The Cost of an Emergency Department Visit and Its Relationship to Emergency Department Volume

Anil Bamezai, PhD
Glenn Melnick, PhD
Amar Nawathe, MD, MHA

From RAND, Santa Monica, CA (Bamezai, Melnick); and the University of Southern California School of Policy, Planning and Development, Los Angeles, CA (Melnick, Nawathe).

Study objective: This article addresses 2 questions: (1) to what extent do emergency departments (EDs) exhibit economies of scale; and (2) to what extent do publicly available accounting data understate the marginal cost of an outpatient ED visit? Understanding the appropriate role for EDs in the overall health care system is crucially dependent on answers to these questions. The literature on these issues is sparse and somewhat dated and fails to differentiate between trauma and nontrauma hospitals. We believe a careful review of these questions is necessary because several changes (greater managed care penetration, increased price competition, cost of compliance with Emergency Medical Treatment and Active Labor Act regulations, and so on) may have significantly altered ED economics in recent years.

Methods: We use a 2-pronged approach, 1 based on descriptive analyses of publicly available accounting data and 1 based on statistical cost models estimated from a 9-year panel of hospital data, to address the above-mentioned questions.

Results: Neither the descriptive analyses nor the statistical models support the existence of significant scale economies. Furthermore, the marginal cost of outpatient ED visits, even without the emergency physician component, appear quite high—in 1998 dollars, US$295 and US$412 for nontrauma and trauma EDs, respectively. These statistical estimates exceed the accounting estimates of per-visit costs by a factor of roughly 2.

Conclusion: Our findings suggest that the marginal cost of an outpatient ED visit is higher than is generally believed. Hospitals thus need to carefully review how EDs fit within their overall operations and cost structure and may need to pay special attention to policies and procedures that guide the delivery of nonurgent care through the ED. [Ann Emerg Med. 2005;45:483-490.]

0196-0644/$-see front matter

doi:10.1016/j.annemergmed.2004.08.029

SEE EDITORIALS, P. 491, 493, AND 495.

INTRODUCTION

Background

Health care costs in the United States are once again increasing at double-digit rates,[1,2] increasing pressure on all areas of the health care system to become more cost-efficient. Several studies have suggested that hospital emergency departments (EDs) are a potential source of cost inefficiency within our health care system.[3-5] Between 1992 and 2001, ED visits in the United States increased by 17.7 million, reaching an annual high of 107.5 million at the end of the period.[6,7] Some argue, although not all agree, that a significant percentage of patients currently treated in EDs could in fact be treated in physicians' offices with no reduction in quality or outcomes.[8-12] This better sorting of patients between physicians' offices and hospital EDs, it is argued, would result in significantly lower ED costs and, thus, cost savings to the health care system overall.

Although most agree that EDs practice a resource-intensive style of medicine, given the mission before them, quantifying likely gains from improved ED demand management remains a difficult problem. It is an oft-held opinion that improved demand management may not produce large gains in the real world, according to the argument that average costs of treating ED outpatients overstates marginal costs, implying in turn that EDs enjoy significant scale economies. Economies of scale refers to the relationship between ED volume and the average cost of treating patients in the ED. If marginal costs are below average costs, then average cost per visit ought to decline across EDs with larger and larger visit volumes. Although results from 2 previous studies support the existence of scale economies in ED operations,[13,14] they are constrained by a number of

Editor's Capsule Summary

What is already known on this topic

With health care costs increasing in the United States, some studies have suggested that hospital emergency departments (EDs) are a potential source of cost inefficiency within our health care system. Others have argued that the average costs of treating ED outpatients overstates marginal costs, implying that EDs enjoy significant scale economies.

What question this study addressed

This study attempts to determine whether EDs exhibit economies of scale and whether publicly available accounting data understate the marginal cost of an outpatient ED visit.

What this study adds to our knowledge

Neither descriptive analyses of publicly available accounting data from California hospitals nor statistical cost models support the existence of significant scale economies in this analysis. The marginal cost of an outpatient ED visit appears to be higher than previously proposed.

How this might change clinical practice

Hospital administrators need to improve cost measurement and management. Payers need to consider whether the prices they set properly compensate hospitals for their ED services.

methodologic problems (eg, small samples, only a single year of data) that do not plague our study.

Now, all productive enterprises deploy some inputs that are lumpy in nature. By "lumpy" we mean inputs, such as plant and equipment, that one may not be able to procure at exactly the right scale to match a desired level of output. A portion of labor inputs might also fall into this lumpy category, especially if the overall operation is small, although generally speaking, labor and other inputs can be considered much more fungible. Until these lumpy inputs are fully used, marginal cost for any given enterprise will remain below its average cost. The key question is, at what output threshold are these lumpy inputs fully used? If relatively low—as would be the case when plant and equipment costs are a small proportion of total costs—most enterprises will choose an output level greater than this threshold, and a comparison across enterprises will show no significant difference in average costs. Such a pattern would indicate that most enterprises are operating within a realm in which marginal costs are no longer below average costs.

The concept of marginal cost also perhaps needs clarification. Some have asserted that because on any given day the ED is already fully staffed, marginal cost of treating an extra visitor is quite close to zero. Examining the issue in this way does not strike us as very meaningful. The real question is, of total expenses what proportion is easily varied, and over what time? Take the example of a grocery store. If on a given day grocery store shelves are already stocked with merchandise, can one seriously argue that the marginal cost of supplying shoppers on that day is almost zero? We think not, for a simple reason: a large portion of a grocery store's costs are variable. The shelves are stocked with merchandise on the basis of projected demand. If demand were expected to double the following year, one would not stock for that eventuality this year but would plan to increase shelving inventory the following year. Total costs would closely scale output over time, implying that marginal costs are quite close to average costs. This is unlike, say, building an electricity transmission network, where it might indeed be cheaper to build a level of capacity today in the full knowledge and expectation that demand for that capacity will not materialize for several years. Applying these analogies to an ED, clearly one would want to size the building that houses an ED so that it can meet current and projected demand. What one does not need to do, however, is staff ED beds today on the basis of expected demand, say, 2 years hence. If most ED costs are staff related (presumably more easily adjusted than the cost of plant and equipment) and the overall operation is well managed, one would expect costs and outputs to closely scale together.

Because in this study we are working with annual data, it is essentially the year-over-year variation in hospital costs relative to output that drives our estimate of marginal cost. Time frame matters, and for studying the scalability of ED costs relative to output, a year strikes us as a more meaningful planning horizon than 1 day.

Finally, we discuss the issue of standby capacity and its implication for marginal costs. Undoubtedly, EDs face variable demand, which administrators recognize, plan, and staff for, using flexible scheduling as best as they can. It is thus reasonable to argue that provision of nonurgent care during the lulls can only help improve resource utilization within the ED and that perhaps, in the context of filling the lulls, marginal costs of nonurgent care can be quite low. This argument must be made with care, however, because to some extent it is circular. Obviously, investing in greater standby capacity will lower marginal costs and vice versa. But standby capacity is not cheap. The correct question to ask is how much standby capacity is desirable and socially cost-effective? In the case of EDs, where the key input is physician and nursing labor, the desired level of standby capacity is a policy choice, driven less by technical and economic imperatives of the kind that drive, to use a previously cited example, the construction of electricity transmission networks. Increased reports of crowding, long wait times, and patients leaving the ED without being treated suggest that hospitals are finding it difficult to maintain a large amount of ED standby capacity in the current reimbursement environment. What this discussion points to is that ED administrators must carefully define their core mission and then staff the ED accordingly. Although, in principle, an ED's optimum product

mix could include some amount of nonurgent care (strategically delivered during the lulls), arguments about marginal costs being low rapidly lose credibility when demand for nonurgent care exceeds this optimum level and EDs start expanding staff in response to it. To repeat, our point is not that expanding nonurgent care capacity in an ED, or elsewhere in the hospital, is irrational. In some instances, it may be rational. But this needs to be demonstrated through hard economic analysis, not by leaning on generic arguments about marginal costs being low on account of standby capacity (itself a policy choice).

Importance

Despite the importance of EDs in the US health care system, little is known about their current cost structure. The published literature is limited and generally out of date. The most recent studies[13,15] were published in 1996 using data from 1991 to 1993. The other detailed study[14] used data from the 1980s. With the introduction of managed care and price competition, the economic incentives facing hospitals changed dramatically, which probably has affected EDs as well.[16-27] Other recent factors also may have affected ED cost structures, such as Emergency Medical Treatment and Active Labor Act regulations, nursing shortages, higher malpractice insurance costs that hospitals sometimes subsidize from their administrative budgets, and possibly other physician retention–related expenses.

Goals of This Investigation

This article has 2 goals. First, we test whether ED operations exhibit economies of scale. Second, using statistical models we develop a more complete estimate of the marginal (hospital) cost of outpatient ED visits. The models attempt to capture what accounting data fail to, namely, costs incurred by outpatient ED visitors in ancillary cost centers and other hidden costs that normally do not get charged to the ED by hospital accounting systems. We do not directly observe the aforementioned ancillary or hidden costs. The whole point of the statistical models is to tease out from total hospital expenditures (not charges or payments) the cost of an outpatient ED visit inclusive of these ancillary and other hidden expenses. Total expenses reported by hospitals, however, exclude physician expenses. Therefore, our statistical estimates also exclude the ED physician component. All our estimates reflect costs from the point of view of the institution, not society at large.

MATERIALS AND METHODS

Study Design

Our analyses are based on 2 complementary approaches: (1) a traditional hospital-accounting data approach and (2) a multiple regression cost-modeling approach.

Publicly available hospital accounting data delineate hospital operations into several cost centers, some being revenue producing, others being non–revenue producing. From these data, it is possible to identify each revenue-producing center's (for example, the ED) direct costs, as well as the allocated overhead (costs incurred in the non–revenue-producing centers are allocated to the revenue-producing centers on the basis of myriad formulae, which then becomes the allocated overhead). These data can be used to estimate costs of services provided within the ED cost center but not the cost of any ancillary services used by ED visitors (such as imaging or laboratory services), because these would be charged to the respective ancillary cost centers.

Furthermore, although hospitals are supposed to remove physician compensation from patient care costs before filing their annual financial reports, possibly some physician retention–related costs remain buried as overhead. Examples include malpractice insurance subsidies paid on behalf of emergency physicians and billing services provided on behalf of emergency physicians.

Estimating a composite per-visit cost from accounting data is thus problematic. Of course, if one had access to individual-level encounter data, perhaps one could trace out a composite per-visit cost within an accounting framework, although one still would have to deal with tough issues, such as which costs are fixed, which variable, and over what time frame. But that is not the level of detail available to us. We thus use accounting data to estimate ED-only per-visit costs and to examine whether services delivered within the ED exhibit economies of scale.

To develop a composite estimate of the marginal cost of an outpatient ED visit, taking into account ancillary services used by ED outpatients and perhaps other ED-related costs that remain hidden elsewhere, we rely on a statistical modeling approach. The statistical models capture only the facility portion of marginal costs because the reported data do not include physician compensation. And, as mentioned earlier, it is the year-over-year variation in hospital costs relative to output that drives our estimate of marginal costs. Such an approach allows us to be agnostic about which inputs to consider fixed and which to consider variable. To the extent that hospitals and EDs have high fixed costs, say, because of a high level of standby capacity, the correlation between cost and output changes over time will show up as being weak and vice versa. Thus, our statistical approach relies more on patterns prevalent in the data than a priori assumptions.

We focus primarily on outpatient ED visits because that is where savings can potentially be realized through better triage or better ED-demand management policies. For the most part, emergency patients who are admitted through the ED do not constitute a misuse of ED resources. We include in our models case mix–adjusted discharges as a control variable to capture the cost of all inpatients (ie, elective admissions, ED admissions, clinic admissions, inhospital deaths) to keep these costs separate from those of ED outpatients.

Our statistical model is drawn from the hospital cost literature[28] and follows a standard structure in which total hospital costs are modeled as follows: total hospital costs are regressed on measures of inpatient and outpatient outputs (case mix–adjusted inpatient discharges, outpatient ED visits,

outpatient clinic visits), input prices (Medicare wage index), demand (county per-capita income), teaching intensity (intern-to-bed ratio), ownership (for-profit, not-for-profit, public), and cost-containment pressures exerted by private and public payers. We capture the pressure exerted by private payers through a measure of hospital competition (Hirschman-Herfindahl index) and that by public payers through measures that capture the fiscal burden Medicare and Medicaid reimbursement policies impose on various hospitals. Construction of key variables is described next.

Dependent variable. The logarithm of total hospital expenditures (excluding physician compensation) is used as the dependent variable.

Hospital output. Three measures are used to capture hospital outputs: (1) case mix–adjusted inpatient discharges, (2) outpatient ED visits, and (3) outpatient clinic visits. An all-payer case-mix index was derived from scratch to avoid biases inherent in the Medicare case-mix index—the latter represents only the Medicare population. Derivation of the all-payer case-mix index involved several steps. First, charge data from the discharge abstracts were converted into costs using a hospital-specific, cost-to-charge ratio. Diagnosis-related group weights were constructed as the ratio of average costs of treating patients in a particular diagnosis-related group relative to the average cost of a discharge overall. Finally, a hospital-level case-mix index was constructed by taking a weighted average of diagnosis-related group weights, with discharges from each diagnosis-related group in that hospital serving as the weight. Apart from an overall case-mix index, we also derived one just for Medicare discharges for validation purposes (correlation between ours and the official case-mix index published by Medicare turned out to be 0.84).

Market structure. We estimated a Hirschman-Herfindahl index to capture the level of competition in hospital markets, using actual ZIP-code level patient-flow data to define hospital markets, based on Zwanziger and Melnick's[29] methodology. The Hirschman-Herfindahl index varies between 0 and 1, with lower levels indicating greater competition.

We capture Medicare fiscal pressure through an index that ranks hospitals on the basis of how profitable their Medicare business was in 1990, the beginning of our analysis period. This index does not change over time, but its interaction with each year is entered into the model to capture how hospitals responded to this baseline pressure in subsequent years. If costs among hospitals subject to high or low pressure converge over time, then the coefficient on this pressure index ought to become insignificant in later years. Medicaid fiscal pressure is captured by the proportion of total hospital days accounted for by Medicaid beneficiaries. This proportion enters the model in the form of interactions with the yearly dummies.

Setting and Selection of Participants

The analyses presented here are based on publicly available data from California hospitals. Obtaining institutional review board permission was unnecessary because no human subjects were involved. Our final analysis file includes data on all acute-care hospitals with EDs for 1990 through 1998 (34 Level I and II trauma hospitals, 246 other hospitals). In our sample, in 1998, median staffed bed size was 294 for trauma hospitals, 136 for nontrauma hospitals, and 45 for hospitals excluded from our analyses because of not having an ED.

We also excluded the County of Los Angeles–University of Southern California public hospital from the database because its operational scale makes it an extreme outlier. As a point of reference, in 1998, County of Los Angeles–University of Southern California handled slightly more than 200,000 ED visits. The next largest trauma center in California handled slightly more than 90,000 visits, whereas the average trauma center (excluding County of Los Angeles–University of Southern California) handled roughly 40,000 visits.

Data Collection and Processing

Our primary source of data is the State of California's Office of Statewide Health Planning and Development. We draw information from 2 key reports that each hospital submits to the Office of Statewide Health Planning and Development: the Annual Disclosure Report (which includes detailed financial and use statistics) and the Discharge Abstract File (which includes information about patient demographics, patient ZIP code, primary procedure and diagnosis, payer source, etc.). Each year's Annual Disclosure Report corresponds to the hospital's fiscal year, unless an interruption occurs because of a merger or a temporary (eg, for renovation) or permanent closure. The Discharge Abstracts are reported by calendar year. To place all these data elements on a comparable footing in terms of time, we combined several years of the Annual Disclosure Report and then "calendarized" them using linear interpolation so that each year implies a standardized period (January 1 through December 31). These data were supplemented with other variables, such as the Medicare wage index, intern-to-bed ratio, urban/rural location, and county per-capita income.

The statistical model uses a translog specification, which requires that the dependent and independent variables be logarithmically transformed and that the second power and interactions among the output variables be included as well. A strong theoretical and empirical foundation exists for modeling the production function of a multioutput firm, such as a hospital, within a translog framework, and the present authors and others have successfully used this specification in previous research.[29-31] One problem with such models is that cases with 1 or more zero outputs cannot be included; as a result, our model includes only those hospitals that reported clinic and ED visits, in addition to inpatient utilization. Because this model includes quadratic and interaction terms, the estimated coefficients do not have a straightforward interpretation. We perform the necessary transformations to convert these coefficients into dollar estimates of the marginal cost of outpatient ED visits (hospital characteristics are set at the respective sample means for the purpose of performing this transformation). Models were estimated using the Stata

Table 1. Distribution of costs (1998): nontrauma EDs, trauma EDs, and overall hospital.

Cost Category	Allocation of Direct ED Costs, %		Allocation of Total Hospital Costs, %
	Nontrauma EDs	Trauma EDs	
Personnel expenses			
Salaries, wages, and benefits	81.8	80.6	49.8
Professional fees*	5.1	3.6	5.4
Subtotal	86.9	84.2	55.2
Supplies	6.9	7.1	16.6
Purchased services	3.1	4.6	14.5
Other direct expenses	0.7	1.0	5.0
Capital expenses			
Depreciation	2.1	2.3	5.3
Leases and rentals	0.3	0.8	1.4
Interest expense	—	—	2.0
Total	100.0	100.0	100.0

*Includes costs incurred for activities falling into categories such as legal, audit, consultants, and registry but not physicians.

statistical analysis package (version 7.0, Stata Corporation, College Station, TX).

Sensitivity Analyses

Sensitivity analyses and specification tests suggested that pooling of data across (Level I and II) trauma centers and other hospitals with EDs was not producing a good model fit. Therefore, we ended up estimating 2 separate models, 1 for (Level I and II) trauma hospitals (N=34) and 1 for the remaining hospitals (N=246). Both models generate statistically significant marginal cost estimates (estimated at sample means) and exhibit high explanatory power (R^2=0.93 and 0.86 for the nontrauma and trauma models, respectively). However, because the trauma model is based on data from only 34 hospitals, the results should be interpreted as being more indicative than definitive.

The model specification also implicitly fits dummy variables (fixed effects) for each hospital to account for unobserved hospital characteristics, such as unmeasured patient severity, quality, and unmeasured input price variation. Sensitivity and specification tests suggested that accounting for hospital fixed effects was necessary. A correction for heteroscedasticity was also incorporated in the nontrauma model because error variance exhibited a small but significant inverse correlation with hospital size (measured using number of staffed beds). Detailed regression output can be obtained from the corresponding author on request.

RESULTS

Table 1 summarizes the percentage distribution of hospital costs across different accounting cost categories. For comparison purposes, the allocation of "total" hospital costs across the entire sample is shown. (The distribution of total hospital costs is qualitatively similar between trauma and nontrauma hospitals.)

As can be seen, total hospital expenses are highly labor driven. Across the entire hospital, personnel expenses (ie, wages, fringe benefits, professional fees) account for roughly 55% of total hospital expenses. Professional fees include costs incurred for activities falling into categories such as legal, audit, consultants, and registry but not physicians. Examining just the ED cost center, we see that the cost structure is even more heavily skewed toward labor. Total personnel expenses in EDs constitute 84.2% (for trauma EDs) and 86.9% (for nontrauma EDs) of direct annual ED operating costs. Supplies and purchased services account for another 10% to 12% of direct ED expenses. Of importance to this study, for EDs as well as for hospitals as a whole, less than 10% of total costs are related to capital (eg, depreciation, leases and rentals, interest), making quite small the likelihood of observing significant economies of scale. The point here is not that labor inputs are completely variable, only that these inputs are fungible and can be more easily scaled to meet a certain level of demand. For example, if ED demand is projected to increase by, say, 10% per year for the following 3 years, staffing increases could be matched accordingly over time. Nothing in the "technology" underlying ED services requires one to increase staffing in minimum chunks of, say, 30% (unless of course the ED is so tiny that hiring even 1 extra staff would amount to a large proportional increase).

Table 2 examines the variation in average accounting cost per visit as a function of total ED visits per year. Table 2 is based on accounting data that include direct costs for services provided in the ED plus the allocated overhead, but not inpatient, ancillary, and other hidden costs incurred by ED visitors. For trauma EDs, the overall average cost per visit is US$192, with a low of US$171 at about 50,000 visits and a high of US$215 at about 64,000 visits. For nontrauma EDs, the overall average cost per visit is US$126, with a low of US$116 at about 13,000 visits and a high of US$130 at about 26,000 visits.

If EDs exhibit economies of scale, we would expect to see average cost per visit start at higher levels and then decline as volume increases. Beyond some output threshold, average costs may once again begin to increase, indicating diseconomies of scale. However, we see a relatively flat curve in the case of trauma and nontrauma EDs. Pairwise t tests between quintiles with highest and lowest estimates were insignificant at the 5% level, suggesting that there is no significant trend relationship. Thus, it is difficult to conclude that an ED visit's marginal cost is significantly below its average cost.

Table 3 presents model-based estimates of the marginal (hospital) cost of an outpatient ED visit for the average nontrauma and trauma hospital (hospital characteristics are set at their respective sample means for the purpose of converting estimated coefficients into corresponding dollar values). For comparison purposes, the average estimated accounting cost per visit is also included. The statistical marginal cost estimates in 1998 dollars are US$295 and US$412 for nontrauma and trauma EDs, respectively, or approximately twice those of the accounting estimates. These findings confirm that accounting

Table 2. Average accounting cost per visit by ED volume (1998).

	Nontrauma EDs		Trauma EDs	
Quintile	**Cost per ED Visit, US$**	**Average Annual ED Visits**	**Cost per ED Visit, US$**	**Average Annual ED Visits**
First (0–20th percentile)	129	7,566	198	27,244
Second (21st–40th percentile)	116	13,029	203	33,846
Third (41st–60th percentile)	120	18,800	173	39,614
Fourth (61st–80th percentile)	130	26,080	171	50,072
Fifth (81st–100th percentile)	128	43,362	215	63,860
Overall average	126		192	

data significantly understate per-visit costs and that marginal costs are higher than is generally believed.

The higher marginal cost of trauma center ED outpatient visits could have many explanations. For example, it is possible that trauma hospitals receive a patient population that is systematically sicker than indicated by our case mix measures or that trauma centers are fundamentally more expensive. Comparing estimates of the marginal cost of case mix–adjusted inpatient discharges and clinic visits across the 2 types of hospitals can shed some light on these possibilities. For the average nontrauma and trauma hospital, the marginal cost of case mix–adjusted discharges works out to US$2,984 and US$6,213, respectively, and for clinic visits, US$110 and US$81, respectively. The large difference in the marginal cost of discharges, despite adjustment for patient severity, but not in the case of clinic visits, makes it difficult to argue that trauma centers are fundamentally more expensive. Therefore, more than likely, it is the medical profile of the inpatient and emergency populations that differs across trauma and nontrauma hospitals.

We also tested for the presence of scale economies using our more rigorous statistical approach. In the case of multi-output cost functions, examining scale economies amounts to assessing how costs change as all outputs are increased without changing their relative proportions. If the summation of each output's estimated cost elasticity is insignificantly different from 1, then economies of scale are absent. This turned out to be the case for nontrauma and trauma hospitals with average sample characteristics (for the latter group, the test is not sensitive to County of Los Angeles–University of Southern California's inclusion in the sample). To perform this test, however, it is necessary to force the hospital output and other control variables to explain the full variation (not just the year-over-year change) in costs across hospitals, which requires exclusion of the hospital fixed effects from the model. Although this exclusion may introduce some heterogeneity bias in any given output's elasticity, across outputs these biases are likely to counterbalance one another, thus influencing the summation of elasticities to a much lesser degree.

LIMITATIONS

By design, our marginal-cost estimate applies only to outpatient ED visits. However, even outpatient ED visitors present with different levels of urgency, which we cannot account for, for lack of reliable data. Our marginal cost estimates, therefore, best apply to average-urgency outpatient visits. Estimating how marginal costs vary by outpatient triage severity could be a fruitful area for further research.

DISCUSSION

We present cost estimates for ED visits using 2 approaches: a traditional accounting data approach and a statistical cost modeling approach. We use accounting data that are publicly available to estimate average per-visit costs booked to the ED and to test for scale economies. We also use a statistical modeling approach to evaluate how much accounting data tend to understate the marginal (hospital) cost of outpatient ED visits. Because in this study we are working with annual data, it is essentially the year-over-year variation in hospital costs relative to output that drives our estimate of marginal costs. Time frame matters, and for studying the scalability of ED costs relative to output, 1 year strikes us as a meaningful planning horizon. Marginal costs can be made to appear lower by compressing the time frame to a few days or weeks because more inputs would appear unchangeable, but we contend that this is not very meaningful from a policy perspective.

Economies of scale exist when certain inputs can only be purchased in discrete lumps, such as plant and equipment, causing per-unit output costs to decline as scale is expanded until the lumpy inputs are fully used. A descriptive analysis of the components of costs measured at the hospital and at the ED level shows that only a small percentage of costs are capital related and that costs are largely labor driven. These conclusions are consistent with the Medicare Payment Advisory Commission's recent findings based on a national sample of hospitals. The Medicare Payment Advisory Commission reports that nationally, capital costs (eg, depreciation, interest, leases, rentals) amount to less than 10% of total annual hospital operating costs.[32] To the extent labor inputs can be scaled up or down according to expected demand, the likelihood of observing scale economies is limited. Although some labor and supply costs may appear fixed in the short run because of contracts and inventories, they are increasingly variable over the long run and, in fact, have become more variable in recent years as a result of pressure from managed care organizations and price competition. For example, most hospitals in California (and probably elsewhere) now use flexible scheduling systems

Table 3. Statistical estimate of the marginal cost of an outpatient ED visit (1998 dollars).

Type of ED	Statistical Estimate, US$ (95% CI)	Accounting Estimate, US$
Trauma EDs	412* (53–771)	192
Nontrauma EDs	295† (204–387)	126

CI, Confidence interval.
*Significant at 5% level.
†Significant at 1% level.

that adjust staffing levels according to hospital occupancy and visit rates, varying the number of on-duty staff by time of day and day of week on the basis of historical trends and expected demand. With costs being variable to such a high degree, and because of the widespread practice of staffing according to census, it is unsurprising that we are unable to find evidence in favor of scale economies.

Our second set of analyses attempted to provide an improved and updated estimate of the marginal (hospital) cost of outpatient ED visits. Using a modeling approach, we estimate the marginal cost of an ED visit controlling for different factors that are likely to influence ED costs. The statistical cost estimates are US$295 and US$412 (in 1998 dollars) for nontrauma and trauma EDs, respectively. When we compare model-based estimates with the ones based on accounting data, we find a large difference, which confirms our hypothesis that ED cost estimates based solely on accounting data are likely to understate the full cost impact of EDs on hospital operations. Accounting estimates capture only the direct and allocated overhead costs booked to the EDs but do not capture the costs of ancillary or other services that ED outpatients use during their visit. In addition, hospitals are reporting that they are incurring significant expenses from their administrative budgets for activities related to physician retention.

How do our results compare with previous studies? Granneman et al[14] provided the earliest estimate of per-ED visit hospital costs using data from the American Hospital Association's 1982 hospital survey (the data themselves are from the previous year, that is, 1981). They derived average and marginal costs using a statistical model that relates total hospital costs to inpatient and outpatient outputs, controlling for hospital characteristics. Their analysis was cross-sectional, with all its inherent limitations, such as inadequate accounting of unobserved hospital characteristics. In any event, their estimate of per-ED visit average and marginal costs in 1981 dollars was US$201 and US$123, respectively. They performed additional analyses and concluded that EDs exhibit significant economies of scale, a finding with which we do not concur. As a point of comparison, we estimate that the average and marginal costs in the study by Grannemann et al[14] in 1998 dollars would be roughly US$425 and US$260, respectively, derived by applying an average inflation rate of 4.5% per year (authors' estimate from California data) between 1981 and 1998. Their marginal cost estimate, which also excludes the emergency physician component, appears reasonably close to ours.

The next study that estimates per-visit ED costs was by Williams.[13] His study was based on data from 6 Michigan hospitals. The period covered was 1991 through 1993. Williams[13] found the average and marginal cost per ED visit to be approximately US$209 and US$88, respectively, inclusive of all hospital and ED physician expenses. Although Williams did not explicitly address the economies-of-scale question, his findings may be construed as being supportive of the idea. Williams'[13] description about the methodology used to separate average from marginal costs is somewhat cryptic, however. A possible explanation for his rather low marginal cost estimate could be that he used monthly instead of annual data. Inflating his average and marginal cost estimates from 1992 dollars (midpoint year) to 1998 dollars, using cost-per-visit inflation estimates for California during that 6-year period (roughly 0.6% per year according to our calculations), yields average and marginal cost estimates of US$217 and US$91, respectively. These estimates appear significantly lower than those by Granneman et al[14] and than ours, especially considering that Williams'[13] estimates include the emergency physician component as well.

Although not the primary focus of this article, the difference between trauma and nontrauma EDs is noteworthy. Visits to trauma EDs appear to cost substantially more (although note the large confidence interval) than visits to nontrauma EDs. Reimbursement policies should recognize this difference to ensure the economic viability of trauma EDs. However, we had great difficulty in pooling data between trauma and nontrauma hospitals, ostensibly because they are much different. This observation is not so much meant for practitioners as for researchers who intend to pursue economic analyses of EDs.

In summary, although we do not provide direct cost comparisons between care provided in alternative settings, our findings suggest that the marginal cost of an ED outpatient visit is higher than is commonly believed. How and when to deliver nonurgent care in an ED therefore merits careful review. Overall, ED cost management must involve a broader view incorporating other parts of the hospital, and hospital administrators need to pay greater attention to improving cost measurement and management within the ED and in other parts of the hospital. In light of accounting-data deficiencies highlighted here, large payers such as Medicare also perhaps need to reexamine how they set prices for ED services to ensure that the administered price properly compensates hospitals for their ED services.

The analyses presented here were developed as part of a larger study—funded by the California Health Care Foundation—devoted to improving the understanding of ED economics in California. We thank them for their support.

Author contributions: AB and GM conceived this study and obtained research funding. AB was in charge of all the data

analyses, including model estimation. AN took the lead in reviewing the literature and crosschecking references. AB and GM drafted major portions of the initial manuscript, whereas all 3 authors helped refine it. AB takes responsibility for the paper as a whole.

Funding and support: Supported by the California Health Care Foundation.

Publication dates: Received for publication February 9, 2004. Revisions received May 17, 2004, and July 13, 2004. Accepted for publication August 25, 2004. Available online April 2, 2005.

Reprints not available from the authors.

Address for correspondence: Anil Bamezai, PhD, RAND, 1776 Main Street, Santa Monica, CA 90401; 310-393-0411 ext. 6458, fax 310-451-7061; E-mail bamezai@rand.org.

REFERENCES

1. Mellon Financial Corporation Web site. National health care trend survey. Available at: http://www.mellon.com/hris/news/index.html. Accessed February 2, 2004.
2. Towers Perrin Web site. 2004 healthcare cost survey. Available at: http://www.towersperrin.com/hrservices/global/default.htm. Accessed February 2, 2004.
3. Baker L, Baker LS. Excess cost of emergency department visits for nonurgent care. *Health Aff (Millwood)*. 1994;13:162-171.
4. Kelly KA. Cost containment in the emergency department: shifting the cost of caring for patients with non-emergency conditions from crowded emergency department to primary care settings. *J Emerg Nurs*. 1994;20:454-457.
5. Washington DL, Stevens CD, Shekelle PG, et al. Next-day care for emergency department users with non-acute conditions: a randomized, controlled trial. *Ann Intern Med*. 2002;137:1-18.
6. McCaig LF, Burt CW. *National Hospital Ambulatory Medical Care Survey: 2001 Emergency Department Summary: Advance Data from Vital and Health Statistics*. No. 335. Hyattsville, MD: US National Center for Health Statistics; 2003.
7. McCaig LF. *National Hospital Ambulatory Medical Care Survey: 1992 Emergency Department Summary: Advance Data from Vital and Health Statistics*. No. 245. Hyattsville, MD: US National Center for Health Statistics; 1994.
8. Young GP, Wagner MB, Kellermann AL, et al. Ambulatory visits to hospital emergency departments: patterns and reasons for use: 24 hours in the ED Study Group. *JAMA*. 1996;276:460-465.
9. Afilalo M, Guttman A, Colacone A, et al. Emergency department use and misuse. *J Emerg Med*. 1995;13:259-264.
10. O'Brien GM, Shapiro MJ, Woolard RW, et al. Inappropriate emergency department use: a comparison of three methodologies for identification. *Acad Emerg Med*. 1996;3:252-257.
11. Gill JM. Nonurgent use of the emergency department: appropriate or not? *Ann Emerg Med*. 1994;24:953-957.
12. Tyrance PH Jr, Himmelstein DU, Woolhandler S. US emergency department costs: no emergency. *Am J Public Health*. 1996;86:1527-1531.
13. Williams RM. The costs of visits to emergency departments. *N Engl J Med*. 1996;334:642-646.
14. Grannemann TW, Brown RS, Pauly MV. Estimating hospital costs: a multiple-output analysis. *J Health Econ*. 1986;5:107-127.
15. Williams RM. Distribution of emergency department costs. *Ann Emerg Med*. 1996;28:671-676.
16. Franco SM, Mitchell CK, Buzon RM. Primary care physician access and gatekeeping: a key to reducing emergency department use. *Clin Pediatr*. 1997;36:63-68.
17. Kerr HD. Access to emergency departments: a survey of HMO policies. *Ann Emerg Med*. 1989;18:274-277.
18. Young GP, Lowe RA. Adverse outcomes of managed care gatekeeping. *Acad Emerg Med*. 1997;4:1129-1136.
19. Zautcke JL, Fraker LD, Hart RG, et al. Denial of emergency department authorization of potentially high-risk patients by managed care. *J Emerg Med*. 1997;15:605-609.
20. Kravitz RL, Zwanziger J, Hosek S, et al. Effect of a large managed care program on emergency department use: results from the CHAMPUS reform initiative evaluation. *Ann Emerg Med*. 1998;31:741-748.
21. Osborn HH. Health maintenance organizations: managed care or mismanaged care? *Ann Emerg Med*. 1996;27:225-228.
22. Hodge D 3rd. Managed care and the pediatric emergency department. *Pediatr Clin North Am*. 1999;46:1329-1340.
23. Hoffman DE. Emergency care and managed care: a dangerous combination. *Washington Law Rev*. 1997;71:327-340.
24. Karpiel M. *Managed Care in Emergency Medicine: Understanding the New Economics and Opportunities*. Dallas, TX: American College of Emergency Physicians; 1995.
25. Johnson LA, Derlet RW. Conflicts between managed care organizations and emergency departments in California. *West J Med*. 1996;164:137-142.
26. Johnson LA. Managed care and emergency medicine: current experience in California. *Ann Emerg Med*. 1998;31:414-416.
27. Tsai AC, Tamayo-Sarver JH, Cydulka RK, et al. Declining payments for emergency department care, 1996-1998. *Ann Emerg Med*. 2003;41:299-308.
28. Breyer F. The specification of a hospital cost function. *J Health Econ*. 1987;6:147-157.
29. Zwanziger J, Melnick GA. The effects of hospital competition and the Medicare PPS program on hospital cost behavior in California. *J Health Econ*. 1988;7:301-320.
30. Gaynor M, Anderson GF. Uncertain demand, the structure of hospital costs, and the cost of empty hospital beds. *J Health Econ*. 1995;14:291-317.
31. Zwanziger J, Melnick GA, Bamezai A. The effect of selective contracting on hospital costs and revenues. *Health Serv Res*. 2000;35:849-867.
32. Medicare Payment Advisory Commission. *Report to the Congress: Medicare Payment Policy*. Washington, DC: MedPac; 2003.