SPOTLIGHT ON trauma

Cost-effectiveness of Teaching Hospitals for the Operative Management of Hip Fractures

KEVIN J. MCGUIRE, MD, MS; ARON T. CHACKO, BS; JOSEPH BERNSTEIN, MD, MS

abstract

Full article available online at ORTHOSuperSite.com. Search: 20110826-17

Hospitals with lower costs are not necessarily superior to those that are more expensive, because the more costly institutions might offer better outcomes. The purpose of this study was to consider prices and outcomes in an integrated model and thereby determine if teaching hospitals are cost-effective for the care of hip fractures. We analyzed the claims data of a sample of 18,908 Medicare patients who were admitted to one of 190 acute care hospitals for surgical treatment of a hip fracture. For each hospital, we assessed the relationship between the total per capita Medicare payments over a 6-month period following admission and the 30-day and 6-month mortality. The data were analyzed as a function of hospital type: teaching vs nonteaching. The mean adjusted costs were $5910 per patient higher at teaching hospitals compared to nonteaching hospitals (approximately $24,000 vs $18,000) However, the adjusted 6-month mortality was 1.4% lower at major teaching hospitals. The adjusted incremental cost-effectiveness for teaching hospitals was $422,143 per life saved. By that measure, each life saved would have to yield nearly 8.5 additional quality-adjusted life years (QALY) to attain the $50,000/QALY standard thought to represent cost-effective spending, an unlikely target given the age of the typical hip fracture patient. Nonetheless, because teaching hospitals are more expensive than non-teaching hospitals, a relatively small cut in the overall cost of care at teaching hospitals could dramatically decrease the marginal cost of each life saved. The elements of teaching hospital care that improve survival might be identified in further studies and instituted, perhaps, at non-teaching hospitals without greatly increasing their cost structure.

Dr McGuire and Mr Chacko are from Beth Israel Deaconess Medical Center, Spine Center, Boston, Massachusetts; and Dr Bernstein is from Philadephia Veterans Hospital, the University of Pennsylvania School of Medicine, and the Center for Outcomes Research, Philadelphia, Pennsylvania.

Dr McGuire has received funding from the Orthopedic Research and Education Foundation Resident Award; and Dr Bernstein received the OREF/Zimmer Surgical Career Development Award. Mr Chacko has no relevant financial relationships to disclose.

The views expressed herein are those of the authors and not of the Veterans Hospital.

Correspondence should be addressed to: Joseph Bernstein, MD, Department of Orthopaedic Surgery, Veterans Hospital, Philadelphia, PA 19104 (orthodoc@uphs.upenn.edu).

doi: 10.3928/01477447-20110826-17

Teaching hospitals typically provide better outcomes compared to non-teaching hospitals[1-5] but at a higher cost.[1,3,6,7] It can be asked, then, if the relatively higher quality of care offered by teaching hospitals justifies its higher price. To begin to answer that question, one can measure the incremental cost-effectiveness ratio[8-10] of the 2 types of institutions: namely, the ratio of the marginally increased costs compared to measures of augmented effectiveness. This ratio informs the analyst how much benefit is delivered for a given cost.

In this study, we determined the incremental cost-effectiveness ratio for geriatric hip fracture care at teaching hospitals vs non-teaching hospitals. We calculated the difference in the costs at the 2 types of hospitals and assessed the differences in the mortality rate. Our working assumption was that teaching hospitals would be more effective yet more expensive. The purpose of this study was to measure this effect and determine the dollar cost of saving a life. Only by explicitly articulating the parameters of comparative effectiveness and delineating what is bought with each dollar spent can policy makers begin to address the question of which venue is preferable.

Materials and Methods

A retrospective cohort was studied, based on a Medicare database spanning a 21-month period for the state of Pennsylvania. The database contained all index admissions for patients who were at least 65 years of age who sustained a closed fracture of the hip and underwent surgical treatment. Costs were calculated as the total payments made on behalf of the patients by Medicare from the date of admission to 6 months after the date of admission, excluding acute rehabilitation care. Thirty-day and 6-month mortality were recorded, with severity adjustments made based on an established model for surgical patients.[11,12] The incremental cost-effectiveness ratio was then calculated as the difference in the costs divided by the difference in the mortality rate by hospital type.

The data were drawn from The Medicare Inpatient 100% Standard Analytic File; Medicare Physician/Supplier Part B; the Pennsylvania Health Care Cost Containment Council (PHC-4) database (which includes the MedisGroups severity score on admission)[13-17]; and the Vital Statistics File. Approval was obtained from our institutional review board as well as the Medicare administrator.

We identified all patients with either a closed transcervical, intertrochanteric, subtrochanteric, or unspecified neck of femur fracture using specific International Classification of Diseases Codes, 9th Revision, Clinical Modification.[18] The diagnostic codes used excluded pathologic fractures, open fractures, and patients who sustained multiple traumas. Only patients aged 65 years or older undergoing surgical stabilization of the fracture whose costs were recorded were included.[6,19]

The severity of a given patient's overall medical condition was calculated, taking into account the presence of concomitant medical conditions.[11,12,20] In determining whether a concomitant medical condition was a comorbidity (ie, a condition that antedated the fracture) or a complication (ie, one that appeared during the index admission), the Medicare database was examined for a period of 60 days prior to the index admission. Conditions noted during the fracture admission that were not present during the 60-day review were considered to be postoperative complications and therefore not included in the severity adjustment.[12]

All general acute care hospitals that treated >10 study-eligible hip fractures during the study period[6] were included. Hospitals without residency programs were classified as non-teaching hospitals, while those with residency programs were designated teaching hospitals. The latter group was further split, with those holding membership in the Council of Teaching Hospitals labeled as major teaching hospitals, following the taxonomy suggested in prior studies.[6]

The primary outcomes studied were total costs over a 6-month period, as well as 30-day and 6-month mortality rates.[21,22] From these data, the incremental cost-effectiveness ratio[10] was then calculated by hospital type.

Results

Hospital Attributes

In this study, 190 hospitals met the inclusion criteria and were distributed as follows: 12% were major teaching, 18% were minor teaching, and 70% were non-teaching hospitals. The major teaching hospitals, in general, were classified as Level I trauma centers, had a magnetic resonance imaging (MRI) machine on site, and offered a transplant program. These hospitals had >200 beds and a nurse-to-bed ratio of 2.

Patient Attributes

There were 18,908 patients who met the criteria for inclusion in this study: 15% were admitted to major teaching hospitals, 27% to minor teaching hospitals, and 57% to non-teaching hospitals. Average patient age was 82.4 years, and 79% of patients were women. Forty-nine percent sustained an intertrochanteric fracture of the hip and 56% underwent an open reduction internal fixation of the fracture. Comorbidities were common: 48% of patients had hypertension, 19% had congestive heart failure, 19% had chronic pulmonary obstructive disease, and 17% had diabetes.

Costs

The mean cost totaled $19,553 per patient. Major teaching hospitals had the highest mean cost per patient ($24,209), compared to $19,889 for minor teaching hospitals and $18,105 for non-teaching hospitals (Table 1).

Even after adjusting for patient severity, major teaching hospitals remained

Table 1

Unadjusted Outcomes by Hospital Type

Outcome	All Hospitals	Major Teaching Hospitals	Minor Teaching Hospitals	Non-Teaching Hospitals
Overall cost, $/patient	19,553	24,209 (<.001)[a]	19,889 (<.001)[b]	18,105
30-day mortality rate	6.8	6.75 (.73)[a]	6.56 (.38)[b]	6.93
6-month mortality rate	18	17.26 (.26)[a]	17.95 (.75)[b]	18.2

[a] *P value comparing outcome for major teaching vs non-teaching hospitals.*
[b] *P value comparing outcome for minor teaching vs non-teaching hospitals.*

Table 2

Outcome Differences: Major Teaching Hospitals vs Non-teaching Hospitals

	Unadjusted (*P*)	Unadjusted for Severity (*P*)
Mean difference in costs, $	6104 (<.001)	5910 (<.001)
Absolute difference in 6-month mortality rate, %	.94	1.4 (.067)
Incremental cost-effectiveness ratio, $	649,362	422,143

Table 3

Outcome Differences: Minor Teaching Hospitals vs Non-teaching Hospitals

	Unadjusted (*P*)	Unadjusted for severity (*P*)
Mean difference in costs, $	1,783 (<.001)	1,913 (<.001)
Absolute difference in 6-month mortality rate, %	.25	.07 (.234)
Incremental cost-effectiveness ratio, $	713,200	273,286

the most costly per patient. The adjusted mean difference in costs for major teaching compared to non-teaching hospitals was $5,910. The severity-adjusted costs at minor teaching hospitals were $1,913 per patient higher than at non-teaching hospitals ($P<.001$) (Table 2).

Effectiveness

The 30-day and 6-month mortality for the entire sample was 6.8% and 18%, respectively, consistent with previous studies.[19,23] Major teaching hospitals had the lowest adjusted and unadjusted mortality rates. The adjusted 6-month mortality rate for major teaching hospitals was 17% compared to 18.4% for non-teaching hospitals, an absolute difference of 1.4%.

Incremental Cost-effectiveness Ratio

The unadjusted incremental cost-effectiveness ratio of major teaching vs non-teaching hospitals was $649,362 per life saved. The incremental cost-effectiveness ratio adjusted for patient severity was $422,143 per life saved. The unadjusted incremental cost-effectiveness ratio comparing minor teaching to non-teaching hospitals was $713,200 per life saved. The severity-adjusted value was $273,286 (Table 3).

Discussion

In the present study, teaching hospitals were shown to have a lower mortality rate for geriatric hip fractures than non-teaching hospitals, yet were also shown to be more expensive: their average costs were approximately one-third higher than those of non-teaching hospitals. This finding is particularly germane to the current health care reform debate. The American Recovery and Reinvestment Act of 2009 provided funds for studies comparing the effectiveness of different treatments for a given illness, so-called comparative-effectiveness research.[24] Although the typical goal of such work is to find the most effective method of treatment, comparative effectiveness data such as that reported here might likewise help find the most effective venue for treatment.

The findings reported here echo those of Taylor et al,[6] who studied the cost-effectiveness of teaching hospitals for the care of hip fractures, coronary artery disease, and congestive heart failure. That study also found that the mortality rate for patients with hip fractures was lower at major teaching hospitals compared to for-profit non-teaching hospitals, but did not compute a cost-effectiveness ratio.

A major limitation of the present study is the choice of quality metric: namely mortality. Preventing death is not the only metric of quality, and perhaps not the best one for hip fractures. Specifically, 1 of the great consequences to be feared after hip fracture is the loss of mobility and function, and patients may value functionality over some risk of mortality. The routine willingness of patients to submit to total hip replacement, which brings with it a measurable risk of death, testifies to the fact that some potential gains in mobility and function can balance mortality risks. A complete measure of quality would include measures of functional outcomes. The data here allow no inferences to be drawn regarding functionality, as it was not measured.

An emphasis on the lower mortality rates of teaching hospitals does not tell the whole story. That lower mortality rate cost approximately $425,000 to save 1 additional life. If one applies the standard that spending up to $50,000 to generate 1 additional, worthwhile quality-adjusted life year, the spending levels found here are justified only if the average patient saved by teaching hospital care enjoys an additional 8.5 full quality years of life. Given the age of geriatric patients with hip fractures and the prevalence of comorbidities, such outcomes are unlikely.

Accordingly, it is perhaps worthwhile to discern which features of teaching hospitals could be exported to non-teaching hospitals without disturbing the latter's lower cost structure. It remains unanswered if that is possible. Although multiple factors were included in the study pertaining to hospital attributes, 1 possible explanation for our finding of lower mortality at teaching hospitals is that teaching hospitals are more likely to offer full services 7 days a week, and doctors at teaching hospitals can operate expeditiously. This is most likely not an inherent feature of teaching, but rather of staffing and size. Because surgical delays might increase mortality,[25] a hospital that is fully operational Saturdays and Sundays is less likely to arbitrarily delay surgery for patients who present on the weekend, and in turn spare these patients from the hazards such delays impose. However, it may be the case that non-teaching hospitals are able to deliver care at a lower cost precisely because they do not offer full services every day of the week. If so, non-teaching hospitals cannot copy the method of the teaching hospitals without copying their cost structures as well.

Overall, our data demonstrate that teaching hospitals provide lower mortality rates for geriatric hip fracture but at a greater cost. The reason for this disparity is unknown, but our work suggests that further investigation to discover the reasons would be worthwhile. The goal of such work would be to amalgamate the best aspects of teaching hospitals and non-teaching hospitals: the highest possible quality at the lowest possible cost.

REFERENCES

1. Garber AM, Fuchs VR, Silverman JF. Case mix, costs, and outcomes. Differences between faculty and community services in a university hospital. *N Engl J Med*. 1984; 310(19):1231-1237.
2. Hartz AJ, Krakauer H, Kuhn EM, et al. Hospital characteristics and mortality rates. *N Engl J Med*. 1989; 321(25):1720-1725.
3. Iezzoni LI, Shwartz M, Moskowitz MA, Ash AS, Sawitz E, Burnside S. Illness severity and costs of admissions at teaching and non-teaching hospitals. *JAMA*. 1990; 264(11):1426-1431.
4. Keeler EB, Rubenstein LV, Kahn KL, et al. Hospital characteristics and quality of care. *JAMA*. 1992; 268(13):1709-1714.
5. Kuhn EM, Hartz AJ, Krakauer H, Bailey RC, Rimm AA. The relationship of hospital ownership and teaching status to 30- and 180-day adjusted mortality rates. *Med Care*. 1994; 32(11):1098-1108.
6. Taylor DH, Jr, Whellan DJ, Sloan FA. Effects of admission to a teaching hospital on the cost and quality of care for Medicare beneficiaries. *N Engl J Med*. 1999; 340(4):293-299.
7. Zimmerman JE, Shortell SM, Knaus WA, et al. Value and cost of teaching hospitals: a prospective, multicenter, inception cohort study. *Crit Care Med*. 1993; 21(10):1432-1442.
8. Bozic KJ, Rosenberg AG, Huckman RS, Herndon JH. Economic evaluation in orthopaedics. *J Bone Joint Surg Am*. 2003; 85(1):129-142.
9. Drummond MF, Sculpher MJ, Torrance GW, Stoddart GL. *Methods for the Economic Evaluation of Health Care Programmes*. 3rd ed. Oxford, NY: Oxford University Press; 2005.
10. Gold MR, Siegel JE, Russell LB, Weinstein MC. *Cost-effectiveness in Health and Medicine.* Oxford, NY: Oxford University Press; 1996.
11. Aiken LH, Clarke SP, Sloane DM, Sochalski J, Silber JH. Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *JAMA*. 2002; 288(16):1987-1993.
12. Silber JH, Kennedy SK, Even-Shoshan O, et al. Anesthesiologist direction and patient outcomes. *Anesthesiology*. 2000; 93(1):152-163.
13. Brewster AC, Karlin BG, Hyde LA, Jacobs CM, Bradbury RC, Chae YM. MEDISGRPS: a clinically based approach to classifying hospital patients at admission. *Inquiry*. 1985; 22(4):377-387.
14. Silber JH, Rosenbaum PR. A spurious correlation between hospital mortality and complication rates: the importance of severity adjustment. *Med Care*. 1997; 35(10 suppl):OS77-92.
15. Steen PM, Brewster AC, Bradbury RC, Estabrook E, Young JA. Predicted probabilities of hospital death as a measure of admission severity of illness. *Inquiry*. 1993; 30(2):128-141.
16. Silber JH, Rosenbaum PR, Williams SV, Ross RN, Schwartz JS. The relationship between choice of outcome measure and hospital rank in general surgical procedures: implications for quality assessment. *Int J Qual Health Care*. 1997; 9(3):193-200.
17. Silber JH, Williams SV, Krakauer H, Schwartz JS. Hospital and patient characteristics associated with death after surgery. A study of adverse occurrence and failure to rescue. *Med Care*. 1992; 30(7):615-629.
18. American Medical Association. *ICD-9-CM, 1996: International Classification of Diseases, 9th Revision, Clinical Modification*. Vol 1, 2. Dover, DE: American Medical Association; 1995.
19. HCIA Inc, Ernst & Young LLP. *DRG Handbook: Comparative Clinical and Financial Standards.* Baltimore, MD; 1995.
20. Silber JH, Kennedy SK, Even-Shoshan O, et al. Anesthesiologist board certification and patient outcomes. *Anesthesiology*. 2002; 96(5):1044-1052.
21. Chassin MR, Park RE, Lohr KN, Keesey J, Brook RH. Differences among hospitals in Medicare patient mortality. *Health Serv Res*. 1989; 24(1):1-31.
22. Landon B, Iezzoni LI, Ash AS, et al. Judging hospitals by severity-adjusted mortality rates: the case of CABG surgery. *Inquiry*. 1996; 33(2):155-166.
23. Dartmouth Medical School. Center for the Evaluative Clinical Sciences. *The Dartmouth Atlas of Health Care 1998*. Chicago, IL: American Hospital Publishing; 1998.
24. Pear R. U.S. to Compare Medical Treatments. *The New York Times*. Feb 16, 2009:A1.
25. McGuire KJ, Bernstein J, Polsky D, Silber JH. The 2004 Marshall Urist award: delays until surgery after hip fracture increases mortality. *Clin Orthop Relat Res*. 2004; (428):294-301.