

# Economic Viability of Geriatric Hip Fracture Centers

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## abstract

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Management of geriatric hip fractures in a protocol-driven center can improve outcomes and reduce costs. Nonetheless, this approach has not spread as broadly as the effectiveness data would imply. One possible explanation is that operating such a center is not perceived as financially worthwhile. To assess the economic viability of dedicated hip fracture centers, the authors built a financial model to estimate profit as a function of costs, reimbursement, and patient volume in 3 settings: an average US hip fracture program, a highly efficient center, and an academic hospital without a specific hip fracture program. Results were tested with sensitivity analysis. A local market analysis was conducted to assess the feasibility of supporting profitable hip fracture centers. The results demonstrate that hip fracture treatment only becomes profitable when the annual caseload exceeds approximately 72, assuming costs characteristic of a typical US hip fracture program. The threshold of profitability is 49 cases per year for high-efficiency hip fracture centers and 151 for the urban academic hospital under review. The largest determinant of profit is reimbursement, followed by costs and volume. In the authors' home market, 168 hospitals offer hip fracture care, yet 85% fall below the 72-case threshold. Hip fracture centers can be highly profitable through low costs and, especially, high revenues. However, most hospitals likely lose money by offering hip fracture care due to inadequate volume. Thus, both large and small facilities would benefit financially from the consolidation of hip fracture care at dedicated hip fracture centers. Typical US cities have adequate volume to support several such centers.

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**F**ragility fractures of the hip are painful, impairing, and often deadly.<sup>1-6</sup> These fractures also generate great financial costs,<sup>2,4,7-11</sup> and the incidence and expense are only expected to grow as the population continues to age.<sup>12</sup> Indeed, this “fragility fracture epidemic”<sup>13</sup> is predicted to generate costs of \$240 billion by 2040.<sup>7,14,15</sup>

Clinicians, policy experts, and researchers have responded to this looming crisis. Several management innovations have been implemented to improve outcomes and reduce costs.<sup>16</sup> For instance, programs that decrease surgical delays have been shown to improve outcomes<sup>17,18</sup> in a cost-effective manner.<sup>19</sup> Superior clinical results and, in some cases, reduced costs can be obtained by coordinated care of patients with hip fractures through a comanagement model between orthopedic surgeons and other physicians, usually a geriatrician, general internist, or hospitalist.<sup>20-25</sup> Protocol-driven care and use of high-volume centers may also improve outcomes and efficiency in hip fracture care,<sup>26,27</sup> particularly by reducing length of stay and complications, the 2 largest drivers of inpatient costs.<sup>8,28</sup> Protocol-driven care with comanagement of the patient are the fundamentals of what can be called a hip fracture center: namely, a unit in the hospital dedicated to the care of patients with fragility fractures of the hip.

The establishment of coordinated geriatric hip fracture centers has been described most extensively by Kates et al<sup>20,29,30</sup> and Friedman et al.<sup>27,31</sup> Their Rochester model has demonstrated both clinical and cost benefits through the management techniques described above, specifically comanagement and protocol-driven care.<sup>29</sup> Despite this success, the hip fracture center model has not yet spread broadly. One possible reason may be that the investment necessary to develop a hip fracture center is not perceived as financially worthwhile. The question addressed in the current study is whether an economic justification exists for institutions to operate such centers.

## MATERIALS AND METHODS

An economic model to estimate hospital profit as a function of costs, reimbursement, and annual patient volume was built. The model compared 3 values for estimated cost: the costs reported at a typical hip fracture program in the United States; the costs reported by Kates et al<sup>29</sup> (low-cost, high-volume hip fracture center); and the costs found at the current authors' home institution (an urban tertiary care academic center with no formal hip fracture center program). In each scenario, the per-case reimbursement for hip fracture care was defined as the Centers for Medicare & Medicaid Services payment of \$16,467<sup>32</sup>; this number multiplied by the annual volume of patients yields the calculated revenue.

Total costs were calculated as the sum of the fixed costs and variable costs. Fixed costs represent the expense of operating a hip fracture program independent of patient volume, such as salaries for administrators and depreciation of hospital facilities. Variable costs represent the marginal expense of taking care of each additional patient, such as operating room and office supplies, medications, implants, and nursing wages. The total cost of hospital care for the hip fracture center described by Kates et al<sup>29</sup> was \$576,684 in annual fixed costs plus \$4622 per patient in variable costs. The total cost of care for a patient at an average US hip fracture program was \$11,417, as calculated by Kates et al<sup>29</sup> using the Solucient national database and adjusting for patient characteristics. Because the reported data did not apportion this sum into fixed and variable costs, the fixed costs of the average US program were set equal to those reported by Kates et al<sup>29</sup>: \$2988 per patient, with the remainder, \$8429, attributed to variable per-patient costs (on the assumption that the lower costs in the model of Kates et al<sup>29</sup> were the result of decreased variable costs, largely through decreased length of stay). At the current authors' institution, fixed and variable costs were derived

from the retrospective database associated with the Horizon Performance Manager cost accounting software (McKesson Corporation, San Francisco, California) used by the health system. Total hospital costs were \$1.17 million in annual fixed costs allocated to hip fracture care plus \$8705 per patient in variable costs.

Modeling was assessed in a prototypical metropolitan area market with a population of 1 million. Fifty-one metropolitan areas in the United States have at least 1 million residents, comprising approximately 60% of the population.<sup>33</sup> Among these, 34 areas have a population between 1 and 3 million. An incidence rate of 1150 hip fracture patients per 1 million residents was derived by considering the total annual number of hip fractures in the United States (350,000<sup>29</sup>) divided by the country's population (approximately 305,000,000 in 2009<sup>33</sup>).

Consequently, for each of the 3 aforementioned scenarios, profit was modeled over the volume range of 0 to 1150. A 1-way sensitivity analysis was performed for the scenario, simulating the average US hip fracture program with annual volumes chosen to represent 2 hypothetical hip fracture centers: 1 small, but large enough to be profitable (200 patients annually), and 1 very large (1000 patients annually). For each hypothetical hip fracture center, each input variable (fixed cost, variable cost, total cost, revenue, and volume) was increased and decreased by 20%, a relatively standard practice in 1-way sensitivity analysis, and effects on profit were compared.

To consider the current level of regionalization in hip fracture care, a market analysis was performed with reference to the authors' home city. Market share calculations were conducted using the average number of cases managed at each center between fiscal years 2008 and 2010; these data were provided by the finance department at the authors' institution.

All data analyses were performed using Microsoft Excel software (Microsoft,

Redmond, Washington) and an abacus. No external funding was used in this study.

## RESULTS

The 3 modeled scenarios demonstrated similar patterns. Profit for the scenario simulating the average US hip fracture program ranged from a loss of \$568,000, if the annual volume is just 1 case, to a profit of \$8.7 million with a volume of 1150 cases (providing all hip fracture care for a population of 1 million). The model indicated that if costs and reimbursement were assumed to be typical, hip fracture centers become profitable above a volume threshold of 72 cases.

The model found that using the cost data of Kates et al,<sup>29</sup> a hospital performing a single case would lose \$565,000 and performing 1150 cases would generate a profit of \$13.0 million. The threshold of profitability was 49 cases. A hip fracture center that had costs similar to those of the authors' home institution, a large urban teaching hospital, would generate a loss of \$1.16 million if performing only 1 case and would generate a profit of \$7.8 million if performing 1150 cases. The break-even point would be 151 cases (Figure 1).

Sensitivity analysis revealed that changes in reimbursement have the largest direct effect on profitability. At an annual volume of 200 hip fracture cases, a 20% increase in reimbursement results in a 64% rise in profitability. Total cost is the second largest factor in profitability, with a 20% reduction in cost translating into a 44% increase in profitability. The major determinant of total cost is variable cost, which accounts for three-quarters of the total cost change at this volume. A 20% fluctuation in volume also had a major effect on the bottom line, resulting in a 31% change in profitability at an annual volume of 200 cases (Figure 2). To assess very large centers, the same analysis was performed at an annual volume of 1000 hip fractures. Changes in reimbursement remained the largest determinant of profit,

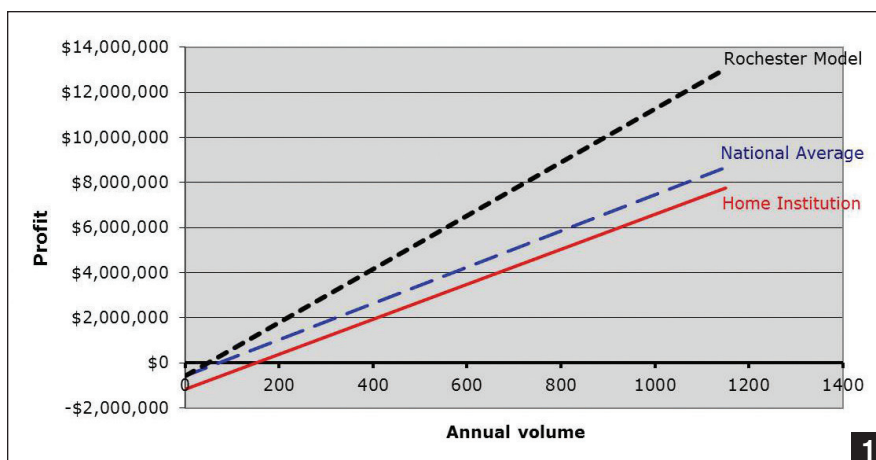


Figure 1: Line graph depicting the profitability of 3 hip fracture programs (the Kates et al<sup>29</sup> model, a program with the average US costs of hip fracture management, and the authors' home institution [a large urban academic center]) as a function of patient volume over a range of 0 to 1150 annual cases.

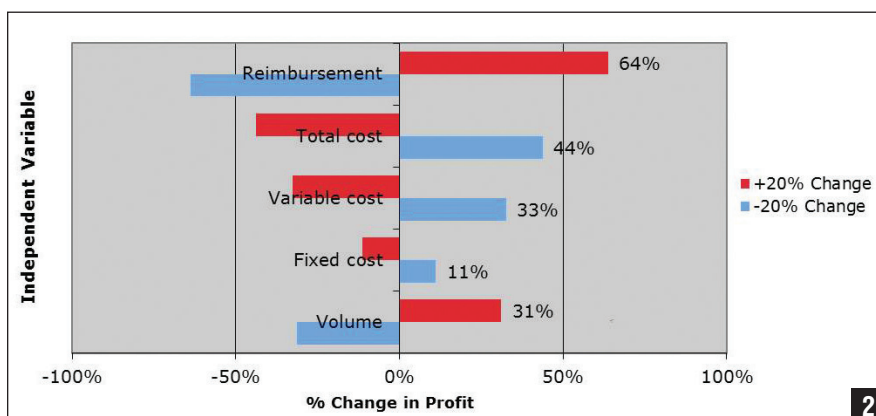
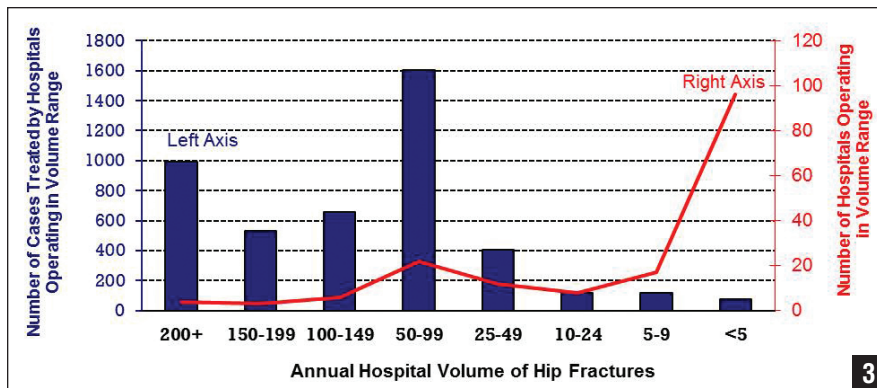


Figure 2: Bar tornado graph depicting 1-way sensitivity analysis of the financial modeling results for profitability of a hip fracture center with average US costs and reimbursement, treating 200 cases per year.

with a 20% increase resulting in a 44% increase in profits. A 20% reduction in total cost would result in a 24% increase in profits, with variable costs accounting for 95% of that change. In addition, at very large centers, the impact of volume changes on profitability surpasses variable costs, with a 20% fluctuation resulting in a 31% change in the bottom line.

Market analysis of the authors' metropolitan area demonstrated that 168 hospitals offer hip fracture care for, on average, 4506 patients per year. Four centers treat more than 200 cases per year; these centers had a total of 991 cases and 22% of

total market share. An additional 3 centers treat 150 to 199 cases per year, accounting for 530 cases and 12% of the market share (Figure 3). One hundred forty-three (85%) local hospitals operate below the volume threshold of 72 annual cases, accounting for 30% of total market share (1335 cases per year); 133 (79%) of these centers fall below the threshold of 49 annual cases, accounting for 720 cases per year and 16% of the market share. One hundred sixty-one (96%) hospitals fall below the threshold of 151 cases per year, having 2984 cases per year and 66% of the market share.



**Figure 3:** Bar graph depicting the current distribution of the hip fracture market in the Philadelphia metropolitan area.

**DISCUSSION**

Fragility fractures are a major health care expense for the country and are apt to increase in cost, primarily as a function of increasing incidence. In response, some hospitals have established hip fracture centers. The current authors examined the economics of hip fracture programs of various types and sizes and found that high-volume centers, especially in the form of dedicated hip fracture centers, can be highly profitable. However, most hospitals providing hip fracture care have low annual volumes and, thus, are likely to lose money. The authors further found that cost-reducing measures, such as those reported by Kates et al,<sup>20,29,30</sup> have a substantial impact on profitability, but changes in reimbursement and volume are also major determinants of profit. These findings have 2 noteworthy implications.

First, most hospitals, whether they manage a large or small volume of hip fractures, have an economic interest in the regionalization of hip fractures. The authors’ modeling suggests that the average US hip fracture program only becomes profitable once annual volume reaches 72 cases. In the authors’ home city, 85% of hospitals operate below the 72-case threshold, suggesting that these centers lose money by offering hip fracture care. From a financial perspective, hospitals would do well to cede their market share

(currently 30%) to larger centers and to distribute the fixed costs of their hip fracture programs to other areas of care. It should be noted that some patients would likely see increased travel times and other inconveniences with this type of consolidation. However, the 72-case threshold of profitability allows any modern metropolitan area to support several profitable regional hip fracture centers, likely enough to minimize any decrease in access to care. This remains true over the range of thresholds seen in this study: from 49 at a low-cost center, such as that described by Kates et al,<sup>20,29</sup> to 151 at a high-resource, high-cost tertiary center like the authors’ institution. Moreover, centers of excellence are regularly established with the understanding that gains in quality and efficiency can be expected with high patient volumes, outweighing any losses in access. Although a correlation between volume and outcomes has not yet been explicitly demonstrated in hip fracture care, volume-outcome relationships are a well-known phenomenon in health care and have been documented in many specialties.<sup>34-36</sup>

Second, financial analyses in the literature on hip fracture centers have primarily focused on cost savings,<sup>29</sup> but the strongest financial incentive for developing a hip fracture center appears to be the potential to increase revenue by expand-

ing volume. In the case of most hospitals, finite capacity exists to decrease costs (a 33% reduction demonstrated by Kates et al<sup>29</sup> seems remarkable), but vast potential exists to grow market share. Moreover, at very large centers, incremental increases in volume are more valuable than incremental reductions in cost. Still, this finding is likely to favor the low-cost, high-efficiency hip fracture centers often described in the literature because hospitals able to demonstrate superior outcomes and refined processes, such as those reported by Kates et al,<sup>29</sup> should be able to position themselves as the local experts in hip fracture care, thus attracting patients away from competing hospitals. (Although reimbursement is the largest determinant of profit, the authors do not discuss changes in reimbursement as a lever for hospitals to raise profit because hospitals currently have little control in this realm due to rates typically being set by Medicare, which has nearly unlimited bargaining power.)

The concept of regionalization of care is not unique to orthopedics. The National Institute on Disability and Rehabilitation Research has recognized 18 model spinal cord injury centers across the United States.<sup>37</sup> Likewise, the American College of Surgeons has established guidelines for the development of trauma centers.<sup>38</sup> The distribution of trauma centers suggests the viability of hip fracture centers. The current authors’ city, with an urban population of 1.5 million people,<sup>33</sup> has 6 level I or II trauma centers.<sup>39</sup> If a similar number of hip fracture centers were established, even if these centers were to capture only 50% of the total market, each could have an adequate case volume to earn a large profit.

This comparison with trauma care also raises the question of whether hip fracture centers should be built on the foundation of trauma centers (ie, comanagement between orthopedic surgeons and general trauma surgeons). Trauma centers began with the recognition that trauma

is a complex disease process best managed by integrated teams of experts who have rapid access to necessary resources and adhere to established best practices.<sup>40</sup> Now, the same argument has been made about patients with geriatric hip fractures.<sup>19,22,24,29,41</sup> By definition, trauma centers have established strong ties to the department of anesthesia and operating room personnel, suggesting that surgical delays may be minimized with this approach. The alternative construct, namely, a hip fracture center relying primarily on the geriatric or general medicine service, may have advantages in that these physicians have focal expertise in the problems besetting the typical hip fracture patient. The current model does not speak to this question, but the relative advantages and disadvantages of these 2 models are worthy of further consideration.

Another important subject not directly addressed here is the startup investment necessary to develop a dedicated hip fracture center. Although the transition is largely managerial (most hospitals already have the physical and human resources necessary to treat hip fractures), real expenditures would be needed in the areas of staff retraining and, ideally, marketing. In Rochester, the transition grew out of 14 years of aggressive management in the form of a “Lean Total Quality Management” initiative.<sup>29</sup> Further reporting on this process and the associated expenses by established hip fracture centers would be a meaningful contribution to the literature.

In addition to institutions’ financial motives, physicians’ motives must also be considered. Surgeons at low-volume hospitals may be resistant to the establishment of dedicated hip fracture centers and the loss of work it implies. Surgeons, even at small centers that lose money on hip fracture care, make a profit for every case they perform. As a result, these surgeons are incentivized to offer hip fracture care, even if the hospital is not. With the advent of bundled payments, through which physicians and

hospitals will be paid 1 lump sum for inpatient care and will be responsible for dividing up the income among themselves, the current incentive structure is expected to change. After physicians and hospitals negotiate and decide on a scheme for sharing income, physicians will presumably share the same incentives as the hospital and will be less motivated to provide hip fracture care at small centers.

This study has 2 notable limitations beyond the general point that economic modeling is, by its nature, an inexact simplification of reality. First, the cost and reimbursement estimates of the typical hip fracture program do not account for variations between hospitals and geographic regions. A well-documented variation exists in health care expenditure across the country,<sup>42</sup> making it impossible to generalize a single cost estimate. In addition, reimbursement levels vary between hospitals based on insurance providers, teaching status, bargaining power, and numerous other factors. However, although this imprecision casts some doubt on the exact profitability thresholds identified in this study, it is unlikely to alter the principal finding that thresholds exist and that hip fracture care is unprofitable for small programs and highly profitable for large centers. Second, the potential exists for imprecision in the breakdown of fixed and variable costs. These figures for the typical US hip fracture program were not known and could only be inferred. Further, even when cost data are reported with precision, there is often some subjectivity to their apportionment into fixed and variable categories. Thus, the elimination of hip fracture care at a hospital may not eliminate all of the fixed costs. For instance, a hospital with 30,000 annual admissions that pays its chief financial officer \$300,000 per year may charge \$10 to each admission to pay this salary; if there were 20,000 admissions, the charge would be \$15. If hip fracture care were eliminated from this hospital, this fixed administrative cost would not disap-

pear. More advanced accounting practices solve this discrepancy by allotting this salary proportionately to each hospital activity the chief financial officer works on. Similarly, the fixed costs used in this model were estimated from centers treating 150 to 200 cases per year and were then applied to both small and large centers. Although fixed costs technically do not change with volume, in reality, certain incremental costs would likely be considered fixed and were not built into the model (eg, when a program grows enough that a new operating room must be built). However, these incremental costs are unlikely to fundamentally alter the study’s findings because they typically only play a major role at very large centers, such as a hip fracture center that must be prepared to run 2 simultaneous operating rooms (a large volume because, while time sensitive, hip fractures do not frequently need to be rushed to surgery immediately).

## CONCLUSION

This study demonstrates the economic potential of large geriatric hip fracture centers. Hospitals able to replicate the quality achievements seen by Kates et al<sup>29-31</sup> may be able to establish themselves as local centers of excellence. They will have significant potential to increase profits by reducing costs and increasing market share. In addition, small centers may be willing to facilitate this expansion by giving up their market share because treating small volumes of hip fractures appears to be an unprofitable yet common undertaking. Moreover, increasing volume may lead to further profitability through increased bargaining power. With the advent of accountable care organizations and bundled payments, the regionalization of hip fracture care may make even more economic sense for institutions. The implications of hip fracture centers for surgeons, especially those operating at low-volume facilities, are not addressed by this analysis but are worthy of future consideration. ■

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