Geriatric Orthopaedic Surgery & Rehabilitation
2015, Vol. 6(1) 22-27

DOI: 10.1177/2151458514561787
gos.sagepub.com
SAGE

Comparing Survival Following Hip Fracture Repair in VHA and Non-VHA Facilities

Evelyn Hutt, MD[1,2], Tiffany A. Radcliff, PhD[3], William Henderson, PhD[2], Matthew Maciejewski, PhD[4], Diane Cowper-Ripley, PhD[5], and Emily Whitfield, PhD[1]

Abstract

Introduction: Although postsurgical outcomes are similar between Veterans Health Administration (VHA) and non-VHA hospitals for many procedures, no studies have compared 30-day and 1-year survival following hip fracture repair. Therefore, this study compared survival of veterans aged 65 years and older treated in VHA hospitals with a propensity-matched cohort of Medicare beneficiaries in non-VHA hospitals. **Materials and Methods:** Retrospective cohort study of 1894 hip fracture repair patients in VHA or non-VHA hospitals between 2003 and 2005. Current Procedural Terminology codes identified 3542 male patients aged ≥65 years who had hip fracture repair between 2003 and 2005 in the Veterans Affairs' National Surgical Quality Improvement Program database. The Medicare comparison sample was drawn from 2003 to 2005 Medicare Part A inpatient hospital claims files. To create comparable VHA and Medicare cohorts, patients were propensity score matched on age, admission source (community vs. nursing home), repair type, comorbidity index, race, year, and region. Thirty-day and 1-year survival after surgery were compared between cohorts after further adjustment for selected comorbidities, year of surgery, and pre- and postsurgical length of hospital stay using logistic regression. **Results:** Odds of survival were significantly better in the Medicare than the VHA cohort at 30 days (1.68, 95% CI 1.15-2.44) and 1 year (1.*35*, 95% CI 1.08-1.69). **Conclusion:** Medicare beneficiaries with hip fracture repair in non-VHA hospitals had better survival than veterans in VHA hospitals. Whether this is driven by unobserved patient characteristics or systematic care differences is unknown.

Keywords

hip fracture repair, comparative effectiveness, survival, veteran

Introduction

Hip fractures in elderly patients are prevalent[1] and are associated with an increased risk of death that continues well after the 30-day postoperative period.[2] Approximately 25% of all hip fractures in the Medicare population occur among men,[3] who experience higher morbidity and mortality than women,[4-6] despite the fact that the incidence of hip fracture is greater among women.

Patients cared for in Veterans Health Administration (VHA) hospitals are typically men who are younger and sicker than those whose care is reimbursed by Medicare in non-VHA facilities,[1;7-9] and their care is organized and delivered differently. Veterans Health Administration implemented a comprehensive program in 1994 that reports risk adjusted surgical outcomes and benchmark data at VHA hospitals and provides consultation services in an effort to inform and empower local quality improvement initiatives.[10] These initiatives have helped VHA hospitals to improve postsurgical morbidity and mortality, which may or may not counteract the greater complexity of VHA patients.

Most of the recent studies regarding men with hip fracture in the United States have been conducted within the VHA population. Prior work has found that postsurgical outcomes are generally similar between VHA and non-VHA hospitals across a range of surgical procedures,[12] but no studies to date have compared survival between hip fracture repair patients cared for within VHA and in non-VHA facilities reimbursed by Medicare. Given current changes in the way health care is

[1] Denver-Seattle Center of Innovation VA Eastern Colorado Health Care System Denver, CO, USA
[2] Department of Medicine and School of Public Health University of Colorado Anschutz Medical Campus Aurora, CO, USA
[3] Department of Health Policy & Management, School of Public Health, Texas A&M Health Science Center, College Station, TX, USA
[4] Department of Medicine, Duke University Medical Center, Center for Health Services Research in Primary Care, Durham VA Medical Center, Durham, NC, USA
[5] Department of Health Outcomes and Policy Malcolm G. Randall VA Medical Center, Gainesville, FL, USA

Corresponding Author:
Evelyn Hutt, Denver VAMC, 1055 Clermont Street, Mail Code 151A, Denver, CO 80220, USA.
Email: Evelyn.hutt@va.gov

being paid for and delivered in the United States, investigations of the impact of care organization on the relationship between comorbid conditions and mortality are timely and important, even when comparisons must be made between qualitatively different databases generated by the systems being compared. The current study compares 30-day and 1-year survival of a propensity-matched cohort of male veterans receiving hip fracture repair in VHA hospitals and male Medicare beneficiaries receiving hip fracture repair in non-VHA hospitals between 2003 and 2005.

Materials and Methods

Sample and Data

Data for this retrospective comparative analysis were obtained from the Veterans Affairs' (VA) National Surgical Quality Improvement Program (VASQIP) and VA administrative claims data (Patient Treatment and Medical SAS files). Medicare data were obtained via a data use agreement with the VA Information Resource Center. Human subject approvals were obtained from the Colorado Multiple Institutional Review Board, and authorization to use VASQIP data was obtained from the VA Surgical Quality Data Use Group of the National Surgery Office in VHA Central Office, Washington, DC.

The VASQIP data were used to identify hip fracture surgeries in VHA facilities from fiscal years 2003 to 2005. The VASQIP data collection methods have been described in detail elsewhere.[13;14] Briefly, trained nurses collect information preoperatively, intraoperatively, and 30 days postoperatively with a standardized protocol for most major surgical operations performed at participating VHA hospitals. The database contains information regarding age, gender, ethnicity, preoperative comorbidities, laboratory values, and prefracture functional status measures. Operative data include Current Procedural Terminology (CPT) codes, operative times, anesthesia technique, American Society of Anesthesiologists (ASA) class, whether the operation was emergent, wound class, and training status of the primary surgeon. Postoperative outcomes include 30-day mortality and 20 different predefined postoperative complications.

We selected all male patients during fiscal years 2003 to 2005 identified through VASQIP data with CPT codes 27235, 27236, 27244, or 27245, indicating skeletal traction or open or closed treatment of a hip fracture. We also included CPT codes 27125 (hemiarthroplasty) and 27130 (arthroplasty) when the patient had a diagnosis code consistent with an acute hip fracture (*International Statistical Classification of Diseases 9* [*ICD-9*] codes 820.x, 820.2x, or 820.8). We selected only the first hip fracture repair procedure for patients who had multiple operations during the 2003 to 2005 timeframe. Records from the VASQIP database were matched to records in other VA data sets, including the Patient Treatment File that tracks inpatient admissions and the Vital Status files through 2006 to provide 12-month follow-up on mortality. The initial sampling criteria identified 3542 unique male patients with VHA hip fracture surgeries. We excluded 1 patient with a geographic code consistent with a foreign country, resulting in a final VHA sample of 3541.

The Medicare comparison sample was drawn from 2003 to 2005 Medicare Part A inpatient hospital claims files based on *ICD-9* and CPT-4 codes consistent with hip fracture (n = 12, 342), as detailed previously and included data through 2006 to provide 12-month follow-up for 1-year mortality assessment. Second procedures (n = 1033), patients whose surgery fell outside the timeframe of interest or who were younger than 65 years (n = 301), and those who received some form of VA benefits (n = 473) were excluded, leaving 10 535 patients. Female patients (n = 8253) were excluded, as were those missing data on region or type of repair (n = 3), leaving a final sample size of 2279 male patients. Members of the VASQIP sample who were also in the Medicare sample were excluded from further analysis.

There are significant differences between the VASQIP and Medicare databases. The VASQIP is a clinical database designed to analyze and improve surgical outcomes. As such, it contains many pre-, post-, and perioperative variables that impact surgical risk and outcomes. The Medicare files, by contrast, contain only demographic, pre- and postsurgical hospital length of stay (LOS), comorbid diagnoses, type of procedure, and hospital charge data. Because of the data limitations of the Medicare files, this kind of comparison is less than ideal, but it is the only way to compare mortality outcomes between the 2 systems of care.

Outcomes and Explanatory Variables

Mortality was assessed using multiple data sources from VA files, including the VASQIP, VHA Mini Vital Status File, which contains cross-checks with the Beneficiary Identification Records Locator Subsystem death file and the Medicare Denominator file. The Medicare Denominator file includes a date of death for decedents. These VA and Medicare files are considered accurate sources of mortality information.

Key covariates included age (5-year increments from 65-99 and greater than 99), ethnicity (White, African American, Asian, and other—which included Hispanic, American Indian, and unknown), admission source (categorical—nursing home or other), type of repair (open, closed, or arthroplasty), the Deyo variation of the Charlson Comorbidity Index,[15] and US Census Bureau region (Northeast, South or Midwest, or West). Procedures in Puerto Rico (n = 115) were classified as being in the South.

Analysis

Patient characteristics, 30-day, and one-year survival between VASQIP and Medicare cohorts were compared using descriptive statistics. Pair-wise correlations and bivariate relationships between the explanatory and outcome variables were compared using *t* tests for normally distributed continuous

variables, Wilcoxon tests for nonnormally distributed variables, and Chi-square tests for categorical variables.

Multivariable analysis was conducted in 2 stages. First, to create a Medicare cohort as similar as possible to the VASQIP cohort, we used propensity score methods to match male VHA and Medicare patients 1-to-1 on observable characteristics,[16,17] including year of surgery, region, age, race, Deyo-Charlson Index,[15] admission source, and primary diagnosis. The Deyo-Charlson Index was used rather than individual comorbidities at this stage in order to maintain adequate sample size for further analysis. Relying on recent methodological recommendations for propensity score matching algorithms, we used a caliper matching method that specifies a nearest neighbor distance of no more than one-fifth of a standard deviation in the propensity score estimate,[18] using a macro in the SAS software package version 9.2 (SAS Institute, Cary, North Carolina). Characteristics of the resulting matched sample were then retested to ensure similarity in the key baseline patient and preoperative characteristics used for the match. A 1:1 match yielded a final analytic sample of 947 Medicare and 947 VHA cases for comparison. This sample of 1894 matched patients has over 90% power to detect small differences (4%) in 1-year survival rates between VHA and Medicare patients, based on a 36% VHA mortality rate and a 34% Medicare mortality rate.

Second, logistic regression was used to estimate 30-day survival and 1-year survival on the matched cohort, with site of hip fracture repair being the explanatory variable of interest. To increase efficiency of estimates and understand patient factors that explain variation in mortality in the entire cohort, this model controlled for year of surgery, number of hospital days before and after surgery, and whether or not the patient was diagnosed with one or more of several chronic conditions (cerebral vascular disease [CVD], congestive heart failure [CHF], chronic obstructive pulmonary disease [COPD], dementia, diabetes with complications, metastatic neoplasm, mild liver disease, myocardial infarction, peptic ulcer disease, peripheral vascular disease [PVD], renal disease, and rheumatoid arthritis). Days before surgery were trichotomized as <1, 1-4, or >4 days). Interactions among explanatory variables (eg, between year of surgery and days from admission to surgery) were evaluated in the logistic regression but found not to be statistically significant, so they were excluded from the final model.

Results

The unmatched VHA and Medicare male hip fracture cohorts were significantly different from each other in unadjusted age, ethnic background, and geographic region, comorbidity burden, year of surgery, and type of surgical repair (Table 1). Veterans Health Administration patients were approximately 5 years younger, more ethnically diverse, had greater comorbidity than the Medicare cohort, had more surgeries in 2003 and 2005, and they were less likely to have undergone a repair that included arthroplasty. Propensity matching effectively eliminated most of these presurgical differences, based on postmatch statistical tests. Notable persistent and significant differences in the propensity-match cohort included more VHA patients having had CVD, PVD and rheumatoid arthritis, while more Medicare patients had CHF and renal disease. Significant differences in number of days before and after surgery also remained. Unadjusted survival differed significantly between matched VHA and Medicare male patients. In the propensity-matched cohort at 30 days, absolute survival differed by 3.28% (92.93% for Medicare cohort and 89.65% for VHA cohort, $P = .01$). At 1 year, absolute survival differed by 7.39% (70.43% for Medicare cohort and 63.04% for VHA cohort, $P < .001$; see Table 1).

When 30-day and 1-year survival were estimated in the propensity-matched cohorts (Table 2), the regression models, which adjusted for designated chronic conditions, year of surgery and length of pre- and postsurgical stay, had a moderate fit, both by C statistic ≈ 0.68 and by Hosmer–Lemeshow test (30-day survival model: $P = .6170$; 1-year model: $P = .1419$). The models confirmed significant survival differences between patients treated in non-VHA facilities reimbursed by Medicare and in VHA at 30 days (odds ratio [OR] = 1.68, 95% confidence interval [CI]: 1.15-2.44 and 1 year (OR = 1.35, 95% CI: 1.08-1.69). As anticipated, there was significantly worse survival at both 30 days and 1 year for those with CHF, COPD, and renal disease. In addition, patients with dementia and metastatic neoplasm had significantly worse survival at 1 year. Those with CVD had worse survival at 30 days. Other comorbidities were not significantly associated with survival at either 30 days or 1 year.

Having fewer than 4 presurgical hospital days was associated with better odds of survival at both 30 days and 1 year. Having less than 1 presurgical hospital day was associated with better odds of survival at 1 year. One-year survival was better in 2005 than in 2003. Longer postsurgical hospital stays were associated with worse odds of survival at 30 days.

Discussion

In a cohort of matched patients who had hip fracture repair in VHA hospitals or in non-VHA hospitals reimbursed by Medicare between 2003 and 2005, odds of short- and long-term survival were better for patients treated under Medicare than in VHA hospitals. These differences remained even after further adjustment for key comorbidities, year of care, and hospital LOS preceding and following surgery. These results diverge from a recent comparison of surgical quality between VHA and non-VHA hospitals, which found that morbidity and mortality were similar across a range of surgical procedures.[12] However, mortality following cardiac surgery was found to be higher among veterans, which is consistent with the results of this study.

Survival may have been greater for Medicare patients with hip fractures due to unobserved pre-operative patient characteristics or intraoperative and postoperative characteristics of care provided in the different health systems. Unobserved preoperative differences including fracture location and type, ASA class, preoperative laboratory data (eg, sodium, hemoglobin, and serum albumin[19]), and sociodemographic factors such as

Table 1. Characteristics of Study Population.

	Entire sample			Propensity-matched sample		
	VA	Medicare		VA	Medicare	
	n = 3541	n = 2279	*P*	n = 947	n = 947	*P*
[a]Gender, % male	100.00	100.00	1.000	100	100	1.00
[a]Average age (SD)	79 (6.48)	83 (7.73)	<.0001	81 (6.95)	80 (7.13)	.5014
[a]Ethnic background, %			<.0001			.4155
Unknown	18.07	1.05		2.11	2.32	
White	67.07	95.57		91.24	92.93	
African American	8.87	2.06		4.54	3.58	
Asian	0.25	0.97		0.63	0.32	
Other	5.73	0.35		1.48	0.84	
[a]Admitted from NH, %	8.36	1.93	<.0001	3.38	2.22	.1254
[a]Type of repair, %			<.0001			.1425
Arthroplasty	20.67	63.76		45.41	47.10	
Closed reduction	7.96	10.57		12.57	9.71	
Open reduction	71.36	25.67		42.03	43.19	
Comorbidity						
[a]Average Deyo index (SD)	1.46 (1.70)	1.15 (1.43)	<.0001	1.30 (1.57)	1.24 (1.58)	.4146
[b]CHF	14.09	19.61	<.0001	13.02	18.06	.0036
[b]CVD	2.88	0.66	<.0001	2.64	0.63	.0006
[b]COPD	26.86	21.37	<.0001	24.08	23.02	.5881
[b]Renal disease	5.54	7.33	.0058	4.86	7.71	.0106
[b]Diabetes with com-plications	2.99	1.62	.0010	2.32	2.01	.6357
[b]Metastatic neoplasm	2.85	1.97	.0366	2.01	2.75	.2909
[b]Mild liver disease	1.95	0.70	<.0001	1.90	0.74	.0268
[b]Myocardial infarction	4.80	5.05	.6723	4.75	3.91	.3664
[b]Peptic ulcer disease	1.30	0.61	.0116	1.16	0.42	.0696
[b]PVD	6.18	2.46	<.0001	6.34	2.75	.0002
[b]Rheumatoid arthritis	1.30	0.75	.0465	1.48	0.53	.0380
[b]Dementia	10.53	7.55	<.0001	8.66	6.86	.1443
[a]Region (%)			<.0001			.8500
Midwest	21.49	2.81		6.44	6.34	
Northeast	14.69	66.30		41.82	43.61	
South	43.60	24.75		39.60	38.86	
West	20.22	6.14		12.14	11.19	
[a]Year of surgery			<.0001			.8043
2003	38.89	33.14		36.43	35.37	
2004	36.97	45.24		40.34	41.82	
2005	24.15	21.63		23.23	22.81	
[b]Average days from admission to surgery (SD)	4.41 (28.35)	1.75 (2.30)	<.0001	5.64 (43.25)	1.78 (2.35)	.0063
Time from admission to surgery < 1 day	8.16	19.48	<.0001	7.71	19.96	<.0001
Time from admission to surgery $\leq$1 day and $\leq$4 days	70.29	73.67	.0052	69.38	73.07	.0757
Time from admission to surgery >4 days	21.55	6.85	<.0001	22.91	6.97	<.0001
[b]Average days from surgery to discharge (SD)	10.86 (10.99)	5.85 (4.49)	<.0001	11.83 (11.30)	5.71 (4.50)	<.0001
Survival at 30 days	90.43	90.35	.9197	89.65	92.93	.0106
Survival at 1 year	64.42	66.83	.0592	63.04	70.43	.0006

Abbreviations: CHF, congestive heart failure; CVD, cerebral vascular disease, COPD, chronic obstructive pulmonary disease; PVD, peripheral vascular disease; SD, standard deviation.
[a]Propensity-matched variable.
[b]Included in logistic model.

marital and socioeconomic status and lifestyle[20] may account for much of the difference.

Survival was also impacted by presurgical LOS, which was higher in VHA than in non-VHA facilities reimbursed under Medicare; more VHA patients had preoperative stays of greater than 4 days. The current study does not permit differentiation between this reflecting greater surgical risk and comorbidity, or limited operating room and staff availability. Nevertheless, even after adjustment for this difference, odds of short- and long-term survival were better for patients treated under Medicare than in VHA.

Intraoperative care differences, such as type of anesthesia,[11] choice of surgical technique,[21,22] and procedure length may also contribute to the survival differences observed in this

Table 2. Survival Odds for Propensity-Matched Cohort.

	30 Day C statistic = 0.671			1-Year C statistic = 0.664		
Variable	Odds ratio	Lower CI	Upper CI	Odds ratio	Lower CI	Upper CI
Type of care: Medicare vs VA	**1.701**[a]	**1.184**	**2.445**	**1.504**[a]	**1.208**	**1.872**
2003 vs 2005	0.867	0.567	1.326	0.766	0.586	1.001
2004 vs 2005	1.147	0.742	1.774	1.105	0.846	1.444
# days from admission to surgery	1.002	0.991	1.012	1.003	0.996	1.011
# days from surgery to discharge	1.024	**1**	**1.048**	0.995	0.984	1.006
Cerebral vascular disease	**0.342**[b]	**0.136**	**0.859**	0.86	0.392	1.885
Congestive heart failure	**0.403**[a]	**0.276**	**0.588**	**0.549**[b]	**0.421**	**0.716**
Chronic obstructive pulmonary disease	0.71	0.494	1.022	**0.577**[b]	**0.459**	**0.727**
Dementia	0.787	0.437	1.417	**0.518**[c]	**0.359**	**0.747**
Diabetes with complication	1.488	0.494	4.479	0.978	0.501	1.91
Metastatic neoplasm	0.607	0.229	1.608	**0.132**[a]	**0.065**	**0.269**
Mild liver disease	1.727	0.371	8.042	0.544	0.238	1.244
Myocardial infarction	0.723	0.368	1.419	0.762	0.484	1.2
Peptic ulcer disease	0.447	0.123	1.625	1.333	0.452	3.935
Peripheral vascular disease	1.758	0.72	4.288	1.406	0.842	2.35
Renal failure	**0.293**[a]	**0.178**	**0.482**	**0.421**[a]	**0.285**	**0.621**
Rheumatoid arthritis	1.44	0.4	5.178	0.374	0.118	1.187

Abbreviations: CI, confidence interval; VA, Veterans Affairs; a = $p < .001$; b = $p < .05$; c = $p < .005$.

study. Perioperative care characteristics that might differ between systems of care include use of prophylactic antibiotics and anticoagulation. Postoperative factors including time to mobilization after surgery, transfusion thresholds, anticoagulation, and postacute care (home vs. subacute rehabilitation or nursing home) may all impact mortality. Other systematic differences that deserve exploration include urban/rural location, type and availability of postacute care, proportion of the hospitals affiliated with teaching institutions, and specifics about types and rates of complications.

Clearly, more detailed study of differences in care characteristics between the two care systems and the relationship between care and outcomes needs to be undertaken. For the present study, detailed perioperative care data were available only for the VHA cohort. More detailed case information for Medicare patients would allow us to compare characteristics more completely across health care systems. Given the changes in reimbursement and organization of care currently underway in the United States, it is both important and timely to conduct prospective studies across systems of care, using unified databases, in order to answer these critical questions.

This study has several important limitations. Patients observed in the study were not prospectively randomized nor representative of the entire Medicare or VHA hip fracture population. Despite propensity score matching and adjustment for observed differences in baseline characteristics across sites of care, unobserved confounding likely remains. In order to avoid both loss of sample and potential violations of confidentiality, we chose very large geographic subunits for analysis. This may obscure important regional or state-by-state variations in care and case mix. It is also likely that this sample excludes some surgeries that were performed in VHA facilities during the time frame studied due to the VASQIP sampling frame. Because the VASQIP protocol selects only the first 36 consecutive cases across all surgeries over 8-day cycles, cases in larger VHA facilities may be under-represented. Because surgical volume is known to impact outcome, and larger facilities may have higher hip fracture repair rates, VHA outcomes may be negatively skewed. And, because case identification relied primarily on CPT codes to identify repair procedures, cases with unstable subtrochanteric fractures may be in the sample and could introduce surgeon bias. Finally, data analyzed in this study are now approximately 10 years old. Changes in surgical care over the last 10 years may make the current study less relevant to current surgical and postoperative care. The study's strengths include the size of the cohort and our ability to propensity-match a large enough sample to permit comparisons between two unique systems of care. To date, no other such comparisons have been published for hip fracture repair patients.

Conclusion

Medicare beneficiaries with hip fracture repair in non-VHA hospitals had better survival than veterans in VHA hospitals. This study represents an important first step in identifying systematic differences in hip fracture repair outcomes across these 2 large care systems. Future research will be needed to determine whether these discrepancies have persisted over the past decade; what drives them; whether both systems of care deliver equivalent functional outcomes in terms of return to community living and independent mobility, and whether costs for providing care are equivalent in both systems.

Acknowledgments

The authors would like to acknowledge the VA Surgical Quality Data Use Group (SQDUG) for its role as scientific advisors and for the

critical review of data use and analysis presented in this manuscript. Additionally, the authors acknowledge Sandra Marcus for manuscript preparation and administrative support.

Authors' Note

This work was supported by the Office of Research and Development, Health Services Research and Development Service, Department of Veterans Affairs, project number IIR 04-173. The views expressed are those of the authors and not necessarily those of the Department of Veterans Affairs, the United States Government, Duke University, the University of Colorado Denver, or Texas A&M Health Science Center.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: the article is funded by VA HSR&D.

References

1. Bass E, French DD, Bradham DD, Rubenstein LZ. Risk-adjusted mortality rates of elderly veterans with hip fractures. *Ann Epidemiol*. 2007;17(7):514-519.
2. Empana JP, Dargent-Molina P, Breart G. Effect of hip fracture on mortality in elderly women: the EPIDOS prospective study. *J Am Geriatr Soc*. 2004;52(5):685-690.
3. Brauer CA, Coca-Perraillon M, Cutler DM, Rosen AB. Incidence and mortality of hip fractures in the United States. *JAMA*. 2009; 302(14):1573-1579.
4. Sterling RS. Gender and race/ethnicity differences in hip fracture incidence, morbidity, mortality, and function. *Clin Orthop Relat Res*. 2011;469(7):1913-1918.
5. Endo Y, Aharonoff GB, Zuckerman JD, Egol KA, Koval KJ. Gender differences in patients with hip fracture: a greater risk of morbidity and mortality in men. *J Orthop Trauma*. 2005;19(1):29-35.
6. Pande I, Scott DL, O'Neill TW, Pritchard C, Woolf AD, Davis MJ. Quality of life, morbidity, and mortality after low trauma hip fracture in men. *Ann Rheum Dis*. 2006;65(1):87-92.
7. Agency for Healthcare Research and Quality. *Healthcare Cost and Utilization Project Nationwide Inpatient Sample (NIS) 2002*. Rockville, MD: Agency for Healthcare Research and Quality; 2002.
8. Bass E, French DD, Bradham DD. A national perspective of Medicare expenditures for elderly veterans with hip fractures. *J Am Med Dir Assoc*. 2008;9(2):114-119.
9. Ajmera M, Wilkins TL, Sambamoorthi U. Dual Medicare and Veteran Health Administration use and ambulatory care sensitive hospitalizations. *J Gen Intern Med*. 2011;26(suppl 2):669-675.
10. Khuri SF, Daley J, Henderson WG. The comparative assessment and improvement of quality of surgical care in the Department of Veterans Affairs. *Arch Surg*. 2002;137(1):20-27.
11. Radcliff TA, Henderson WG, Stoner TJ, Khuri SF, Dohm M, Hutt E. Patient risk factors, operative care, and outcomes among older community-dwelling male veterans with hip fracture. *J Bone Joint Surg Am*. 2008;90(1):34-42.
12. Matula SR, Trivedi AN, Miake-Lye I, Glassman PA, Shekelle P, Asch S. Comparisons of quality of surgical care between the US Department of Veterans Affairs and the private sector. *J Am Coll Surg*. 2010;211(6):823-832.
13. Khuri SF, Daley J, Henderson W, et al. The Department of Veterans Affairs' NSQIP: the first national, validated, outcome-based, risk-adjusted, and peer-controlled program for the measurement and enhancement of the quality of surgical care. National VA Surgical Quality Improvement Program. *Ann Surg*. 1998;228(4): 491-507.
14. Daley J, Khuri SF, Henderson W, et al. Risk adjustment of the postoperative morbidity rate for the comparative assessment of the quality of surgical care: results of the National Veterans Affairs Surgical Risk Study. *J Am Coll Surg*. 1997;185(4): 328-340.
15. Deyo RA, Cherkin DC, Ciol MA. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. *J Clin Epidemiol*. 1992;45(6):613-619.
16. Rosenbaum P RD. The central role of the propensity score in observational studies for causal effects. *Biometrika*. 2003;70(1): 41-55.
17. Dehejia R WS. Propensity score matching methods for non-experimental causal studies. *Rev Econ Stat*. 2002;84(1):151-161.
18. Austin PC. Comparing paired vs non-paired statistical methods of analyses when making inferences about absolute risk reductions in propensity-score matched samples. *Stat Med*. 2011;30(11): 1292-1301.
19. Pimlott BJ, Jones CA, Beaupre LA, Johnston DW, Majumdar SR. Prognostic impact of pre-operative albumin on short-term mortality and complications in patients with hip fracture. *Arch Gerontol Geriatr*. 2011;53(1):90-94.
20. Marcinkowska M, Horst-Sikorska W, Wawrzyniak A, Michalak M, Sewerynek E. Prognostic factors in patients surgically treated after hip fracture. *Endokrynologia Polska*. 2013;64(2):108-113.
21. Radcliff TA, Regan E, Cowper Ripley DC, Hutt E. Increased use of intramedullary nails for intertrochanteric proximal femoral fractures in veterans affairs hospitals: a comparative effectiveness study. *J Bone Joint Surg Am*. 2012;94(9):833-840.
22. Fisher MA, Matthei JD, Obirieze A, et al. Open reduction internal fixation versus hemiarthroplasty versus total hip arthroplasty in the elderly: a review of the National Surgical Quality Improvement Program database. *J Surg Res*. 2013;181(2):193-198.