

Research Article

Admitting Geriatric Hip Fracture Patients to the Orthopaedic Service Decreases Cost of Care

Nicole A. Zelenski, MD¹^a, John Logan Brock, MD²^b, Ryan D. DeAngelis, MD²^c, Ryan S. Charette, MD²^d, Alexander L. Neuwirth, MD³^e, Samir Mehta, MD²^f

¹ Department of Orthopaedic Surgery, Emory University, ² Department of Orthopaedic Surgery, Hospital of the University of Pennsylvania,

³ Department of Orthopaedic Surgery, Columbia University

Keywords: trauma, cost, hip fracture

<https://doi.org/10.60118/001c.24344>

Journal of Orthopaedic Experience & Innovation

Vol. 2, Issue 1, 2021

Introduction

Hip fractures are common and costly, costing \$12 billion annually in the US. A large portion of the cost of care is related to inpatient care, which is highly variable. There is a lack of strong evidence regarding whether medicine or orthopaedics should serve as the primary admitting and managing service in the care of hip fracture patients with neither having improved outcomes. The purpose of this study is to compare the cost of care between patients who were admitted to orthopaedic vs. non-orthopaedic services after geriatric hip fractures.

Methods

A retrospective chart review was conducted of patients over the age of 55 with hip fractures undergoing operative treatment at a Level 1 trauma center between 2010-2013. We examined demographic information, admitting service (orthopaedic vs. non-orthopaedic), length of stay, ASA score as well as reimbursement and cost information. Statistical analysis was performed to evaluate what factors most influence cost of care.

Results

A total of 326 patients with hip fractures were included in the analysis. After controlling for age, sex, BMI, and ASA score, admission to the orthopaedic service was associated with \$3,172 lower total costs than admission to a non-orthopaedic service ($p=0.0001$). Patients admitted to the orthopaedic service were discharged an average of 2.6 days earlier than patients on the non-orthopaedic service ($p<0.0001$). There was no difference in 30-day readmission or 90-day mortality between the two groups.

-
- a [Conflicts of Interest Statement for Dr. Zelenski](#)
[Visit the Open Payments Data Page for Dr. Zelenski](#)
 - b [Conflicts of Interest Statement for Dr. Brock](#)
 - c [Visit the Open Payments Data Page for Dr. DeAngelis](#)
[Conflicts of Interest Statement for Dr. DeAngelis](#)
 - d [Conflicts of Interest Statement for Dr. Charette](#)
[Visit the Open Payments Data Page for Dr. Charette](#)
 - e [Visit the Open Payments Data Page for Dr. Neuwirth](#)
[Conflicts of Interest Statement for Dr. Neuwirth](#)
 - f [Conflicts of Interest Statement for Dr. Mehta](#)
[Visit the Open Payments Data Page for Dr. Mehta](#)

Discussion

Hip fracture patients admitted to the orthopaedic service are discharged sooner than patients admitted to a non-orthopaedic service, even when controlling for ASA score. Nationally, this implies substantial potential cost savings from admitting patients to orthopaedic rather than non-orthopaedic services. Systems should develop clear guidelines on when it is appropriate to admit hip fracture patients to non-orthopaedic services, and the orthopaedic service should be the default admitting service.

INTRODUCTION

Hip fractures in the elderly are common and costly. In 2005, approximately 300,000 Americans sustained a hip fracture, costing \$12 billion annually. This number is expected to increase to 450,000 with a projected cost of \$18 billion by 2025 (Burge et al. 2007). Worldwide, the incidence of hip fractures is expected to reach over 6 million per year by 2050 (Cooper, Campion, and Melton 1992). Despite constituting only 14% of osteoporosis-related fractures, hip fractures accounted for nearly 75% of the economic burden. These fractures are associated with significant morbidity and mortality, with one-year mortality after a hip fracture approaching 30% in some studies (Wolinsky, Fitzgerald, and Stump 1997; Panula et al. 2011; Okike, Chan, and Paxton 2017).

Several studies show direct cost of medical care related to a hip fracture is upwards of \$21,000-\$66,000 (Haentjens et al. 2001; Braithwaite, Col, and Wong 2003) with the lifetime attributable cost of hip fracture estimated to be \$81,000 (Braithwaite, Col, and Wong 2003). Some of the variability in these costs is related to inpatient care, which can account for an estimated 16% of direct cost (Braithwaite, Col, and Wong 2003). Additionally, hospital readmissions after hip fracture are largely because of non-surgical illness and are associated with increased cost, morbidity and mortality (Boockvar et al. 2003). Patient-specific factors, such as American Society of Anesthesiology (ASA) score, have been noted to increase length of stay and cost of care for hip fracture patients as well (Brown, Olson, and Zura 2013; Garcia et al. 2012; Aigner et al. 2016). However, these are non-modifiable factors at the time of presentation.

There has been much investigation on the effect of a coordinated multidisciplinary approach for inpatient treatment of geriatric hip fractures with mixed results. Although some studies show benefit to primary medical management, many show little or no benefit (Antonelli Incalzi, Gemma, Capparella, et al. 1993; Tallis and Balla 2010; Choong et al. 2000; Bandis, Murtagh, and Solia 1998; Adunsky et al. 2002; Phy et al. 2005; Elliot et al. 1996; Khan et al. 2002; Jette et al. 1987; Koval et al. 1998; Fordham 1993; Roder et al. 2003). A Cochrane review of nine trials trended toward better outcomes with multidisciplinary rehabilitation, but the results were not statistically significant (Cameron et al. 2001).

There is a lack of strong evidence regarding whether medicine or Orthopaedics should serve as the primary admitting and managing service in the care of hip fracture patients. A retrospective, single-center study of hip fracture patients over the age of 55 comparing the cost of care when

the patient was admitted to the Orthopaedic service versus a non-Orthopaedic service was conducted. Our hypothesis was that the cost of care would be higher for patients admitted to a non-Orthopaedic service.

METHODS

PATIENT POPULATION

Institutional review board approval was obtained for this retrospective cohort study. A search was conducted using ICD codes 820.* and 733.14 to identify all patients with hip fractures at a single center between 2010 and 2013. Patients under 55 years old, patients with a previous hip fracture in the one-year period before current fracture, polytrauma patients, those with pathologic fractures and patients managed non-operatively were excluded. Patients admitted to the Orthopaedic service at the time of this study underwent standard post-operative care with medicine or cardiology consulting if medically necessary.

DATA COLLECTION

After identifying patients using ICD-9 codes, radiographs and, when necessary and available, CT scans were reviewed by a senior resident physician and the senior author to confirm the presence of hip fracture. Demographic information including age, sex, body mass index (BMI), and American Society of Anesthesiologists' (ASA) classification of Physical Health was collected for each patient. The mechanism of injury for each patient was recorded. Medical and operative records were reviewed and fixation method, estimated blood loss (EBL), procedure time, and anesthesia type were noted. The admitting service, units of blood transfused, services that were consulted during the hospital stay, and the length of stay were recorded. Readmission within 30 days, and mortality within 90 days of surgery were noted. Discharge location was recorded for each patient (home, another healthcare facility, or deceased). Data on hospital costs were obtained from the Strategic Decision Support Services Group within the health system, which included direct costs, indirect costs, total cost and profit ([Table 1](#)).

STATISTICAL ANALYSIS

Descriptive and comparative statistics were performed. Students' T-test was used for comparisons between groups for continuous variables and Chi-Squared test was used to compare categorical variables. Multiple regression analysis was used to test for the effects of multiple variables on financial metrics while controlling for possible confounding.

Table 1. Cost Definitions

	Definition
Direct Cost	All hospital costs directly associated with patient care including, but not limited to, room costs, nursing care, implant cost, operating room costs, etc.
Indirect Cost	Hospital costs attributed to patient, but not directly related to patient care, including hospital administration, information technology costs, hospital utilities, etc.
Profit	Calculated by subtracting both direct and indirect costs attributed to the patient from DRG-linked reimbursement for the patient

All financial metrics were calculated individually for each patient

Table 2. Patient Demographics

	Ortho	Non-ortho	p
Age (years)	77 +/- 10	81 +/- 11	0.0004
Sex (% female)	70%	60%	0.081
BMI	25.0 +/- 4.7	23.5 +/- 5.3	0.007
ASA Score	2.6 +/- 0.6	3.0 +/- 0.5	<0.0001

Patient demographics for patients admitted to the Orthopaedic service versus a non-Orthopaedic service. Values are presented as mean +/- standard deviation.

Data is presented as mean and standard deviation for two-group comparisons and as mean +/- standard error for multiple regressions. Statistical analysis was performed using RStudio statistical software (RStudio, Inc., Boston, MA).

RESULTS

A total of 326 patients over the age of 55 with hip fractures were included in the analysis. Of these patients, 187 were admitted to a non-Orthopaedic service and 139 were admitted to the Orthopaedic service. Patients admitted to the Orthopaedic service averaged 77 years of age, whereas patients admitted to a non-Orthopaedic service averaged 81 years of age ($p<0.0004$). There was no difference in sex, with females comprising 70% of the patients admitted to the Orthopaedic service and 60% of the patients admitted to non-Orthopaedic service. Patients admitted to the non-Orthopaedic service had significantly higher ASA scores. The average ASA score for a patient admitted to the Orthopaedic service was 2.6, whereas the average for a non-Orthopaedic service was 3.0 ($p<0.0001$). Patient demographics are summarized in [Table 2](#).

Eighty-nine percent of patients admitted to the Orthopaedic service were taken to the operating room within 48 hours. On a non-Orthopaedic service, this occurred in 72.0% of patients ($p=0.0002$). There was no difference in units of packed red blood cells transfused to either group, with the Orthopaedic patients receiving an average of 0.94 units and non-Orthopaedic patients receiving an average of 1.13 units ($p=0.258$). The non-Orthopaedic service group sought the input of an average of 1.7 consultants, whereas the Orthopaedic team averaged 0.9 consultants ($p<0.0001$). Patient in-hospital management is summarized in [Table 3](#).

There was a significantly longer length of stay for patients admitted to a non-Orthopaedic service compared to the Orthopaedic service, averaging 9.3 and 5.9 days, respec-

tively ($p<0.0001$). The Orthopaedic team also discharged 21.8% of patients to home, whereas the non-Orthopaedic services discharged 8.9% of patients to home ($p=0.001$). There was no difference in 30-day readmission, 90-day mortality, procedure time, or estimated blood loss between the two groups. Patient peri-operative outcomes are summarized in [Table 4](#).

All measured cost metrics were significantly different between the two groups ([Table 5](#)). Patients admitted to the Orthopaedic service had lower direct, indirect and total costs compared to the patients admitted to a non-Orthopaedic service ($p<0.05$ for all costs), while the health system loss was greater for patients admitted to non-Orthopaedic services ($p=0.018$).

Multiple regression analysis was performed to identify factors associated with direct costs, indirect costs, and profit. For each regression, the model included age, gender, BMI, ASA score, and admitting service (Orthopaedic vs non-Orthopaedic) as independent variables ([Table 6](#)). Admission to a non-Orthopaedic service was associated with increased direct and indirect costs, even after controlling for ASA score. Admission to a non-Orthopaedic service was associated with an increase of \$1,991 +/- \$616 in direct costs ($p=0.0014$) and an increase of \$1,181 +/- \$280 in indirect costs ($p<0.0001$). Controlling for other variables, admission to a non-Orthopaedic service was associated with a \$3,172 +/- \$824 increase in total costs when compared to admission to the Orthopaedic service ($p=0.0001$). An increase in ASA score was associated with an increase in indirect costs of \$1,695 +/- \$489 per ASA class ($p=0.0006$) and an increase in total cost of \$3,347 +/- \$1,439 per ASA class ($p=0.0207$). None of the other factors examined were significantly associated with costs.

Linear regression of total costs against length of stay found that total costs increased by \$1,926 for each additional day in the hospital ($p<0.0001$), indicating that length of stay was a major cost driver. A multiple regression exam-

Table 3. In-Hospital Management of Patients

	Ortho	Non-ortho	p
Time from admission to OR (% < 48h)	89.2%	72.0%	0.0002
Unit RBC	0.9 +/- 1.2	1.1 +/- 1.6	0.258
Consults (number)	0.9 +/- 1.0	1.7 +/- 1.0	<0.0001

Comparison of the in-hospital management of patients admitted to the Orthopaedic service versus a non-Orthopaedic service. Values are presented as mean +/- standard deviation.

Table 4. Peri-operative Patient Outcomes

	Ortho	Non-ortho	p
Length of stay (days)	5.9 +/- 2.7	9.3 +/- 5.8	<0.0001
Discharge to home (%)	21.8%	8.9%	0.001
30d readmission (%)	11.9%	16.8%	0.24
90d mortality (%)	3.9%	8.3%	0.13
Procedure time (min)	106 +/- 45	107 +/- 46	0.95
EBL (mL)	214 +/- 183	199 +/- 169	0.46

Peri-operative patient outcomes compared between patients admitted to the Orthopaedic service versus a non-Orthopaedic service. Values are presented as mean +/- standard deviation.

Table 5. Patient Financial Metrics

	Ortho	Non-ortho	p
Direct Cost (USD)	\$20,031 +/- \$760	\$24,388 +/- \$769	<0.0001
Indirect Cost (USD)	\$6,876 +/- \$205	\$9,665 +/- \$411	<0.0001
Total Cost (USD)	\$29,907 +/- \$859	\$34,052 +/- \$1,112	<0.0001
Profit (USD)	-\$954 +/- \$744	-\$3,360 +/- \$683	0.018

Patient financial metrics compared between patients admitted to the Orthopaedic service versus a non-Orthopaedic service. Values are presented as mean +/- SEM.

Table 6. Cost Drivers

Financial Metric (USD)	Intercept	Age	Male Sex (vs. Female)	BMI	ASA	Non-Ortho Service (vs. Ortho)
Direct Cost	\$24,223 +/- \$5,992 p<0.0001	-\$103 +/- \$54 p=0.0598	-\$617 +/- \$602 p=0.3061	\$64 +/- \$110 p=0.5629	\$1,652 +/- \$1,077 p=0.1262	\$1,991 +/- \$616 p=0.0014
Indirect Cost	\$3,871 +/- \$2,722 p=0.1560	-\$29 +/- \$25 p=0.2403	\$198 +/- \$274 p=0.4701	\$71 +/- \$50 p=0.1581	\$1,695 +/- \$489 p=0.0006	\$1,181 +/- \$280 p<0.0001
Total Cost	\$28,094 +/- \$8,009 p=0.0005	-\$131 +/- \$72 p=0.0707	-\$420 +/- \$805 p=0.6026	\$135 +/- \$147 p=0.3613	\$3,347 +/- \$1,439 p=0.0207	\$3,172 +/- \$824 p=0.0001
Health System Profit	\$16,065 +/- \$5,477 p<0.0001	-\$66 +/- \$49 p=0.1808	-\$873 +/- \$550 p=0.1138	-\$152 +/- \$101 p=0.1313	-\$3,114 +/- \$984 p=0.0017	-\$721 +/- \$563 p=0.2013

The effects of patient and care factors on financial metrics by multiple regression. Results are presented as a change in financial metric per unit change in age, BMI, and ASA score. Sex is reported as the impact of male sex as compared to a female baseline. Service is presented as the change in the financial metric on the orthopedic service relative to a non-Orthopaedic service. All values are presented as the change +/- SEM. All numbers are reported as USD.

ined age, gender, BMI, ASA score, and service as independent variables to identify drivers of increased length of stay. A higher ASA score was associated with an increased length of stay (1.8 +/- 0.5 additional days in the hospital for each point increase in ASA, p=0.0002). Admission to the orthopaedic service was associated with a 2.6 +/- 0.5-day shorter

length of stay, controlling for all other factors including ASA score (p<0.0001). Age, gender, and BMI were not associated with changes in the length of stay.

Finally, we calculated the theoretical savings to the health system of admitting all patients to the orthopedic service. We found that after controlling for ASA status, ad-

mission to the Orthopaedic service decreased total costs by \$3,172 +/- \$824 as compared to admission to a non-Orthopaedic service. Thus, if the 187 patients in our study admitted to non-Orthopaedic services had instead been admitted to Orthopaedic services, the total cost savings for the health system would be \$593,164 +/- \$154,088.

DISCUSSION

The analysis in this paper supported our hypothesis that the cost of care would be higher for hip fracture patients admitted to a non-Orthopaedic service. Overall, we found greater direct, indirect, and total costs for patients admitted to a non-Orthopaedic service, even after controlling for patient age, sex, BMI, and ASA score (Tables 5, 6). Multiple regression analysis revealed that total costs were associated most strongly with ASA score and admitting service.

We found that each additional day in the hospital increased total costs by an average of \$1,926. Given the strong association between length of stay and costs, we examined the factors associated with an increased length of stay. We found that each point increase in ASA score was associated with a 1.8-day increase in length of stay, while admission to the Orthopaedic service was associated with a 2.6-day shorter length of stay. A 2012 study on geriatric hip fractures showed similar findings, demonstrating that for each ASA score increase of 1, the average length of stay increased by 2.053 days (Garcia et al. 2012). This group also determined the total daily cost for a hip fracture patient was \$4530, and extrapolated this number to determine that each increase in ASA score translated to an increased cost of \$9300 per patient (Garcia et al. 2012).

Ricci et al. also associated higher ASA scores with increased length of stay. Not surprisingly, patients with higher ASA scores and need for preoperative cardiac testing also had higher rates of delayed time to surgery (Ricci et al. 2015). Our study also showed a significant difference in time to surgery between patients admitted to the Orthopaedic service versus a non-Orthopaedic service. As highlighted by Ricci et al, the patients admitted to a non-Orthopaedic service with higher ASA scores may require further pre-operative testing and this may cause a delay in time to surgical intervention (Ricci et al. 2015). Additionally, this delay to surgery may also contribute to the patient's longer length of stay. Patients with a prolonged time to surgery will ultimately spend more total time in the hospital, even if they have the same post-operative course as another patient who went to the operating room sooner.

Numerous studies have demonstrated longer length of stay for hip fracture patients admitted to a non-Orthopaedic service compared to the Orthopaedic service. A 2016 study reviewed 614 geriatric hip fractures and compared length of stay for those patients admitted to medicine versus Orthopaedics. The authors found a significant difference in length of stay between the groups, with the patients admitted to medicine versus Orthopaedics averaging 7 days and 4.5 days, respectively (Greenberg et al. 2016). Another study later developed a predictive model for length of stay of geriatric hip fracture patients. This study

saw admission to the medicine service and male sex as independent predictors for increased length of stay (Knoll et al. 2019).

Our patients admitted to a non-Orthopaedic service were on average older with higher ASA scores, as seen in other studies (Greenberg et al. 2016). It may be that hip fracture patients admitted to the Orthopaedic service are healthier, younger patients who go to the operating room shortly after admission and therefore have a shorter length of stay. However, even when controlling for other factors, patients with the same ASA score are discharged sooner when admitted to the Orthopaedic service compared to a non-Orthopaedic service. Given that direct cost is strongly associated with length of stay, one can then argue that admission of hip fracture patients to the Orthopaedic service saves the health system money. As seen in Table 5, the hospital system loses money when caring for these patients, and admission to the Orthopaedic service minimizes losses to the healthcare system as a whole.

We calculated the theoretical savings that could be generated by admitting all patients to Orthopaedic service. Within the health system, we found theoretical cost savings of nearly \$600,000 if all patients admitted to the non-Orthopaedic service had instead been admitted to the Orthopaedic service. We acknowledge that these numbers are specific to our health system and cannot necessarily be extrapolated on a national level. These authors now advocate for admission to the Orthopaedic service as the default option at our institution if either service is a viable choice. Additionally, since this data has been analyzed, a "hip fracture pathway" has been initiated at our institution where the default admission service is Orthopaedics with hospitalist or geriatrics co-management. There are several factors that may have contributed to the lower length of stay on the orthopaedic surgery service including aggressive mobilization, early discharge planning, and approaching the patient care episode in a more focused manner (e.g., fixing the patient's hip fracture as the primary goal). Hip fracture patients managed by the orthopaedic surgery service were also admitted to the Orthopaedic floors with increased access to Physical Therapy, Occupational therapy and orthopaedic nursing resources not available on medicine floors. Decreasing length of stay had direct implications on decreasing cost. Additionally, while not analyzed in this paper, it is possible that different goals of care and thus resources utilized (labs, additional testing etc.) between the two services are reflected in these results. Of course, certain patients may warrant admission to non-Orthopaedic services if they have concomitant medical needs better managed on another service. Health systems should create clear guidelines on when admission to a non-Orthopaedic service is appropriate.

One concern is that premature discharge may save the health system inpatient costs, but ultimately require more rehabilitation time or home nursing care leading to overall increased cost. However, a 2017 study reviewing Medicare patients undergoing major surgery showed overall lower cost of care for patients with shorter length of stay with no increase in payments for post-discharge care or readmis-

sions (Regenbogen et al. 2017). Although these were not hip fracture patients, these patients underwent procedures of similar magnitude, such as large joint arthroplasty, coronary artery bypass graft, or colectomy.

There are several limitations to this study. First, this is a retrospective cohort study at a single Level 1 trauma center. Therefore, causation cannot be determined and the results are not necessarily generalizable amongst the entire population. Additionally, there may be a ceiling effect with the ASA classification as used. For instance, if a patient has chronic obstructive pulmonary disease (COPD), the patient may be declared an ASA III. However, that same patient with COPD may also have pneumonia and still be declared an ASA III. These patients appear equivalent on the surface, but one patient is clearly “sicker.” One could reasonably assume the patient with COPD and pneumonia is more likely to be admitted to medicine and ultimately stay longer. These circumstances may account for some of the increased length of stay of an ASA III on a non-Orthopaedic service compared to another ASA III on the Orthopaedic service. Thus, controlling for ASA score may not account for

all patient-level differences in health status at the time of admission. Lastly, the financial metrics for these patients were pulled directly from our university’s accounting department and are reflected in 2013 dollars. Direct and indirect costs are not entirely objective and uniform across all health systems; designation of certain costs as direct versus indirect may vary slightly by institution and may ultimately slightly affect each variable.

Hip fracture patients admitted to the Orthopaedic service are discharged sooner than patients admitted to a non-Orthopaedic service, even when controlling for ASA score. As a result, this minimizes overall cost and increases profitability for the health system. In order to minimize unnecessary cost to the healthcare system, admission to the Orthopaedic service should be considered as the default option for hip fracture patients, and institutions should develop clear guidelines as to when a hip fracture patient should instead be admitted to a non-Orthopaedic service.

Submitted: March 06, 2021 EDT, Accepted: May 21, 2021 EDT



This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CCBY-NC-ND-4.0). View this license’s legal deed at <https://creativecommons.org/licenses/by-nc-nd/4.0> and legal code at <https://creativecommons.org/licenses/by-nc-nd/4.0/legalcode> for more information.

REFERENCES

- Adunsky, A., R. Levi, A. Cecic, M. Arad, S. Noy, and V. Barell. 2002. "The 'Sheba' Model of Comprehensive Orthogeriatric Care for Elderly Hip Fracture Patients: A Preliminary Report." *Isr Med Assoc J* 4 (4): 259–61.
- Aigner, R., T. Meier Fedeler, D. Eschbach, J. Hack, C. Bliemel, S. Ruchholtz, and B. Bücking. 2016. "Patient Factors Associated with Increased Acute Care Costs of Hip Fractures: A Detailed Analysis of 402 Patients." *Archives of Osteoporosis* 11 (1). <https://doi.org/10.1007/s11657-016-0291-2>.
- Antonelli Incalzi, R., A. Gemma, O. Capparella, et al. 1993. "Continuous Geriatric Care in Orthopaedic Wards: A Valuable Alternative to Orthogeriatric Units." *Aging (Milano)* 5:207–16.
- Bandis, Susan, Shelley Murtagh, and Robyn Solia. 1998. "The Allied Health BONE Team: An Interdisciplinary Approach to Orthopaedic Early Discharge and Admission Prevention." *Australian Health Review* 21 (3): 211–22. <https://doi.org/10.1071/ah980211>.
- Boockvar, Kenneth S., Ethan A. Halm, Ann Litke, Stacey B. Silberzweig, MaryAnn McLaughlin, Joan D. Penrod, Jay Magaziner, Kenneth Koval, Elton Strauss, and Albert L. Siu. 2003. "Hospital Readmissions after Hospital Discharge for Hip Fracture: Surgical and Nonsurgical Causes and Effect on Outcomes." *Journal of the American Geriatrics Society* 51 (3): 399–405. <https://doi.org/10.1046/j.1532-5415.2003.51115.x>.
- Braithwaite, R. Scott, Nananda F. Col, and John B. Wong. 2003. "Estimating Hip Fracture Morbidity, Mortality and Costs." *Journal of the American Geriatrics Society* 51 (3): 364–70. <https://doi.org/10.1046/j.1532-5415.2003.51110.x>.
- Brown, Christopher A., Steven Olson, and Robert Zura. 2013. "Predictors of Length of Hospital Stay in Elderly Hip Fracture Patients." *Journal of Surgical Orthopaedic Advances* 22 (02): 160–63. <https://doi.org/10.3113/jsoa.2013.0160>.
- Burge, Russel, Bess Dawson-hughes, Daniel H Solomon, John B Wong, Alison King, and Anna Tosteson. 2007. "Incidence and Economic Burden of Osteoporosis-Related Fractures in the United States, 2005-2025." *Journal of Bone and Mineral Research* 22 (3): 465–75. <https://doi.org/10.1359/jbmr.061113>.
- Cameron, Ian D, Helen HG Handoll, Terence P Finnegan, Rajan Madhok, and Peter Langhorne. 2001. "Co-Ordinated Multidisciplinary Approaches for Inpatient Rehabilitation of Older Patients with Proximal Femoral Fractures." *The Cochrane Database of Systematic Reviews*, July. <https://doi.org/10.1002/14651858.cd000106>.
- Choong, Peter F M, Anna K Langford, Michelle M Dowsey, and Nick M Santamaria. 2000. "Clinical Pathway for Fractured Neck of Femur: A Prospective, Controlled Study." *Medical Journal of Australia* 172 (9): 423–26. <https://doi.org/10.5694/j.1326-5377.2000.tb124038.x>.
- Cooper, C., G. Campion, and L. J. Melton. 1992. "Hip Fractures in the Elderly: A World-Wide Projection." *Osteoporosis International* 2 (6): 285–89. <https://doi.org/10.1007/bf01623184>.
- Elliot, J. R., T. J. Wilkonson, H. C. Hanger, N. L. Gilchrist, R. Sainsbury, S. Shamy, and A. Rothwell. 1996. "Collaboration with Orthopaedic Surgeons." *Age and Ageing* 25 (5): 414. <https://doi.org/10.1093/ageing/25.5.414>.
- Fordham, R. 1993. "Hip Fractures and QALYS." *The Journal of Bone and Joint Surgery. British Volume* 75-B (1): 163–64. <https://doi.org/10.1302/0301-620x.75b1.8421022>.
- Garcia, Anna E., J. V. Bonnaig, Zachary T. Yoneda, Justin E. Richards, Jesse M. Ehrenfeld, William T. Obremsky, A. Alex Jahangir, and Manish K. Sethi. 2012. "Patient Variables Which May Predict Length of Stay and Hospital Costs in Elderly Patients with Hip Fracture." *Journal of Orthopaedic Trauma* 26 (11): 620–23. <https://doi.org/10.1097/bot.0b013e3182695416>.
- Greenberg, Sarah E., Jacob P. Vanhouten, Nikita Lakomkin, Jesse Ehrenfeld, Amir Alex Jahangir, Robert H. Boyce, William T. Obremsky, and Manish K. Sethi. 2016. "Does Admission to Medicine or Orthopaedics Impact a Geriatric Hip Patient's Hospital Length of Stay?" *Journal of Orthopaedic Trauma* 30 (2): 95–99. <https://doi.org/10.1097/bot.0000000000000440>.
- Haentjens, Patrick, Philippe Autier, Martine Barette, and Steven Boonen. 2001. "The Economic Cost of Hip Fractures Among Elderly Women." *The Journal of Bone and Joint Surgery-American Volume* 83 (4): 493–500. <https://doi.org/10.2106/00004623-200104000-00003>.
- Jette, A.M., B.A. Harris, P.D. Cleary, and E.W. Campion. 1987. "Functional Recovery after Hip Fracture." *Arch Phys Med Rehabil* 68 (10): 735–40.
- Khan, R., C. Fernandez, F. Kashif, R. Shedden, and P. Diggory. 2002. "Combined Orthogeriatric Care in the Management of Hip Fractures: A Prospective Study." *Ann R Coll Surg Engl* 84 (2): 122–24.
- Knoll, Olivia M., Nikita Lakomkin, Michelle S. Shen, Moses Adebayo, Parth Kothari, Ashley C. Dodd, Basem Attum, Nathan Lee, Deepak Chona, and Manish K. Sethi. 2019. "A Predictive Model for Increased Hospital Length of Stay Following Geriatric Hip Fracture." *Journal of Clinical Orthopaedics and Trauma* 10 (Suppl 1): S84–87. <https://doi.org/10.1016/j.jcot.2019.03.024>.
- Koval, Kenneth J., Mary Louise Skovron, Gina B. Aharonoff, and Joseph D. Zuckerman. 1998. "Predictors of Functional Recovery after Hip Fracture in the Elderly." *Clinical Orthopaedics and Related Research* 348 (March):22–28. <https://doi.org/10.1097/00003086-199803000-00006>.

- Okike, Kanu, Priscilla H. Chan, and Elizabeth W. Paxton. 2017. "Effect of Surgeon and Hospital Volume on Morbidity and Mortality After Hip Fracture." *Journal of Bone and Joint Surgery* 99 (18): 1547–53. <https://doi.org/10.2106/jbjs.16.01133>.
- Panula, Jorma, Harri Pihlajamäki, Ville M Mattila, Pekka Jaatinen, Tero Vahlberg, Pertti Aarnio, and Sirkka-Liisa Kivelä. 2011. "Mortality and Cause of Death in Hip Fracture Patients Aged 65 or Older - a Population-Based Study." *BMC Musculoskeletal Disorders* 12 (1). <https://doi.org/10.1186/1471-2474-12-105>.
- Phy, Michael P., David J. Vanness, L. Joseph Melton, Kirsten Hall Long, Cathy D. Schleck, Dirk R. Larson, Paul M. Huddleston, and Jeanne M. Huddleston. 2005. "Effects of a Hospitalist Model on Elderly Patients with Hip Fracture." *Archives of Internal Medicine* 165 (7): 796. <https://doi.org/10.1001/archinte.165.7.796>.
- Regenbogen, Scott E., Anne H. Cain-nielsen, Edward C. Norton, Lena M. Chen, John D. Birkmeyer, and Jonathan S. Skinner. 2017. "Costs and Consequences of Early Hospital Discharge After Major Inpatient Surgery in Older Adults." *JAMA Surgery* 152 (5): e170123. <https://doi.org/10.1001/jamasurg.2017.0123>.
- Ricci, William M., Angel Brandt, Christopher Mcandrew, and Michael J. Gardner. 2015. "Factors Affecting Delay to Surgery and Length of Stay for Patients with Hip Fracture." *Journal of Orthopaedic Trauma* 29 (3): 109–14. <https://doi.org/10.1097/bot.0000000000000221>.
- Roder, F., M. Schwab, T. Aleker, K. Mörike, K.P. Thon, and U. Klotz. 2003. "Proximal Femur Fracture in Older Patients - Rehabilitation and Clinical Outcome." *Age and Ageing* 32 (1): 74–80. <https://doi.org/10.1093/ageing/32.1.74>.
- Tallis, Graham, and John I. Balla. 2010. "Critical Path Analysis for the Management of Fractured Neck of Femur." *Australian Journal of Public Health* 19 (2): 155–59. <https://doi.org/10.1111/j.1753-6405.1995.tb00366.x>.
- Wolinsky, F. D., J. F. Fitzgerald, and T. E. Stump. 1997. "The Effect of Hip Fracture on Mortality, Hospitalization, and Functional Status: A Prospective Study." *American Journal of Public Health* 87 (3): 398–403. <https://doi.org/10.2105/ajph.87.3.398>.