Exploring the Relationship Between Inpatient Hospital Costs and Quality of Care

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This research explores the potential benefit of improving the clinical quality and reducing the cost of inpatient care using administrative data to inform or restrict provider choice. Cost and quality measures derived from this source are already available to purchasers, payers, and consumers in support of insurance products designed to provide financial incentives for consumers to seek high-quality, low-cost care. It will be important to further refine the clinical and cost data to take into account measurable differences in the severity of illness of patients, and to acknowledge that some of the differences in cost or quality variation among hospitals may not be captured despite such refinements.

Medicare cost report data is merged with Uniform Hospital Discharge Abstracts to identify the additional direct cost of patients experiencing 1 of 6 poor clinical outcomes, or admissions for ambulatory care sensitive conditions, or selected surgical procedures at low volume hospitals. Variability in case mix–adjusted cost per case among community and teaching hospital groups is also quantified; measurable quality differences between low cost and other hospitals in each group is described. Our results suggest that, despite implementation challenges, purchaser and payer initiatives that encourage consumers to seek lower cost inpatient care without sacrificing clinical quality are worth pursuing.

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Inpatient costs per capita are on the rise again after 5 years of decline in the mid-1990s.[1] At the same time, consumers, purchasers, government agencies, and others have become concerned about the quality of inpatient care.[2-4] Health plans, employers, Internet-based information companies, and government agencies are developing and disseminating information about the cost and quality of care along a number of dimensions, from patient satisfaction and process quality to clinical outcomes. Consumer empowerment, in which patients—armed with cost and quality information—are given financial incentives to make better choices, is becoming the latest American answer to healthcare cost containment.[5,6] Most of the data currently available on cost and quality describe inpatient hospital care. Our research expands understanding of these inpatient data.

METHODS

Using publicly available data, we explored the cost and quality implications of more informed and motivated patient choice of inpatient care, as well as of new insurance products that involve tiered pricing of hospitals to steer patients toward lower-cost hospitals. Such products are already on the market in several states, including Massachusetts, California, and Washington. We analyzed inpatient cost and quality data on all acute general hospitals in 10 states (Massachusetts, New York, Virginia, Florida, Texas, Illinois, Iowa, California, Washington, and Colorado) representing 45% of inpatient discharges nationally. These states provided detailed patient data from the 2000 Uniform Hospital Discharge Data Set, which was merged with hospital Medicare cost reports for 1999-2000 to provide direct and full costs for specific inpatient care types (diagnosis-related groups [DRGs] or ICD-9-CM diagnosis or procedure codes, adjusted for case mix).

Our cost data were separated into direct costs (costs before allocating overhead) and total costs (costs after allocating overhead) based on Medicare's step-down methodology. Direct costs were used to approximate the costs that could be reduced under our various cost and quality scenarios, excluding the additional costs that would be required to implement

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such changes. Costs attributable to unfavorable outcomes were calculated as the difference in cost between patients at risk but without the unfavorable outcome and the cost of patients with the unfavorable outcome, after adjusting for case-mix differences based on DRGs.

We used 3 dimensions of inpatient hospital quality, derived from approaches taken by purchasers and the federal government. The first set of indicators was developed by the Agency for Healthcare Research and Quality (AHRQ).[7] (The AHRQ released new measures on March 13, 2003, after completion of this study.) These indicators quantify 6 of the most commonly occurring, measurable quality problems in inpatient care. They include the rates of occurrence of nosocomial infections, including wound infections, pneumonia after surgery, urinary tract infections, adverse effects (ie, care-related complications), pulmonary compromise, and mechanical complications due to devices.

To assess the appropriateness of admissions, we used the 16 ambulatory care sensitive condition (ACSC) indicators defined by the University of California San Francisco–Stanford Evidence-based Practice Center.[8] In our sample, ACSC admissions represented 13.7% of admissions overall, 11.1% of admissions for teaching hospitals, and 14.3% for community hospitals. Rates of admission for ACSCs have risen substantially from 99.2 per 10 000 in 1980 to 133.8 per 10 000 in 1998, even as hospitalizations for other conditions declined 33% during the same period.[9]

The third set of quality measures has been promoted by The Leapfrog Group (TLG; http://www.leapfroggroup.org/), a consortium of more than 135 *Fortune* 500 companies and other healthcare purchasers of health benefits. Combined, these companies provide benefits to more than 33 million Americans, spending well over $52 billion a year. Members of TLG have agreed to purchase healthcare benefits based on a goal of increasing patient safety and implementing healthcare quality initiatives.

One of TLG's recommendations is to shift complex medical procedures to high-volume facilities, which have been shown to improve outcomes. These operations include coronary artery bypass graft, angioplasty, nonruptured abdominal aortic aneurysm repair, carotid endarterectomy, and esophageal cancer surgery.[10] (*Note:* carotid endarterectomy was dropped as a volume measure by TLG in 2003 after completion of this study.)

As shown in **Table 1**, the 10-state dataset of inpatient discharges that we used, in comparison with all hospitals in the United States, slightly overrepresents large hospitals and underrepresents hospitals with fewer than 100 beds. It also overrepresents urban hospitals while underrepresenting rural hospitals.

In adjusting for case mix, we employed direct standardization separately for the teaching and community hospital groups within each state, using Centers for Medicare and Medicaid Services. We applied this method individually for each of the 6 quality indicators we evaluated as well as in determining quartiles. We directly extrapolated, without additional adjustment, our 10-state sample to nationwide estimates using the number of inpatient discharges in our sample compared with national inpatient discharges.

For costing, we used a departmental ratio of cost-to-charge approach based on the Medicare cost report for each hospital, applied to that hospital's patients. This approach provides a reasonable estimate of the hospital inpatient costs of treating patients.[11]

We addressed the cost implications of the quality problems indicated by the AHRQ quality indicators using 2 approaches. The first was to quantify the additional direct cost of all cases that experienced any of these poor clinical outcomes. The second approach was to describe the cost and quality implications if patients, motivated by financial incentives and armed with cost information, go to the hospitals in the lowest cost quartile for their inpatient care. Some portion of the difference in cost between patients experiencing high quality and low quality may not be causally related to the low quality, but rather to severity of illness that is not fully captured through case-mix adjustment. If unobserved patient traits are important, this approach will overstate the cost-savings potential.

For the ACSCs, we quantified the gross cost burden as the direct costs of caring for those patients in an inpatient setting. The costs required to care for those patients in an ambulatory or other alternative setting were not considered.

With regard to TLG surgical procedures, we compared the direct costs of TLG-compliant hospitals with those of hospitals not meeting the volume threshold separately for each procedure, but without any adjustment for severity of illness within a given procedure.

RESULTS

Many patients experience some type of unfavorable outcome during their stay in the hospital.

Table 1. Comparison of Hospital Characteristics in 1998

	No. of Hospitals	Bed Size (%)				Hospital Location (%)	
		<100	100-299	300-499	500+	Urban	Rural
United States	5015	45	39	11	5	56	44
Sample	1880	39	42	13	6	70	30

Source: American Hospital Association. *Hospital Statistics 2000*. Chicago, Ill; American Hospital Association; 2000:8.

Patients who have an unfavorable outcome incur higher costs than those whose outcome is favorable, both in teaching and community hospitals, across all 6 quality indicators (**Table 2**). For the 6 AHRQ quality indicators for inpatient care, the direct cost of poor outcomes amounted to $6.4 billion nationally in 2000, accounting for 2.3% of total inpatient hospital expenditures. For teaching hospitals in our sample, the increase in costs due to quality problems ranged from a low of 47% for urinary tract infection, to a high of 119% for wound infection (Table 2). For community hospitals, the increase in costs related to quality problems ranged from a low of 35% for urinary tract infection to a high of 101% for wound infection.

If patients admitted to teaching hospitals in 2000 had gone to the lowest-cost teaching hospitals for their condition, the direct cost savings could be close to $5.4 billion nationwide. The lowest quartile direct cost per adjusted case was 23.8% lower than that of the other quartiles ($4320 vs $5670 per case). The lowest cost quartile of teaching hospitals had the same or better incidence rates in 3 of the 6 quality indicators (adverse effects, wound infection, and mechanical complications) and worse incidence rates in 3 others (pneumonia, pulmonary compromise, and urinary tract infection). However, some of the poorer performance at the more expensive hospitals may be due to unmeasured differences in case mix.

Patients going to community hospitals could have saved close to $6 billion nationwide if they had chosen the lowest cost quartile hospitals. The direct cost for the lowest-quartile community hospitals was 17.0% lower than that of other community hospitals ($2940 per case vs $3542 per case). The lowest cost quartile was the same or better than the higher cost quartiles for all 6 quality indicators.

The direct cost burden of ACSC admissions was $18 billion nationally in 2000. This amount represented 6.2% of inpatient hospital expenditures. The top 4 conditions, representing roughly two thirds of ACSC-related direct costs and days of care required,

Table 2. Incidence and Cost of 6 Quality Indicators (Case Mix Adjusted)

	At Risk Population (Thousands of Discharges)		Overall Incidence Rate (% of at-Risk Population)		Percent Greater Cost of Patients With Unfavorable Outcomes (%)	
Quality Indicator	Teaching Hospitals	Community Hospitals	Teaching Hospitals	Community Hospitals	Teaching Hospitals	Community Hospitals
Adverse effects	2991	12 384	3.44	2.45	55	44
Wound infection	2991	12 384	0.43	0.26	119	101
Pneumonia after surgery	457	1663	1.37	1.26	89	76
Urinary tract infection	352	1246	3.26	2.91	47	35
Mechanical complications	441	1583	1.39	1.02	57	52
Pulmonary compromise	382	1429	2.25	1.78	83	94

were bacterial pneumonia, congestive heart failure (CHF), low-birth-weight infants, and chronic obstructive pulmonary disease (COPD). While low birth weight represented nearly 15% of the cost of ACSC admissions, it represented only 4.7% of the admissions overall. For teaching hospitals, low-birth-weight admissions had a disproportionate effect on hospital costs, accounting for only 8.3% of the admissions but 28.4% of the direct costs. Some of these admissions could potentially have been prevented through the provision of better outpatient care.

In our sample, compliance with the TLG volume criteria for these procedures varied widely from state to state, both in terms of number of hospitals meeting the criteria and the percentage of patients treated in hospitals that met the criteria. Most hospitals providing the TLG-identified procedures did not meet the volume criteria (**Tables 3** and **4**). We found that the highest compliance with TLG criteria was for coronary angioplasty, with 43% of hospitals and 80% of cases provided in hospitals at or above the recommended volume. The lowest compliance percentage was for esophageal cancer surgery, with only 11.1% of hospitals meeting the criteria, representing 51.1% of cases. Encouraging patients to go to hospitals with surgical mortality rates equivalent to those of "high-volume" hospitals as defined by TLG could substantially reduce patient deaths, by an estimated 1060 deaths per year. However, direct inpatient cost savings would be minimal, and for some procedures, costs would increase if care were shifted to TLG-compliant hospitals.

DISCUSSION

Motivating consumers and health plans to use lower-cost hospitals for care appears to result in substantial cost savings. The preliminary evidence in this report suggests that choosing lower-cost hospitals may not necessarily mean lower-quality providers. An obvious caveat is the limitations of quality measurement used here; the 6 AHRQ measures are commonly occurring and measurable, but they do not cover all quality problems that occur during inpatient care. Patient choice of hospital is subject to several factors including geography, provider recommendations, and perceptions, as well as payer incentives. In addition, patient satisfaction is an important dimension of quality of inpatient care that we did not address, as the necessary data are not publicly available for a sample as large as the one used for these analyses. Finally, not all of these ASCS admissions or quality problems are likely to be preventable.

Caution must also be exercised in the interpretation of the cost-savings data presented in the findings. The term *direct cost* was used as the amount of hospital cost that would change if volume increased or decreased within a particular hospital. Costs that change with volume may approximate direct cost over the longer run, but in the short run (eg, a year or less), these costs may be relatively fixed for a particular hospital. Thus cost savings are more reflective of long-term than short-term savings. Also, the cost savings achieved when patient volume changes may or may not translate into savings enjoyed by patients or payers. That is a function of payment negotiations within local market conditions. It is also possible that higher-cost hospitals that lose volume would try to compensate for lost revenues by charging the remaining users higher prices. Furthermore, our analysis focuses on the correlation between poor performance on quality indicators and higher cost, a relationship that may not reflect causality.

There is also the constraint of inpatient capacity; if patients flocked to lower-cost hospitals, would the facilities be able to absorb the volume without needing to open new beds and raising their cost? Despite excess capacity in the system overall, specific areas appear to be operating at full capacity. An increase in hospital admissions began in 1999, reversing a 15-year trend of declining admissions. More than 33 million people were admitted to community hospitals in 2000, up from a low of 30.7 million in 1994.[12,13] Signs of strain are evident in certain markets (eg, New York City, Boston), despite a nationwide condition of excess bed capacity. These signs can be seen in emergency room diversions, more than a day's wait for an emergency admission to get a bed, nursing staff shortages, and occupancy rates at some hospitals of more than 95%.[13] Some hospitals are seriously considering adding bed capacity in some markets.[13] Our analysis did not include any adjustment for whether high- or low-cost hospitals actually exist in a particular geographic market or consider travel costs to an alternative hospital.

In terms of the ACSC findings, there are potential logistical obstacles to achieving savings as well. One researcher found that the variation in ACSC discharges per 1000 varied by region and was positively related to the supply of hospital beds.[14] Rates of admission for ACSC are rising quickly for elderly persons, an increase that may be exacerbated by

Table 3. The Leapfrog Group Criteria and Mortality Rates

Measure	Percentage of Hospitals (%)		Percentage of Cases (%)		Mortality Rate (%)*	
	Criteria Met	Criteria Not Met	Criteria Met	Criteria Not Met	Criteria Met	Criteria Not Met
Coronary artery bypass	15.5	84.5	44.6	55.4	3.46	3.82
Coronary angioplasty	42.7	57.3	80.0	20.0	1.32	1.79
Abdominal aortic aneurysm repair (nonruptured)	15.4	84.6	53.3	46.7	9.16	14.28
Carotid endarterectomy	17.0	83.0	51.1	48.9	0.76	0.78
Esophageal cancer surgery	11.1	88.9	51.1	48.9	5.25	9.39

*Percent of patients who died in hospitals that either met criteria or did not.

a lack of prescription drug coverage.[9] Admission rates are also rising for African-American populations, perhaps reflecting racial disparities in the delivery of primary care.[9] Just motivating patients financially and arming them with data may not be enough to assure access to appropriate care for these populations.

Finally, the TLG recommendation encouraging patients to seek out high-volume hospitals for specific surgical procedures may not be the right way to focus patient choices. In some cases, hospitals with volumes below TLG recommendations achieved lower mortality rates than did those with volumes above the recommended minimum. This fact may be because lower-volume hospitals have been able to develop a strong team approach that in and of itself has lowered mortality rates. Alternatively, if our risk adjustment mechanism did not adequately control for differences in illness, it is possible that sicker patients may have been attracted to high-volume hospitals. In addition, TLG fails to consider volume at the individual surgeon level. A solo surgeon at a community hospital may perform enough procedures to achieve low mortality rates, yet the hospital itself might fail to achieve recommended volume levels. Also, the relationship between volume and mortality is linear, so volumes just below the cutoff may achieve just as low mortality as those above it.[15] Thus rather than solely using the volume criteria to select hospitals for specific procedures, insurers and patients may be better advised to focus on the mortality rates achieved as well, using as benchmarks those rates achieved by hospitals at or above the TLG-recommended volumes.

CONCLUSIONS

In our study, we found a wide range in cost per adjusted case within community hospitals and within teaching hospitals. Our research suggests that community hospitals providing lower-cost care have

Table 4. Effect of a Shift in Volume to Hospitals That Meet TLG Volume Criteria

TLG Measure	Decreased Mortality (# of Deaths)	Cost Reduction/(Increase)	LOS Reduction/(Increase)
Coronary artery bypass	424.4	($13.2) million	(11 086)
Coronary angioplasty	162.0	$66.6 million	29 212
Abdominal aortic aneurysm repair	433.5	($16.2) million	(3155)
Carotid endarterectomy	7.5	$8.3 million	12 768
Esophageal cancer surgery	32.9	($5.0) million	4585
Total for all measures	1060.3	$40.5 million	32 324

LOS indicates length of hospital stay; TLG, the Leapfrog Group (calculation for sample).

the same or better quality than do community hospitals providing higher-cost care. For major teaching hospitals, the quality differences between low- and high-cost care are more mixed, with lower-cost hospitals providing the same or better care on 3 of 6 common quality measures.

These results suggest that the opportunity exists for cost savings without sacrificing quality through insurance products that motivate patients to become cost sensitive through defined contribution plans, tiered pricing of hospital networks, variation of cost-sharing percentages/amounts, and/or information-based strategies geared toward influencing patient choice. Clearly more research needs to be done to clarify and quantify clinical quality outcomes, but the 6 measures available to date support the notion that low-cost care does not necessarily mean lower clinical quality.

The ACSC findings suggest additional opportunities, particularly for insurers and providers, to reduce cost and probably to improve the quality of life of patients who are admitted for conditions that should be treated on an ambulatory basis. These incentives should encourage the development or expansion of risk assessment programs that identify patients with certain conditions (eg, high-risk pregnancy, COPD, CHF) and provide focused services to avoid the need for hospitalization or expensive treatment. Given the importance of these admissions to some hospitals, the incentives need to be viewed by the hospitals and primary care providers as having financial benefits. We have found that financially distressed hospitals had significantly higher proportions of ACSC discharges than did financially healthier hospitals (unpublished data, Nancy M. Kane, MBA, DBA). Another intervention that both payers and providers might consider is the provision of pharmacy coverage for elderly individuals with chronic illnesses (eg, hypertension, high cholesterol, COPD), coverage that might be funded from some of the savings resulting from reduced use of inpatient care. The high prevalence of ACSC among African-American populations reinforces the need to develop programs that reduce racial disparities in primary care, which would have the added benefit of substantial inpatient cost savings.

Finally, the TLG findings indicate actions that could improve health outcomes (surgical mortality), but do not appear to reduce hospital costs to any great degree, although the lives saved could outweigh a potential increase in costs. Insurers and information providers should consider using the mortality rates of high-volume surgical providers as quality benchmarks for consumer information or for purposes of determining which hospitals should be "centers of excellence" for particular procedures. Given that the mortality differences on either side of the TLG volume cutoff points are not large, the use of a single volume cutoff point is not justifiable. Hospitals should be motivated to achieve the quality levels of higher-volume hospitals, however. This goal may be achievable by having fewer surgeons performing more procedures or by improving the care processes used during the patient stay, without having to achieve an institutional level of volume that hits the TLG cutoffs. The development of centers of excellence for complex procedures in institutions meeting the benchmark mortality levels may be an effective way to motivate mortality improvements among all hospitals. A tiered copayment system that recognizes those centers of excellence would provide patient incentives to seek surgical care in appropriate places.

Combined, these cost- and quality-driven initiatives identified here could achieve substantial savings. Our combined results, extrapolated nationally, represent close to $36 billion, or roughly 12% of total inpatient spending in 2000. Despite the implementation issues involved, these initiatives appear to be worth pursuing.

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