)	1.96 ± 2.1	1.39 ± 1.9	<0.0001	1.96 ± 2.1	2.0 ± 2.3	0.0973
Pre-fracture costs† (USD)	\$8,391 ± \$15,863	\$4,604 ± \$11,698	<0.0001	\$8,391 ± \$15,863	\$8,896 ± \$18,073	0.1064
Age group (no. of patients)			<0.0001			0.0235
65-74 yr	1,084 (18%)	609,436 (52%)		1,084 (18%)	975 (17%)	
75-84 yr	2,142 (36%)	386,804 (33%)		2,142 (36%)	2,155 (36%)	
≥85 yr	2,679 (45%)	174,494 (15%)		2,679 (45%)	2,775 (47%)	
Sex (no. of patients)			<0.0001			0.5674
Male	1,505 (25%)	508,524 (43%)		1,505 (25%)	1,478 (25%)	
Female	4,400 (75%)	662,210 (57%)		4,400 (75%)	4,427 (75%)	
Race (no. of patients)			<0.0001			0.99
White	5,497 (93%)	1,011,881 (86%)		5,497 (93%)	5,491 (93%)	
Black	193 (3%)	87,075 (7%)		193 (3%)	195 (3%)	
Hispanic	86 (1%)	17,031 (1%)		86 (1%)	85 (1%)	
Other	129 (2%)	54,747 (5%)		129 (2%)	134 (2%)	
Geographic region (no. of patients)			<0.0001			0.9992
Northeast	1,086 (18%)	217,560 (19%)		1,086 (18%)	1,095 (18%)	
Midwest	1,355 (23%)	264,775 (23%)		1,355 (23%)	1,346 (23%)	
South	2,495 (42%)	466,143 (40%)		2,495 (42%)	2,489 (42%)	
West	952 (16%)	216,895 (19%)		952 (16%)	957 (16%)	
Unknown	17 (0%)	5,361 (0%)		17 (0%)	18 (0%)	

*Some percentages may not add up to 100% because of rounding. †The values are given as the mean and the standard deviation.

associated with newly diagnosed hip fracture discharges in the 90-day and 365-day post-fracture periods were estimated. In addition, the total annual costs to the U.S. health-care system were estimated as a function of the mean annual cost per patient and the number of hip fracture patients from the 5% LDS data extrapolated to the entire Medicare patient population, according to the formula:

$$\text{Total Cost of Hip Fracture} = \text{Average Annual Cost per Patient} \times \text{Number of Cases} \times 20$$

The total estimated costs associated with the 90-day episode-of-care period post-hip fracture were further broken down by type of service (physician, inpatient hospitalization, outpatient, durable medical equipment, skilled nursing facility, home health agency, hospice, and rehabilitation) to identify specific health-care services responsible for major costs within this period.

Statistical Analyses

Descriptive statistics (mean, standard deviation, and frequency counts) were used to describe the characteristics of the patient

population (age, sex, race, geographic region, CCI score). Paired t tests and Wilcoxon signed-rank tests were employed to account for the paired nature of the patient population following propensity score matching. All statistical analyses were conducted with use of SAS (version 9.3; SAS Institute).

Results

A total of 5,905 patients (representing 5% of 2014 Medicare claims) with an incident hip fracture met the inclusion criteria (Fig. 1); of these, 2,506 (42%) had an intertrochanteric hip fracture. The patients in this cohort had a mean age (and standard deviation [SD]) of 82.7 ± 8.0 years. The majority of patients in the hip fracture cohort were female (75%; 4,400) and white (93%; 5,497) (Table I). The incidence rates per 100,000 for a primary diagnosis of intertrochanteric hip and all hip fractures were 171 and 402, respectively. By sex, the incidence rates per 100,000 for all hip fractures were 223 and 555 in males and females, respectively.

The mean total incremental annual cost attributed to intertrochanteric fracture (derived as the difference in costs

TABLE II Incremental Costs Attributable to Hip Fracture by Type and Post-Fracture Period

Post-Fracture Period	Incremental Cost* (USD)	Percentage of Annual Cost	t Value	P Value
Intertrochanteric hip fractures (n = 2,506)†				
90 days	\$44,135 ± \$20,370	84%	108.47	<0.0001
365 days	\$52,512 ± \$43,188	100%	60.87	<0.0001
All hip fractures (n = 5,905)‡				
90 days	\$42,388 ± \$20,757	83.9%	156.92	<0.0001
365 days	\$50,508 ± \$44,731	100%	86.77	<0.0001

*The values are given as the mean and the standard deviation. †Total annual costs to the U.S. health-care system: $\$52,512 \times 2,506 \times 20 = \2.63 billion. ‡Total annual costs to the U.S. health-care system: $\$50,508 \times 5,905 \times 20 = \5.96 billion.

between the hip fracture and non-hip fracture cohorts) was estimated at $\$52,512 \pm \$43,188$ per patient ($p < 0.0001$), of which 84% ($\$44,135 \pm \$20,370$; $p < 0.0001$) was incurred in the first 90 days post-fracture. For all hip fractures, the mean total annual cost per patient was $\$50,508 \pm \$44,731$ ($p < 0.0001$), of which 84% ($\$42,388 \pm \$20,757$; $p < 0.0001$) was also incurred in the first 90-day post-fracture period (Table II). Total costs attributable to intertrochanteric and all hip fractures corresponded to an estimated annual economic burden of \$2.63 billion and \$5.96 billion, respectively, in direct costs to the U.S. health-care system.

Over the 90-day episode-of-care period following hip fracture, total costs were broken down by the type of service provided. For intertrochanteric hip fractures, costs due to inpatient admissions (\$15,172; 34.4%) and skilled nursing facility services (\$18,480; 41.9%) jointly accounted for the majority (76.3%) of the 90-day episodic costs. Similarly, 75.6% of costs in the same post-acute-care period was accounted for by both inpatient admissions and skilled nursing facility services, accounting for \$15,705 (37.1%) and \$16,309 (38.5%), respectively, for all hip fractures. Physician and rehabilitation costs each accounted for 10% of total costs in both hip fracture groups. These incremental costs attributable to hip fracture were significant (Table III).

Discussion

Despite an increasingly aging U.S. population prone to diseases associated with high morbidity and mortality rates such as hip fracture^{4,5}, there is evidence in the literature to support a decrease in the incidence of hip fracture in the elderly population⁸. Our study further corroborates the decline as the estimated incidence rates of hip fracture of 223 and 555 per 100,000 in males and females were 40% and 30% lower, respectively, compared with the rates of 369 and 793.5 per 100,000 that were previously reported on the basis of 2005 Medicare data⁸. Increased awareness of the risk factors for hip fracture and preventative measures (such as fall-prevention strategies and lifestyle modification, including increased exercise and dietary intake of calcium and vitamin D) are possible explanations for the observed decrease in hip fracture incidence rates¹².

Despite the observed decrease in hip fracture incidence rates, hip fracture continues to pose an enormous economic burden on the U.S. health-care system, with the present study demonstrating that the estimated total annual direct medical costs associated with incident hip fractures is \$5.96 billion. This estimate would have been higher if secondary hip fracture diagnoses and cases not newly diagnosed had been included in the estimation.

TABLE III 90-day Incremental Costs by Service Type Attributable to Hip Fracture Based on Cost Differentials Between Matched Hip Fracture and Non-Hip Fracture Medicare Patients

Service Type	Intertrochanteric Hip Fractures				All Hip Fractures			
	Incremental Cost	Percentage of Total Cost	t Value	P Value	Incremental Cost	Percentage of Total Cost	t Value	P Value
Inpatient admissions	\$15,172 ± \$9,188	34.4%	82.67	<0.0001	\$15,705 ± \$9,726	37.1%	124.08	<0.0001
Outpatient visits	\$377 ± \$3,195	0.9%	5.91	<0.0001	\$378 ± \$3,050	0.9%	9.53	<0.0001
Physician	\$4,311 ± \$3,506	9.8%	61.56	<0.0001	\$4,208 ± \$3,414	9.9%	94.7	<0.0001
DME*	\$44 ± \$1,353	0.1%	1.64	0.1009	\$50 ± \$1,240	0.1%	3.09	0.002
Skilled nursing facility	\$18,480 ± \$15,306	41.9%	60.44	<0.0001	\$16,309 ± \$14,934	38.5%	83.92	<0.0001
Home health agency	\$1,302 ± \$2,354	2.95%	27.68	<0.0001	\$1,397 ± \$2,330	3.3%	46.08	<0.0001
Rehabilitation	\$4,414 ± \$9,614	10.0%	22.99	<0.0001	\$4,320 ± \$9,317	10.2%	35.63	<0.0001
Hospice	\$36 ± \$1,346	0.08%	1.34	0.1814	\$21 ± \$1,239	0.1%	1.28	0.2002
Total†	\$44,135 ± \$20,370	100%	108.47	<0.0001	\$42,388 ± \$20,757	100%	156.92	<0.0001

*DME = durable medical equipment. †Percentages do not add to 100% because of rounding.

Compared with our incremental annual cost estimate of \$50,508 per hip fracture patient, Shi et al. estimated an incremental cost of \$16,823 in 2006 USD⁶. The costs that were included in that estimation were inpatient, outpatient, and pharmacy costs; however, costs associated with skilled nursing facility, hospice, home health agency, and rehabilitation services were not factored into the estimation. With our study showing that skilled nursing facility services accounted for >30% of annual hip fracture costs, underestimation of costs in the previous study is plausible.

Intertrochanteric hip fracture accounted for 42% of all hip fracture types and 44% (\$2.63 billion) of total health-care costs (\$5.96 billion), reflecting substantial health-care spending in this subpopulation. From the breakdown of 90-day episode-of-care costs incurred because of hip fractures, it could be surmised that inpatient hospitalization and skilled nursing facility services are the 2 major cost drivers within the 90-day episode-of-care period following hip fracture. There is evidence in the literature that up to 58% of patients with a hip fracture are discharged to skilled nursing facilities, with a corresponding decrease in discharge to home; this trend has been linked to changes in Medicare reimbursement policies¹³. However, with the Bundled Payments for Care Improvement (BPCI) initiative, which includes hip fracture, the relevance of identifying major cost drivers within the 90-day episode-of-care period cannot be overemphasized^{14,15}.

A recent study based on the BPCI initiative demonstrated improvements in costs and outcomes following total joint replacement procedures: episode-of-care costs were reduced by 20%, all-cause 90-day readmissions were reduced by 43%, and discharges to home increased from 11.6% to 49.8% with a corresponding decrease in admissions to skilled nursing facility services¹⁵. For hip fractures, under the BPCI initiative model, Lott et al. also reported a significant increase in the rate of home discharge along with significant reductions in mean episode-of-care costs¹⁶. Moreover, compared with home discharge, discharge to skilled nursing facility services has been identified as the strongest predictor of 30-day complication and readmission rates following total joint arthroplasty¹⁷. Identifying and understanding major cost drivers during the episode-of-care period following hip fracture treatment is crucial to improved efficiencies and outcomes as there is evidence of better long-term outcomes and reduced overall costs following discharge to home compared with discharge to skilled nursing facility services. Therefore, it is expected that with the BPCI initiative, providers are more incentivized

toward better outcomes. Although the chances of discharge to skilled nursing facility services are high for patients who present with certain risk factors such as a high body mass index (>40 kg/m²), diabetes, American Society of Anesthesiologists class 3 or 4¹⁸, not having a spouse, older age, and poor health status overall¹⁹, the need to proactively risk-stratify patients is crucial.

The strengths of the present study include the estimation of costs due to newly diagnosed hip fractures with use of a propensity-score pair-matched cohort to minimize possible bias in estimation through 12 months in a continuously enrolled Medicare patient population covering major costs incurred within this period. These costs include those associated with physician care; inpatient hospitalization; outpatient care; durable medical equipment; and skilled nursing facility, home health agency, hospice, and rehabilitation services. Moreover, nearly 98% of persons ≥65 years of age are enrolled in Medicare, making the results generalizable to the Medicare population²⁰. To better capture the annual economic burden of newly diagnosed hip fractures, we excluded patients with a secondary diagnosis of hip fracture (about 5%) and patients with incomplete 12-month post-discharge data from the estimation. It is worth noting that the 5% SAF used in the present study does not include pharmacy costs, which, based on previous estimates from the literature, account for <3% of total costs⁶. Hence, although negligible, a slight underestimation in the present study is possible.

In conclusion, intertrochanteric hip fracture represents 42% of all incident hip fractures and accounted for 44% (\$2.63 billion) of \$5.96 billion in direct costs in the first year following hip fracture in the Medicare population. Inpatient hospitalization and skilled nursing facility services were responsible for a majority of the costs within the 90-day post-acute care periods. ■

Note: The authors thank Chris Hogan, PhD (Direct Research, LLC), for his assistance with data management.

Ayoade Adeyemi, PhD¹
Gary Delhougne, MS¹

¹Global Health Economics, Smith & Nephew, Andover, Massachusetts

E-mail address for A. Adeyemi: Ayoade.Adeyemi@smith-nephew.com

ORCID iD for A. Adeyemi: [0000-0002-6987-027X](https://orcid.org/0000-0002-6987-027X)

ORCID iD for G. Delhougne: [0000-0002-2069-755X](https://orcid.org/0000-0002-2069-755X)

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