Racial and Health Insurance Disparities of Inpatient Spine Augmentation for Osteoporotic Vertebral Fractures from 2005 to 2010

C.N. Gu, W. Brinjikji, A.M. El-Sayed, H. Cloft, J.S. McDonald, and D.F. Kallmes

ABSTRACT

BACKGROUND AND PURPOSE: Vertebroplasty and kyphoplasty are frequently utilized in the treatment of symptomatic vertebral body fractures. While prior studies have demonstrated disparities in the treatment of back pain and care for osteoporotic patients, disparities in spine augmentation have not been investigated. We investigated racial and health insurance status differences in the use of spine augmentation for the treatment of osteoporotic vertebral fractures in the United States.

MATERIALS AND METHODS: Using the Nationwide Inpatient Sample from 2005 to 2010, we selected all discharges with a primary diagnosis of vertebral fracture (International Classification of Diseases-9 code 733.13). Patients who received spine augmentation were identified by using International Classification of Diseases-9 procedure code 81.65 for vertebroplasty and 81.66 for kyphoplasty. Patients with a diagnosis of cancer were excluded. We compared usage rates of spine augmentation by race/ethnicity (white, black, Hispanic, and Asian/Pacific Islander) and insurance status (Medicare, Medicaid, self-pay, and private). Comparisons among groups were made by using \( \chi^2 \) tests. A multivariate logistic regression analysis was fit to determine variables associated with spine augmentation use.

RESULTS: A total of 228,329 patients were included in this analysis, of whom 129,206 (56.6%) received spine augmentation. Among patients with spine augmentation, 97,022 (75%) received kyphoplasty and 32,184 (25%) received vertebroplasty; 57.5% (92,779/161,281) of white patients received spine augmentation compared with 38.7% (1405/3631) of black patients \( (P < .001) \). Hispanic patients had significantly lower spine augmentation rates compared with white patients (52.3%, 3777/7222, \( P < .001 \)) as did Asian/Pacific Islander patients (53.1%, 1784/3361, \( P < .001 \)). The spine augmentation usage rate was 57.2% (114,768/200,662) among patients with Medicare, significantly higher than that of those with Medicaid (43.9%, 1907/4341, \( P < .001 \)) and those who self-pay (40.2%, 488/1214, \( P < .001 \)).

CONCLUSIONS: Our findings demonstrate substantial racial and health insurance–based disparities in the inpatient use of spinal augmentation for the treatment of osteoporotic vertebral fracture.

ABBREVIATIONS: NIS = Nationwide Inpatient Sample; ICD = International Classification of Diseases

Vertebroplasty and kyphoplasty are frequently used in the treatment of symptomatic vertebral body fractures. Prior studies have demonstrated that minority patients are significantly less likely to receive spine procedures such as cervical diskectomy for the treatment of pain compared with whites. The Nationwide Inpatient Sample (NIS) has been used in a number of prior studies to demonstrate racial and health insurance status disparities in access to treatment of a variety of diseases such as deep brain stimulation for Parkinson disease, revascularization for lower extremity ischemia, and surgical/endovascular treatment for intracranial aneurysms. The goal of this study was to investigate what, if any, racial or health insurance status disparities existed in the use of spine augmentation for the treatment of osteoporotic fractures in the United States by analyzing the NIS, a large public data base containing discharge information for nearly 8 million hospitals stays per year.

MATERIALS AND METHODS

Patient Population

We purchased the NIS hospital discharge data base for 2005–2010 from the Healthcare Cost and Utilization Project of the Agency for Healthcare Research and Quality, Rockville, Maryland. The NIS is a hospital discharge data base representing 20% of all inpatient admissions to nonfederal hospitals in the United States. Inclusion criteria were the following: 1) adult patients who had a primary diagnosis of vertebral fracture (International Classification of Diseases [ICD]-9 diagnosis code 733.13), and 2) patients treated at centers that performed spine augmentation. Exclusion criteria were the following: 1)
patients with a diagnosis of cancer (ICD-9, 1400-1991, 2000-2089), and 2) patients treated at centers not performing spine augmentation procedures. Patients with vertebroplasty were identified by using the ICD-9 procedure code 81.65, and patients with kyphoplasty were identified by using the ICD-9 procedure code 81.66. Hospitals performing spine augmentation were identified by cross-matching ICD-9 procedure codes with hospital identifier codes. If a hospital performed $\geq 1$ spine augmentation procedure in a given year, patients discharged from that hospital were included in this analysis. In addition to race and insurance, other demographic variables collected included age, Charlson Comorbidity Index (which predicts the 10-year mortality for patients with a variety of comorbid conditions), sex, and the presence of the following comorbidities: congestive heart failure, coronary artery disease, hypertension, hyperlipidemia, osteoporosis, diabetes mellitus, obesity, and smoking.

**Usage**
The usage rate of spine augmentation (combined vertebroplasty and kyphoplasty) was compared across racial/ethnic groups and insurance status. Racial/ethnic groups specified in our analysis included the following categories: white, black, Hispanic, and Asian/Pacific Islander. Patient insurance status groups specified in our analysis included Medicare, private insurance, Medicaid, and self-pay. Two sets of subgroup analyses were performed. First, we compared the ratio of kyphoplasty and vertebroplasty by racial/ethnic categories and by insurance category among patients receiving spine augmentation. Patients who did not receive spine augmentation were excluded from this analysis. Second, we compared spine augmentation usage rates by race/ethnicity among patients whose primary payer was Medicare. The analysis was performed because Medicare was the primary payer for most patients.

**Statistical Analysis**
First, $\chi^2$ testing was used to study the usage rates of spine augmentation, vertebroplasty, and kyphoplasty. The white race was specified as the reference for analyses concerned with racial differences; Medicare was specified as the reference for analyses concerned with differences by insurance status. Odds ratios are presented with their corresponding 95% confidence intervals. Discharge weights were applied throughout our analyses. $P$ values $< .05$ were considered statistically significant.

Second, a multivariable logistic regression model of spine augmentation use was fit by insurance status, race, age, Charlson Comorbidity Index, and sex to assess mutually adjusted disparities in spine augmentation rates. A second multivariate logic regression model comparing the odds of kyphoplasty use versus vertebroplasty among patients receiving spine augmentation was fit by insurance status, race, age, Charlson Comorbidity Index, and sex. This analysis was performed to assess mutually adjusted disparities in kyphoplasty usage rates compared with vertebroplasty. All statistical analyses were performed by using SAS-based JMP 9.0 software (www.jmp.com).

**RESULTS**

**Spine Augmentation Use and Demographics**
Between 2005 and 2010, a total of 228,329 patients were identified who were hospitalized with a primary diagnosis of vertebral fracture. Of these patients, 56.6% (129,206/228,329) underwent any form of spine augmentation. Among patients with spine augmentation, 97,022 (75%) received kyphoplasty and 32,184 patients (25%) received vertebroplasty. Overall, 79.4% of patients were women (181,372/228,329), 91.9% (161,281/175,495) were white, and 88.8% (200,662/225,962) had Medicare. The mean age of the overall patient population was 78.9 years. The mean age among patients with spine augmentation was slightly younger (78.6 years) than the mean age of patients without spine augmentation (79.3 years). Patients with spine augmentation had lower mean Charlson Comorbidity scores than those without spine augmentation (0.8 $\pm$ 2.2 versus 0.9 $\pm$ 2.4, $P < .001$). Patients with spine augmentation had significantly lower rates of congestive heart failure (11.9% versus 16.1%, $P < .001$) and significantly higher rates of osteoporosis (71.5% versus 63.1%, $P < .001$). Demographic and comorbidity characteristics of the patients in this study are summarized in Table 1.

**Overall Spine Augmentation Use**
The spine augmentation usage rate was 57.5% (92,779/161,281) for white patients, significantly higher than that of black patients (38.7%, 1405/3631, $P < .001$), Hispanic patients (52.3%, 3777/7222, $P < .001$), and Asian/Pacific Islander patients (53.1%, 1784/3361, $P < .001$). The spine augmentation usage rate for patients with Medicare was 57.2% (114,768/200,662), significantly higher than that among patients with private insurance (54.2%, 10,766/19,745, $P < .001$), those with Medicaid (43.9%, 1907/4341, $P < .001$), and those who self-pay (40.2%, 488/1214, $P < .001$). These data are summarized in Table 2.

**Medicare Subgroup Analysis**
In our subgroup analysis considering only patients whose primary payer was Medicare, we found that black patients with Medicare had a spine augmentation usage rate of 40.7% (1083/2660), significantly lower than that among white patients (57.9%, 83,477/144,263, $P < .001$). Hispanic patients also had significantly lower rates of spine augmentation use compared with white patients (53.0%, 2870/5326, $P < .001$) as did Asian/Pacific Islander patients (54.9%, 1484/2703, $P < .001$). These data are summarized in Table 3.

**Comparative Use of Kyphoplasty and Vertebroplasty among Patients with Spine Augmentation**
Among white patients receiving spine augmentation procedures, 78.8% (73,059/92,779) underwent kyphoplasty and 21.3% (19,720/97,779) underwent vertebroplasty. Among black patients receiving spine augmentation procedures, 78.0% (1096/1405) underwent kyphoplasty and 22.0% (309/1405) underwent vertebroplasty ($P = .52$ compared with white patients). Hispanic patients with spine augmentation were less likely to receive kyphoplasty compared with white patients as 74.0% (2795/3777) of Hispanic patients received kyphoplasty and 26.0% (982/3777) received vertebroplasty ($P < .001$). Asian/Pacific Islander patients were also significantly less likely to receive kyphoplasty as 76.4% (1362/1784) received kyphoplasty and 23.6% (422/1784) received vertebroplasty ($P = .02$). Among patients with Medicare, 76.8% (88,187/114,768) re-
Table 1: Summary of patient demographics for inpatients with vertebral spinal fractures from 2005 to 2010

| Variable                      | All Patients | Patients without Spine Augmentation | Patients with Spine Augmentation | P     |
|-------------------------------|--------------|-------------------------------------|----------------------------------|-------|
| Mean age (SD) (yr)            | 78.9 (24.0)  | 78.6 (21.7)                         | 79.3 (26.6)                      | <.001 |
| Female (No.) (%)              | 87,137 (79.5)| 79,467 (80.2)                      | 10,190 (78.9)                    | <.001 |
| Mean (SD) [CCI] comorbidities | 0.8 (2.3)    | 0.9 (2.4)                           | 0.8 (2.2)                        | .2    |
| Congestive heart failure      | 31,377 (13.7)| 15,953 (16.1)                      | 15.42 (11.9)                     | <.001 |
| Coronary artery disease       | 53,902 (23.6)| 23,347 (23.6)                       | 30,555 (23.7)                    | .6    |
| Diabetes mellitus             | 41,551 (18.2)| 18,065 (18.2)                       | 23,487 (18.2)                    | .7    |
| Hypertension                  | 14,0843 (61.7)| 61,020 (61.6)                       | 79,824 (61.8)                    | .28   |
| Hyperlipidemia                | 52,651 (23.1)| 22,126 (22.3)                       | 30,525 (23.6)                    | <.001 |
| Smoking                       | 14,656 (6.4) | 5804 (5.9)                          | 8853 (6.9)                       | <.001 |
| Obesity                       | 7968 (3.5)   | 3589 (3.6)                          | 4380 (3.4)                       | .003  |
| Osteoporosis                  | 15,494 (67.9)| 62,528 (63.1)                       | 92,313 (71.5)                    | <.001 |

Table 2: Use of spine augmentation among 228,329 patients presenting with a primary diagnosis of vertebral fracture

| Race               | All Patients | Receiving Spine Augmentation | P     |
|--------------------|--------------|------------------------------|-------|
| White              | 16,1281 (91.9)| 15,484 (91.3)               | <.001 |
| Black              | 3631 (2.7)   | 3291 (2.7)                  | .86   |
| Hispanic           | 7222 (4.1)   | 6575 (4.6)                  | <.001 |
| Asian/Pacific Islander | 3361 (1.9) | 3077 (1.8)                 | <.001 |

Table 3: Comparative usage rate of spine augmentation among patients on Medicare

| Race               | Receiving Spine Augmentation | P     |
|--------------------|------------------------------|-------|
| White              | 18,1372 (79.5)              | <.001 |
| Black              | 19745 (8.7)                 | .85   |
| Hispanic           | 7722 (4.1)                  | <.001 |
| Asian/Pacific Islander | 3361 (1.9) | <.001 |

Table 4: Comparative usage rate of kyphoplasty versus vertebroplasty among patients with spine augmentation

| Race               | Receiving Kyphoplasty | Receiving Vertebroplasty | P Value |
|--------------------|-----------------------|--------------------------|---------|
| White              | 14,0843 (61.7)        | 13,602 (61.7)            | <.001   |
| Black              | 3631 (2.7)            | 3291 (2.7)               | .86     |
| Hispanic           | 7222 (4.1)            | 6575 (4.6)               | <.001   |
| Asian/Pacific Islander | 3361 (1.9) | <.001 |

Multivariable Analysis

After we performed multivariable analysis, black patients had lower odds of receiving any spine augmentation compared with whites (OR = 0.46; 95% CI, 0.43–0.49; P < .001). The same was true for Hispanic patients (OR = 0.83; 95% CI, 0.79–0.89; P < .001). Patients with private insurance had significantly lower odds of spine augmentation compared with those with Medicare (OR = 0.77; 95% CI, 0.75–0.80; P < .001) and Medicaid (OR = 0.50; 95% CI, 0.47–0.53; P < .001) and those who self-pay (OR = 0.41; 95% CI, 0.37–0.56; P < .001).

Among patients receiving spine augmentation, comparative use of kyphoplasty was similar between black and white patients (OR = 0.90; 95% CI, 0.79–1.02; P = .11), though Hispanic patients had significantly lower use of kyphoplasty compared with white patients (OR = 0.76; 95% CI, 0.70–0.82; P < .001). Patients with private insurance (OR = 0.85; 95% CI, 0.80–0.89; P < .001), those with Medicaid (OR = 0.53; 95% CI, 0.48–0.59; P < .001), and those who self-paid (OR = 0.35; 95% CI, 0.29–0.42; P < .001) had significantly lower odds of kyphoplasty use compared with those with Medicare. These data are summarized in Table 5.
DISCUSSION

Our study demonstrated significant racial and health insurance-based disparities in the use of spinal augmentation for the treatment of osteoporotic vertebral fracture. Compared with white patients, all racial and ethnic minority groups had significantly lower rates of inpatient spine augmentation. Indeed, less than one-half of black patients admitted with a primary diagnosis of vertebral fracture were treated with spine augmentation, while nearly two-thirds of white patients underwent spine augmentation. Differences in spine augmentation use among Hispanic and Asian/Pacific Islander patients compared with white patients were also statistically significant, but the degree of difference was much less marked than that seen in black-versus-white patients. Conversely, when implemented, the type of augmentation used, either kypho- or vertebroplasty, was quite similar among racial groups. Despite the large sample size in our study, there is significant under-representation of patients who were not white as black patients composed only 2.7%, Hispanic patients composed 4.1%, and Asian/Pacific Islander patients composed 1.9% of the sample size. The reason for this difference is unclear and may be multifactorial, including lower fracture rates for black, Hispanic, and Asian women compared with white women and disparities in osteoporosis treatment in these minority groups.

Similar to race, the insurance provider also had a profound impact on the use of spine augmentation, with patients with Medicare and private insurance having augmentation at markedly higher rates than either patients with Medicaid or those who self-paid. In our multivariate analysis, the differences noted above were as great or greater than those in the univariate analyses. Overall, these findings suggest that significant health insurance status disparities exist in the use of spine augmentation procedures, findings consistent with the already reported disparities in access to health care by minorities and the uninsured.

These current findings are potentially clinically relevant because prior studies have shown that patients receiving spine augmentation procedures demonstrate improved survival and quality of life compared with patients receiving nonoperative treatment. In a study of the 2006 Medicare Provider Analysis and Review File data base, Chen et al demonstrated that patients who underwent vertebroplasty and kyphoplasty had significantly higher 3-year survival rates compared with patients receiving nonoperative management. The Fracture Reduction Evaluation study, which randomized patients into balloon kyphoplasty and nonsurgical management, demonstrated that kyphoplasty was associated with improved quality of life.

While this study was not designed to determine the specific causes behind racial and insurance-based disparities, we believe that the causes of such disparities are multiple, including but not limited to physician bias, access to care, patient preferences, and communication barriers. While high costs of spine augmentation procedures could contribute to the lower rates of spine augmentation in some groups, our subgroup analysis of patients with Medicare demonstrated that racial minorities still had lower rates of spine augmentation despite having the same type of insurance as their white counterparts. Racial disparities in the care of patients with osteoporosis have been previously identified. In a study of patients with Medicare and osteoporotic fractures, Liu et al demonstrated that black patients were significantly less likely to receive both postfracture and postfracture care compared with white patients. Yoo et al demonstrated significant racial disparities in osteoporosis drug maintenance therapy between black and white patients, especially among patients with Medicare, among whom supplementary health insurance was not affordable.

Insurance-based disparities in spine augmentation use may, at least in part, be explained by costs. In general, Medicare provides higher reimbursement rates for all medical services compared with Medicaid. In 2013, the Medicaid-to-Medicare fee index was 0.66 across the entire United States. The inability of patients who self-pay and those with Medicaid to pay for the costs associated with spine augmentation could contribute to their lower rate of spine augmentation use overall. Cost differences may also explain our finding that patients with Medicaid and those who self-pay had significantly lower usage rates of kyphoplasty compared with patients who were privately insured, because kyphoplasty has been reported to cost between 2 and 20 times more than vertebroplasty. It is unclear to us as to why patients who were privately insured used spine augmentation less than those with Medicare in our study; one theory may be that there are preauthorization barriers that discourage the use of spine augmentation in this population.

Several prior studies have demonstrated disparities in the surgical treatment of back pain. Carey et al demonstrated that hospitalization and surgery rates were significantly lower in black patients with chronic back pain. In a study of the Nationwide Inpatient Sample, Alish et al found that racial minorities were significantly less likely to receive cervical spine surgery for the treatment of degenerative cervical spine disease. The Alish et al study also demonstrated that patients with Medicaid were significantly less likely to receive surgery compared with those with private insurance. In a study of Workers’ Compensation claims in Missouri, Chibnall et al found that white patients were significantly more likely to receive a diagnosis of a herniated disk and

### Table 5: Multivariate analysis

| Race               | Odds of Spine Augmentation | Odds of Kyphoplasty |
|--------------------|---------------------------|---------------------|
|                    | OR (95% CI) | P    | OR (95% CI) | P    |
| White              | Ref | Ref | Ref | Ref |
| Black              | 0.46 (0.43–0.49) | <.001 | 0.90 (0.79–1.02) | .11 |
| Hispanic           | 0.83 (0.79–0.99) | <.001 | 0.76 (0.70–0.82) | <.001 |
| Asian/Pacific Islander | 0.89 (0.84–0.96) | .002 | 0.93 (0.84–1.04) | .23 |
| **Insurance status** |         |     |         |     |
| Medicare           | Ref | Ref | Ref | Ref |
| Private            | 0.77 (0.75–0.80) | <.001 | 0.85 (0.80–0.89) | <.001 |
| Medicaid           | 0.50 (0.47–0.53) | <.001 | 0.53 (0.48–0.59) | <.001 |
| Self-Pay           | 0.41 (0.37–0.56) | <.001 | 0.35 (0.29–0.42) | <.001 |

Note: —Ref indicates reference.

* Only patients receiving spine augmentation were included in this analysis.
that among those with such a diagnosis, whites were significantly more likely to undergo surgery compared with black patients. These studies further support our findings that minorities and the underinsured are treated differently for spine disease.

There are several limitations to our study. Our use of broad racial designations (white, black, Hispanic, Asian/Pacific Islander) in an effort to maintain consistency within the NIS data base may have limited our sample population because some racial groups are heterogeneous. Despite our ability to demonstrate usage disparities, we did not analyze outcome data for these procedures and cannot comment on morbidity or postoperative functional status across groups. Our study only examined disparities among inpatients diagnosed with osteoporotic vertebral fractures. However, a prior study of Medicare enrollees found that only 40% of vertebroplasties between 2001 and 2005 were performed as inpatient procedures. In addition, while the NIS is a large inpatient data base, it does not include federally funded health care facilities. It is unclear to us as to why privately insured patients used spine augmentation less than Medicare patients in our study; one theory may be that there are preauthorization barriers that discourage the use of spine augmentation in this population. As with any analysis of a large data base, errors in coding are also a potential limitation, though error rates are likely similar between racial and insurance groups. Finally, given the very large size of the data base, numerous comparisons reach statistical significance yet have a very small, absolute difference; we have attempted throughout the article to highlight differences that may be clinically relevant.

CONCLUSIONS
Our study demonstrated significant racial and health insurance-based disparities in the use of spine augmentation for the treatment of osteoporotic vertebral fractures. Significantly more white patients received spine augmentation compared with black, Hispanic, and Asian/Pacific Islander patients and significantly more patients with Medicare received spine augmentation compared with those with Medicaid and those who self-pay. While our findings echo many of the already reported disparities in surgical care, further research is needed to explain the underlying cause.

Disclosures: Harry Cloft—UNRELATED: Grants/Grants Pending. Site Principal Investigator at the enrolling site for the Stenting and Angioplasty with Protection in Acute coronary syndromes. Jennifer S. McDonald—UNRELATED: preclinical and clinical research, University of Virginia Patent Foundation, SurModics*, MicroVention*, Benvenue Medical*, ev3/Covidien*, Codman*, Sequent Medical*, GE Healthcare*, grants, grants pending: University of Minnesota, University of Washington, University of Wisconsin, University of Arizona, University of California, Emory University, University of Texas, University of Miami. Comments: planning and implementation of clinical trials, comments: spine fusion. Money paid to the institution.

REFERENCES
1. Leake CB, Brinjikji W, Cloft HJ, et al. Trends in inpatient spine augmentation: 2001–08. AJNR Am J Neuroradiol 2011;32:1464–68
2. Romano PS, Campa DR, Rainwater JA. Elective cervical discectomy in California: postoperative in-hospital complications and their risk factors. Spine (Phila Pa 1976) 1997;22:267–92
3. Chan AK, McGovern RA, Brown LT, et al. Disparities in access to deep brain stimulation surgery for Parkinson disease: interaction between African American race and Medicaid use. JAMA Neurol 2014;71:291–99
4. Durazzo TS, Frencher S, Gusberg R. Influence of race on the management of lower extremity ischemia: revascularization vs amputation. JAMA Surg 2013;148:617–23
5. Brinjikji W, Rabinstein AA, Lanzino G, et al. Racial and ethnic disparities in the treatment of unruptured intracranial aneurysms: a study of the Nationwide Inpatient Sample 2001–2009. Stroke 2012;43:3200–06
6. HCUP Nationwide Inpatient Sample (NIS). Healthcare Cost and Utilization Project (HCUP). 2005–2010. Rockville: Agency for Healthcare Research and Quality. Published 2011. http://www.hcup-us.ahrq.gov/nisoverview.jsp. Accessed October 26, 2013
7. Charlson ME, Pompei P, Ales KL, et al. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis 1987;40:537–83
8. Cauley JA, Wu L, Wampler NS, et al. Clinical risk factors for fractures in multi-ethnic women: the Women’s Health Initiative. J Bone Miner Res 2007;22:1816–26
9. Cauley JA. Defining ethnic and racial differences in osteoporosis and fragility fractures. Clin Orthop Relat Res 2011;469:1891–99
10. Hughes K, Seetalah S, Oyetunji T, et al. Racial/ethnic disparities in amputation and revascularization: a Nationwide Inpatient Sample study. Vasc Endovascular Surg 2013;48:34–37
11. Brinjikji W, Rabinstein AA, McDonald JS, et al. Socioeconomic disparities in the utilization of mechanical thrombectomy for acute ischemic stroke in US hospitals. AJNR Am J Neuroradiol 2014;35:553–56
12. DeNavas-Walt C, Proctor BD, Smith JC. Income, poverty, and health insurance coverage in the United States: 2011. Issued September 2012. http://www.census.gov/prod/2012pubs/p60-243.pdf. Accessed October 26, 2013
13. Agency for Healthcare Research and Quality. National healthcare quality and disparities reports. http://www.ahrq.gov/research/findings/nhqrdr. Accessed October 26, 2013
14. The Henry J. Kaiser Family Foundation. Racial and ethnic disparities in access to health insurance and health care. July 30, 2000. http://kff.org/disparities-policy/fact-sheet/racial-and-ethnic-disparities-in-access-to. Accessed October 26, 2013
15. Escarce JJ. Racial and ethnic disparities in access to and quality of health care. Research Synthesis Report No 12. Robert Wood Johnson Foundation. September 2007. http://www.cahpf.org/GoDocUserFiles/446.RWJF_Research_Report_11.7.07.pdf. Accessed October 26, 2013
16. Chen AT, Cohen DB, Skolasky RL. Impact of nonoperative treatment, vertebroplasty, and kyphoplasty on survival and morbidity after vertebral compression fracture in the Medicare population. J Bone Joint Surg Am 2013;95:1729–36
17. Van Meirhaeghe J, Bastian L, Boonen S, et al. A randomized trial of balloon kyphoplasty and non-surgical management for treating acute vertebral compression fractures: vertebral body kyphosis correction and surgical parameters. Spine (Phila Pa 1976) 2013;38:971–83
18. Stepanikova I, Cook KS. Effects of poverty and lack of insurance on perceptions of racial and ethnic bias in health care. Health Serv Res 2008;43:915–30
19. Green AR, Carney DR, Pallin DJ, et al. Implicit bias among physicians and its prediction of thrombolysis decisions for black and white patients. J Gen Intern Med 2007;22:1231–38
20. Evans K, Coresh J, Bash LD, et al. Race differences in access to health care and disparities in incident chronic kidney disease in the US. Nephrol Dial Transplant 2011;26:899–908
21. Whittle J, Conigliaro J, Good CB, et al. Do patient preferences contribute to racial differences in cardiovascular procedure use? J Gen Intern Med 1997;12:267–73
22. Saha S, Arbelaez JJ, Cooper LA. Patient-physician relationships and racial disparities in the quality of health care. Am J Public Health 2003;93:1713–19
23. Morales LS, Cunningham WE, Brown JA, et al. Are Latinos less satisfied with communication by health care providers? J Gen Intern Med 1999;14:409–17
24. Liu SK, Munson JC, Bell JE, et al. Quality of osteoporosis care of older Medicare recipients with fragility fractures: 2006 to 2010. *J Am Geriatr Soc* 2013;61:1855–62

25. Yoo JW, Kim S, Kim SJ, et al. Effects of health insurance on racial disparity in osteoporosis medication adherence. *J Am Pharm Assoc* (2003) 2013;53:626–31

26. The Henry J. Kaiser Family Foundation. How much will Medicaid physician fees for primary care rise in 2013? Evidence from a 2012 survey of Medicaid physician fees. December 13, 2013. http://kff.org/medicaid/issue-brief/how-much-will-medicaid-physician-fees-for/. Accessed October 26, 2013

27. Mathis JM, Ortiz AO, Zoarski GH. Vertebroplasty versus kyphoplasty: a comparison and contrast. *AJNR Am J Neuroradiol* 2004;25:840–45

28. Gray DT, Hollingworth W, Onwudiwe N, et al. Costs and state-specific rates of thoracic and lumbar vertebroplasty, 2001–2005. *Spine (Phila Pa 1976)* 2008;33:1905–12

29. Carry TS, Garrett JM, et al. The relation of race to outcomes and the use of health care services for acute low back pain. *Spine* 2003;28:390–94

30. Alosh H, Riley LH, 3rd, Skolasky RL. Insurance status, geography, race, and ethnicity as predictors of anterior cervical spine surgery rates and in-hospital mortality: an examination of United States trends from 1992 to 2005. *Spine (Phila Pa 1976)* 2009;34:1956–62

31. Chibnall JT, Tait RC, Andresen EM, et al. Race differences in diagnosis and surgery for occupational low back injuries. *Spine (Phila Pa 1976)* 2006;31:1272–75

32. Hertzer NR. The Nationwide Inpatient Sample may contain inaccurate data for carotid endarterectomy and carotid stenting. *J Vasc Surg* 2012;55:263–66