Understanding Rising Hospital Inpatient Costs: Key Components of Cost and The Impact of Poor Quality

Nancy M. Kane, MBA, DBA
Richard B. Siegrist, Jr., MS, MBA, CPA

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About the Authors:

Nancy Kane is Lecturer on Management at the Harvard School of Public Health. Dr. Kane has been on the Harvard faculty since 1980, and teaches graduate and executive education courses on financial accounting, financial analysis, payment systems, and competitive strategy. She holds an MBA and a DBA from the Harvard Business School in the field of Business Policy. Dr. Kane is the director of the Master of Science in Health Care Management Program for nonresidential physician executives, and also directs the Health Care Management concentration of the Masters in Public Health Program at the School.

Dr. Kane's research is concerned with measures and determinants of financial and managerial performance in the health delivery system. Her current projects involve measuring nonprofit hospital financial performance for purposes of health policy research and quantifying the relationship between tax-exempt status and community benefit of healthcare organizations. She has also developed a series of case studies on global health policy issues such as access to pharmaceuticals in Brazil, the role of primary care in the British National Health Service, and the role of employers in the US healthcare system.

Dr. Kane has developed new measures of hospital and health maintenance organization financial performance, taking into account long-run sources and uses of funds and the resources of related entities as well as the traditional measures of profitability, solvency, and liquidity. She has worked with health policy makers in the federal government, New Jersey, Maine, Massachusetts, California and Texas to address such questions as: how have hospitals done under regulatory versus competitive payment systems, what are the differences in financial behavior between for-profit and tax-exempt HMOs, and how should the community obligations of tax-exempt healthcare providers and insurers be defined and enforced?

Richard Siegrist is Adjunct Lecturer on Management at the Harvard School of Public Health. He as been on the Harvard faculty for the last 16 years and teaches graduate and executive education courses on financial management, cost accounting and management control. Mr. Siegrist is also founder, President and CEO of HealthShare Technology, Inc., a 35 person healthcare information company that provides decision support software to hospitals and health plans. Previously, he was co-founder and Vice President of Transition Systems, Inc., a leading cost accounting software vendor, now part of Eclipsys, and worked at New England Medical Center.

While at NEMC, Mr. Siegrist directed the development of a cost accounting system under a grant from the Blue Cross Blue Shield Fund for Cooperative Innovation. He also is co-author with Michael Shwartz and David Young from Boston University of "Ratios of Costs to Charges – How good a method for estimating costs?", funded by Robert Wood Johnson and published in the Fall/Winter 1996 issue of *Inquiry*. Rick holds a BA in Political Economy from Williams College, an MS in Accounting from NYU Graduate School of Business and an MBA from the Harvard Business School. He is also a CPA.

Mr. Siegrist and his company have substantial experience in working with Blue Cross Blue Shield plans. BCBS of Massachusetts, BCBS of Illinois, Premera Blue Cross and Empire BCBS are current clients of HealthShare Technology.

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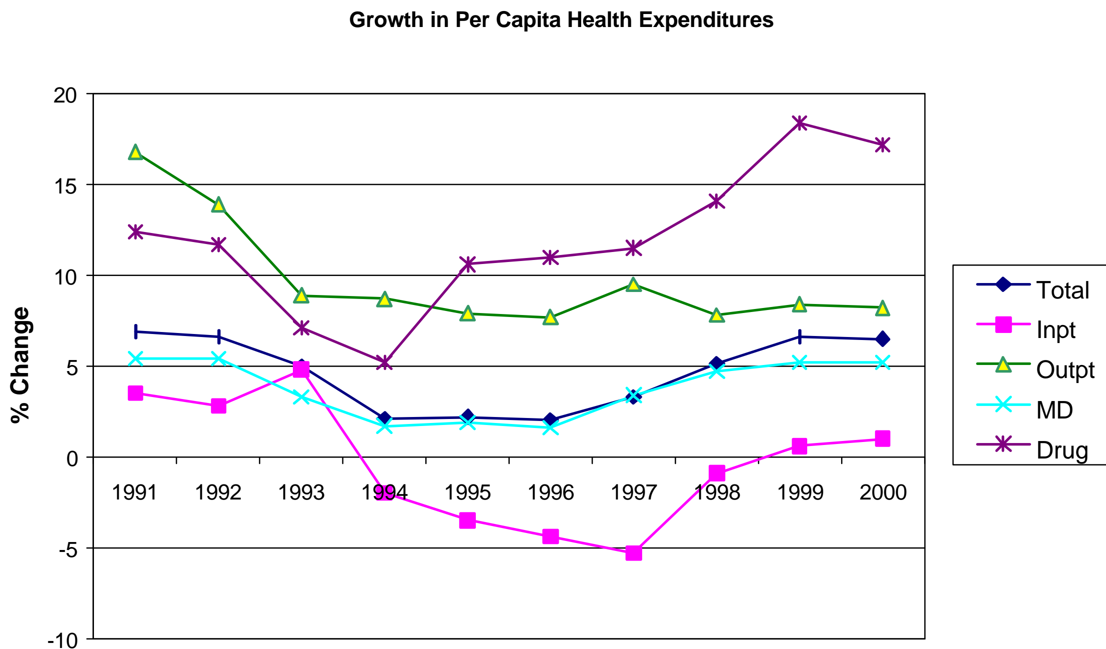
EXECUTIVE SUMMARY

This paper focuses on identifying and assessing the most important drivers of hospital costs in the current environment. The aim is to provide guidance for future initiatives of the Association and other organizations to influence those cost drivers. Our findings should be of significant interest to healthcare opinion leaders and decision-makers throughout the country.

Background and Overview

Total inpatient hospital costs rose 2.8% in 2000, compared to 1.6% in 1999. The last two years represent a reversal of the trend between 1994 and 1998, when inpatient spending declined by as much as 5.3% annually. Outpatient spending grew much faster, by 11.2% in 2000, a 2.3 percentage point increase over 1999 [1]. Total hospital spending rose 5.1%, representing roughly 36% of total personal healthcare expenditures in 2000[1]. Hospitals* contributed an estimated 43% of the growth in total health expenditures in 2000, surpassing pharmaceuticals as the greatest contributor to rising costs. The table below provides an historical summary of the trends in per capita expenditures by type of healthcare service.

Figure 1



Source: Center for Health System Change. Data Bulletin: Tracking Health Care Costs: An Upswing in Premiums and Costs Underlying Health Insurance; No 20, November 2000

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[1] This percentage is down from close to 42% in 1990, due largely to a decline in inpatient utilization brought about by the shift from indemnity to managed care (Heffler et al, CMS, March-April 2002)
*Inpatient, outpatient and emergency department services combined.

The literature identifies a number of reasons for the 2000 (and 1999) inpatient cost increase, including:

- The reversal of historical declines in length of stay and inpatient admissions
- Accelerating payroll costs, due to increased hours (driven by increased patient volume) more than to increased wages
- Rising pharmaceutical costs
- Rising energy costs
- A relaxation of managed care leading to increased admissions and emergency room use
- The BBRA which boosted Medicare spending by 5.6% in 2000, compared to 1.5% in 1999
- Increased consolidation of hospitals, leading to greater bargaining power against health plans.[ii]

Besides specific political, market and cost factors, more general factors have been noted in the literature as well. Quality of care factors are identified in the literature as pushing inpatient costs higher. The Institute of Medicine has identified poor quality care as a major contributor to rising hospital costs as well as to unnecessary loss of life, estimating that at least 44,000, and as many as 98,000 Americans die each year as a result of medical errors. [iii] As technology advances and intensity of services increases, the potential for hospital errors has gone up.

The key findings of our analysis are:

- Nursing cost center direct costs constitute roughly 44% of the direct cost of inpatient care; payroll costs are 80% of those direct costs. Thus small increases in nursing payroll costs will have relatively large effects on inpatient hospital costs. Hospital payroll increased 3.7% in hospitals in 2000, which, when applied to inpatient nursing cost center payroll alone, would translate into roughly 47% of the 2.8% increase in inpatient cost in 2000.

- Pharmacy cost center direct costs are 6.8% of inpatient costs. It is unlikely that these costs rose at the 14% rate of total pharmacy costs in 2000, given the stronger purchasing power and formulary controls that hospitals can exert relative to the average consumer.

- For six common quality indicators for inpatient care, the gross direct cost of poor outcomes is estimated to be $6.4 billion nationally, accounting for 2.3% of total inpatient hospital expenditures [iv]. If hospitals were able to reduce the level of unfavorable outcomes for just these six indicators to the incidence rate of the lowest quartile, the gross cost reduction, prior to the added costs of implementing

such changes, would be $2.9 billion per year. The change in incidence rates required to achieve error rates of the lowest quartile is roughly equal to the 50% reduction called for by the Institute of Medicine in its 2000 report, To Err is Human[1].

- The gross direct cost burden of ambulatory care sensitive condition admissions (ACSC) is estimated to be $18 billion nationally, based on our sample of approximately 45% of nationwide hospital discharges. This amount represents 6.2% of the inpatient hospital expenditure in 2000. The gross cost burden cannot be reduced without additional ambulatory and pharmaceutical spending, but the net effect would be a significant cost savings.

- Approximately one-fifth of secondary care patients are treated in teaching hospitals at a direct cost per case that is 29% higher than in community hospitals, after adjustment for severity of illness. Secondary care represents 93% of the cases and roughly 78% of the total inpatient costs of teaching hospitals, so it is clearly not feasible to shift all secondary care to community hospitals. However, if the one-fifth of secondary care patients is extrapolated nationally, the country is paying roughly $5 billion in additional direct costs per year to treat secondary care patients in teaching hospitals (roughly 1.7% of total inpatient costs).

- As long as demand patterns by age cohort do not change significantly, the near term impact of population aging should not be a major factor in the increase in inpatient hospitals costs. However population growth will increase total healthcare costs over the next five years by roughly 7% for males and 6% for females (averaging 1.4% per year and 1.2% per year respectively).

- The gross direct cost burden of patients treated in teaching hospitals at costs above those of the lowest cost quartile of teaching hospitals was $5.4 billion (extrapolated nationwide). For community hospitals, the gross direct cost burden of patients treated in facilities at costs above the lowest quartile was $6 billion, extrapolated nationwide. The combined excess gross cost represents roughly 4% of total inpatient hospital expenditures in 2000. We did not detect systematic quality differences between the lowest cost and other hospitals, either teaching or community.

- The cumulative gross direct cost burden of quality incidence rates in excess of the best quartile, the ACSC burden, the additional cost of secondary care in teaching hospitals, and the costs of care in excess of that provided by the lowest cost quartile hospitals total roughly $41 billion for 2000, or 14% of total inpatient cost. This cost burden represents areas in which payers can exert some influence over hospital inpatient costs in ways that can also improve patient care quality.

UNDERSTANDING RISING HOSPITAL INPATIENT COSTS: KEY COMPONENTS OF COST AND THE IMPACT OF POOR QUALITY

Background and Overview

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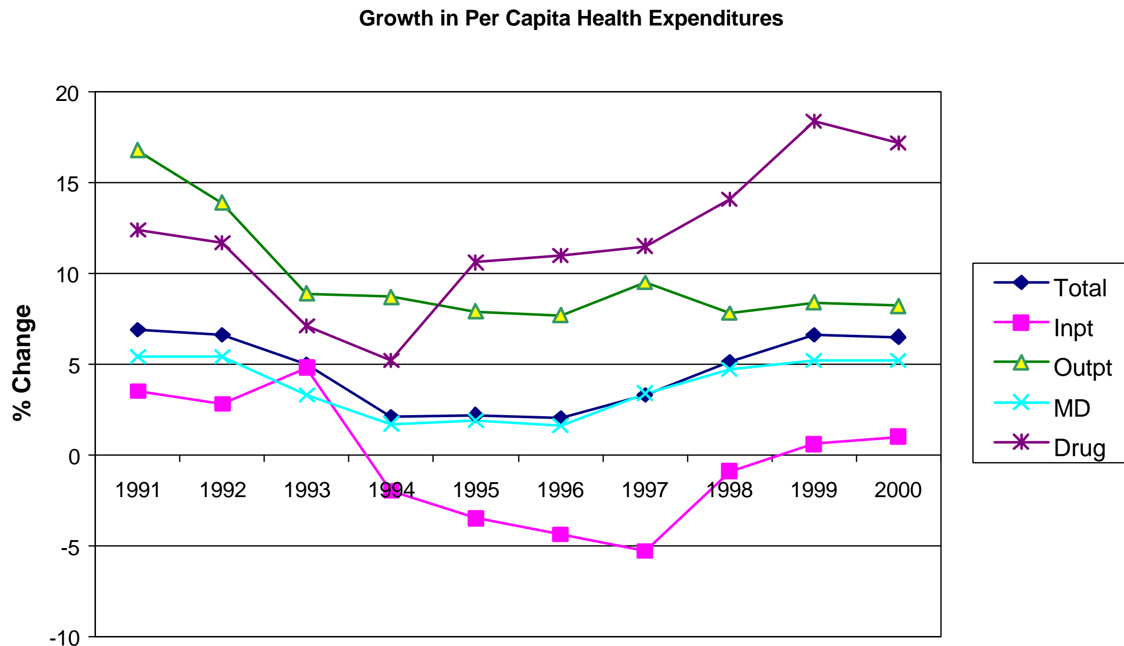

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Besides specific political, market and cost factors, more general factors have been noted in the literature as well. Quality of care factors are identified in the literature as pushing inpatient costs higher. The Institute of Medicine has identified poor quality care as a major contributor to rising hospital costs as well as to unnecessary loss of life, estimating that at least 44,000, and as many as 98,000 Americans die each year as a result of medical errors. [vii] As technology advances and intensity of services increases, the potential for hospital errors has gone up.

As inpatient day demand decreased over the early – mid 1990's, concerns have also grown over the incentives for inappropriate admissions and low volume surgical services. The Leapfrog Group (TLG), a consortium of employers, are demanding that hospitals maintain surgical volume adequate to maintain quality, contending that this is currently not the case. A recent study of the impact of facility surgical volume on mortality of Medicare patients concluded that "Medicare patients undergoing selected cardiovascular and cancer procedures can significantly reduce their risk of operative death by selecting a high volume hospital." [viii]

A similar concern has been voiced about rising admissions of patients for conditions that should have been handled at the primary care level (Ambulatory Care Sensitive Conditions – ACSC). While it is possible that some ACSC admissions are due to a shortage of primary physicians in an area, research indicates that ACSC admissions may be due partially to an increase in excess beds, as well as to inadequate pharmacy coverage and the increased incidence of certain chronic diseases.[ix] A recent analysis of trends in ACSC admissions found that the rate of such admissions increased almost 35%, from 99.2 per 10,000 in 1980 to 133.8 in 1998, even as hospitalizations for other conditions declined 33% over the same period. This rate rose most sharply for those over age 65 and for black patients under age 65.[x]

In an effort to keep beds full in the face of long-term reductions in inpatient demand, in some markets teaching hospitals increased their efforts to compete with community hospitals for patients needing only secondary-level inpatient care[xi]. To the extent that this occurred, secondary care patients are being treated in more expensive sites. [xii]To counter this trend, some insurers are designing products that offer lower-cost networks or

co-payment/deductible arrangements to enrollees who seek secondary care in lower-cost community hospitals.[3]

Finally, some suggest that the impact of an aging population, coupled with population growth, is starting to be felt and may contribute to an "inpatient renaissance."[xiii] An increase in hospital admissions began in 1999, reversed a 15-year trend of declining admissions (even as length of stay declined slightly). Over 33 million people were admitted to hospitals in 2000, up from a low of 30.7 million in 1994. Signs of strain are evident in certain markets (e.g. New York City, Boston), despite a nationwide condition of excess bed capacity, and 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 over 95%[xiv]. While not all of the increase in demand can be attributed to aging or population growth, the trend is being taken seriously enough by some hospitals that they are planning to add bed capacity in some markets.[xv]

All of these are among the factors that have been identified in the literature as contributing to rising hospital costs. Not all factors can be precisely quantified or acted upon by payers or purchasers of care. Our research merges hospital discharge data with related hospital entity Medicare Cost reports for hospitals in ten states to estimate the gross impact on total inpatient hospital cost of the factors that are measurable with this database:

- rising payroll costs, particularly those that are nursing-related
- rising pharmaceutical costs
- cost of adverse effects and other measurable indicators of poor quality
- cost and mortality implications of lower-volume admissions for select procedures
- cost of ACSC admissions
- the cost of secondary care in teaching versus community hospitals.
- the cost effect of an aging and growing population
- the cost effect of variation in hospital cost and quality, using a "best practices" model

Each of these factors is described in greater detail in the sections that follow.

[3] See, for instance, the HMO Blue Preferences product of Blue Cross Blue Shield of Massachusetts, as well as similar products ("tiering" based on hospital cost) in Washington and California)

General Methodology Overview

Selection Criteria
We selected all acute general hospitals in ten states, regionally distributed as follows:

Northeast	Massachusetts, New York
South	Virginia, Florida
Southwest	Texas
Mid-West	Illinois, Iowa
West	California, Washington, Colorado

These states, which include approximately 45% of the inpatient discharges nationally, have publicly available data that contain the necessary detail for our cost and quality analysis. Compared to national hospital statistics, they slightly over-represent large hospitals and underrepresent hospitals under 100 beds; and they overrepresent urban hospitals while underrepresenting rural hospitals.

Comparison of Bed Size and Urban/Rural Characteristics in 1998

	# Hospitals	Bed Size LT 100	Bed Size 100-299	Bed Size 300-499	Bed Size 500+	Urban	Rural
US	5015	45%	39%	11%	5%	56%	44%
Sample	1880	39%	42%	13%	6%	70%	30%

Source: AHA Hospital Statistics 2000

Data Sets
The two data sets involved are:

- the hospital Medicare Cost Reports (MCR) for fiscal year 16 (1999-2000), which provides direct and full cost information at the hospital and hospital cost center level (nursing, pharmacy, surgery, lab, etc), for inpatient and outpatient services combined;
- the 2000 Uniform Hospital Discharge Data Set (UHDDS), which provides charges (including charges disaggregated to the level of hospital cost centers), diagnosis and treatment (ICD-9-CM codes), age, and sex of patients receiving inpatient care. The UHDDS data, which describes individual patient admissions, can be aggregated to the level of the hospital.

In order to develop inpatient cost data for this study, UHDDS-based charges per discharge are marked down to cost using the hospital-specific ratio of cost-center costs to charges, applied to the UHDDS charges. This methodology provides reasonable cost estimates at the discharge level [xvi]. Patient discharges can then be aggregated at the DRG or specialty service level, using commercially available "grouper" software. To ensure proper comparisons among teaching versus community hospitals, we adjusted our results for severity of illness where appropriate. We used the Refined DRG (RDRG) system

from Yale as the basis for that adjustment. The RDRGs separate each surgical DRG into four severity levels and each medical DRG into three levels based on the secondary diagnoses, procedures, age, gender and discharge disposition of the patient.

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

We applied more specific methodologies to look at quality indicators, ambulatory care sensitive conditions, secondary versus tertiary care, TLG indicators and other factors. We describe these methodologies within each of the relevant sections.

Findings

Hospital Cost Structure

The literature indicates that payroll costs, of which nursing is the largest subset, contributed significantly to the rise in hospital costs in 2000:

- Weekly wages increased 4.1% in private hospitals, up from 2.3% in 1999[xvii]
- Total hospital payroll growth was 3.7% in 2000, up from 2.6% in 1999[xviii], and was driven by increased patient volume
- The 2000 payroll growth rate is related more to increased hours worked than increased wages; however the early data for 2001 suggest that wage increases are accelerating, surpassing wage growth in other industries.[xix]

According to our data sets, in aggregate (both in- and outpatient care), the nursing care cost center is the largest cost center of the hospital, representing 33% of total cost (see Table I). It represents an even larger portion of *inpatient* care total cost, roughly 50%. Inpatient nursing costs are much higher in teaching hospitals, averaging $2,379 per case, compared to community hospitals, which average $1,276 per case.

While not all nursing salaries are reported within the nursing cost center (some would be reported in the operating room costs and possibly other cost centers as well), it is clear that small increases in nursing costs will have a very large impact on total hospital costs, and on inpatient costs in particular.

Table I: Inpatient and Aggregate (In and Outpatient) Hospital Costs by Major Cost Centers

Department Area	Inpatient % Total Cost	Aggregate % Total Cost
Nursing	49.7%	33.2%
Operating Room	9.8%	13.3%
Laboratory	8.0%	8.6%
Radiology	3.7%	8.5%
Med/Surg Supplies	8.4%	6.2%
Pharmacy	7.9%	7.9%
Other	12.5%	22.2%

Table I also indicates that operating room, radiology, and "other" cost centers are much larger proportions of outpatient than inpatient costs. Proportions of lab cost are only slightly higher outpatient than inpatient, and pharmacy proportions are the same for in- and outpatient care. The only cost centers with a larger inpatient than outpatient proportion are nursing and medical-surgical supplies.

Table II breaks down the inpatient cost (total and direct) per case by those cost centers.. Direct costs represent roughly 55% of total costs of inpatient care overall, with some variation by cost center.

Table II: Inpatient Hospital Costs by Department*

Department Area	Total Cost per Case	Direct Cost per Case	Percentage of Direct Cost
Pharmacy	$499	$239	6.8%
Med/Surg Supplies	535	317	9.0%
Nursing	3,159	1,537	43.6%
Operating Room	622	351	10.0%
Laboratory	511	331	9.4%
Radiology	238	139	4.0%
Other	793	608	17.3%
	$6,358	$3,522	

*Excludes California, Illinois and Colorado, because the UHDDS data did not disaggregate charges to the level of these key inpatient cost centers

Nursing cost center costs are the largest portion of direct inpatient costs, roughly 44%. 80% of direct nursing costs are payroll-related; applying the 3.7% increase in payroll costs (above) to 80% of the 44% of direct inpatient cost that is nursing, the increase in inpatient nursing costs translate into roughly 47% of the overall increase in inpatient cost (2.8%) in 2000.

There has been a substantial rise in both pharmacy and medical/surgical supply costs in the last decade. Studies on prescription drug spending prepared for the US Dept of Health and Human Services have shown that much of the increase in prescription drug spending is from the introduction of newly-patented drugs. While in many instances new drug technologies have a positive impact on total health expenditures by helping to shorten or avert hospital stays, there remains substantial concern about the impact of direct-to-consumer advertising, inappropriate prescribing by physicians, and consumer compliance, all issues that contribute to inefficient and expensive drug use. These are particularly of concern for those drugs taken on an outpatient basis. On the hospital inpatient side, where hospital formularies have become common and consumer demand and compliance may be less critical factors, more has been written about the cost of medication errors than inappropriate use of expensive new drugs.

It is unlikely that inpatient pharmacy costs rose at the 14% rate of total pharmacy costs in 2000, given the stronger purchasing power and formulary controls that hospitals can exert relative to the average consumer. Assuming inpatient pharmacy costs rose at half the overall rate for pharmacy spending, or 7%, those increases would translate into another 14% of the increase in inpatient cost in 2000.

Quality Indicators

Background:
In 1999, the Institute of Medicine released its report 'To Err is Human: Building a Safer Health System' in which they estimated that between 44,000 and 98,000 people die each year in hospitals due to preventable medical errors. Prior to this report, the Agency for Healthcare Research and Quality (AHRQ) developed a list of quality indicators, some of which can be drawn directly from the UHDDS data set.

We examined the impact of these quality indicators on hospital costs across large populations, using inpatient discharge data and six quality indicator measures developed by the Healthcare Utilization Project (HCUP)[xx] of AHRQ. These indicators are the most recent available from AHRQ for patient safety measures. AHRQ plans to update these indicators in the fall of 2002.

Six of the most commonly occurring and measurable quality problems in inpatient care were analyzed in this study. These include the rates of occurrence of nosocomial infections including wound infections, pneumonia and urinary tract infections, as well as rates of adverse effects, pulmonary compromise and mechanical complications due to devices. These measures were chosen as they are quantifiable by our data and because they are susceptible to improvement.

Methodology and Findings:
We applied the definitions for the outcome of interest and population at risk as outlined by HCUP, and performed our analysis separately for teaching and community hospitals. The direct cost burden of the incidence of each quality indicator was calculated by using the difference in cost between those patients at risk but without unfavorable outcomes to the cost of patients with the unfavorable outcome. These calculations were done after adjustment for case mix differences. Table III shows the absolute number of patients with unfavorable outcomes and the cost burden of those outcomes.

Table III: Unfavorable Outcomes by Quality Indicator and Cost Burden

	Number of Patients with Unfavorable Outcomes		**Percent Greater Cost of Patients with Unfavorable Outcomes**	
Quality Indicator	Teaching Hospitals	Community Hospitals	Teaching Hospitals	Community Hospitals
Adverse Effects	102,846	303,978	55%	44%
Wound Infection	12,812	32,653	119%	101%
Pneumonia After Surgery	6,276	20,975	89%	76%
Urinary Tract Infection	11,505	36,218	47%	35%
Mechanical Complications	6,118	16,195	57%	52%
Pulmonary Compromise	8,607	25,398	83%	94%

We calculated the rate of incidence for each quality indicator and estimated the direct cost burden of incidence rates in excess of the lowest quartile mean incidence rate, after adjustment for case mix. The lowest quartile mean incidence rate was determined separately for teaching versus community hospitals within each state. The cost burden does not translate directly into savings estimates because they do not take into account the additional program costs that may be necessary to achieve such reductions.

Incidence rates for each indicator tend to be higher in the teaching hospitals, which may be because their patient populations are more complex despite the case mix adjustments made in our data. Another possible reason is that the systems of care in teaching hospitals may be more complex and difficult to coordinate[xxi]; care often involves a physician-in-training and multiple specialists, as well as more ancillary staff, requiring a greater level of communication and teamwork among caregivers. These system and care process issues could heighten the opportunities for adverse events to occur in teaching hospitals.

Table IV shows the incidence rates of the six quality indicators for teaching and community hospitals overall and for the lowest quartile. Table V quantifies the cost burden in direct costs of incidence rates in excess of the lowest quartile.

Table IV: Overall and Lowest Quartile Incidence Rates of Six Quality Indicators

	Overall Incidence Rate (% of at Risk Population)		Lowest Quartile Incidence Rate (% of at Risk Population	
Quality Indicator	Teaching Hospitals	Community Hospitals	Teaching Hospitals	Community Hospitals
Adverse Effects	3.44%	2.45%	2.36%	1.09%
Wound Infection	0.43%	0.26%	0.29%	0.12%
Pneumonia After Surgery	1.37%	1.26%	0.89%	0.65%
Urinary Tract Infection	3.26%	2.91%	1.96%	1.57%
Mechanical Complications	1.39%	1.02%	0.86%	0.50%
Pulmonary Compromise	2.25%	1.78%	1.43%	0.86%

Table V: Direct Cost Burden From Incidence Rates in Excess of the Lowest Quartile for Six Quality Indicators

	Direct Cost Burdene (in millions)		
Quality Indicator	Teaching Hospitals	Community Hospitals	Total Cost Burden
Adverse Effects	$192.7	$541.2	$733.9
Wound Infection	$63.1	$129.6	$192.7
Pneumonia After Surgery	$30.4	$73.0	$103.4
Urinary Tract Infection	$21.6	$41.8	$63.4
Mechanical Complications	$18.3	$36.1	$54.4
Pulmonary Compromise	$48.0	$121.2	$169.2
Total Cost Burden	$374.1	$942.9	$1,317.0

A large number of patients experience some type of unfavorable outcome during their stay in the hospital. Patients who have an unfavorable outcome incur higher costs than those who do not, both in teaching and community hospitals, across all six-quality indictors. For teaching hospitals, the increase in costs ranges from a low of 47% for urinary tract infection, to a high of 119% for wound infection. For community hospitals,

the increase in costs ranges from a low of 35% for urinary tract infection to a high of 101% for wound infection.

The total cost burden of incidence rates in teaching hospitals in excess of the lowest quartile is $374.1 million. For community hospitals, the burden is $942.9 million. Extrapolating these results nationwide, the excess cost burden is $2.9 billion.

Ambulatory Care Sensitive Conditions

Background:
According to Milliman & Robertson's LOS Efficiency Index and Admission Appropriateness Index, over 55% of all Medicare inpatient hospital days were potentially unnecessary in 1996. The Indices measure how efficient an individual hospital is relative to the actual length of stay and admission experience of the most efficient hospitals. At 1996 levels, the Medicare average LOS could be reduced from 6.4 days to 4.1 days if all care were provided at these levels, and admissions could be reduced by over 43%. The 55% figure can be broken down into two sources: 37% are due to longer than necessary LOS, and 18% are due to potentially avoidable admissions[xxii].

A study by Kozak et al. compared potentially avoidable hospitalizations due to ambulatory-sensitive conditions in 1980 to 1998. They found an alarming increase in these hospitalizations.[xxiii] The authors noted 2.2 million potentially avoidable hospitalizations in 1980, 5.9% of all hospitalizations for that year. This rose substantially to 3.7 million, or 11.5% of all hospitalizations in 1998. Rates of admission per 10,000 rose from 99.2 in 1980 to 133.8 in 1998. Rates of potentially avoidable hospitalizations rose rapidly for those 65 and older with little change for those younger. They noted no racial or gender differences in rates for the elderly. The increase rate in this age group was hypothesized to be due to a lack of prescription coverage. Rates of potentially avoidable hospitalizations decreased for children between 1980 and 1998, primarily due to a decrease in admissions for pneumonia. This may be due to an increase in the vaccination rate reducing those childhood illnesses that can lead to pneumonia.

For those individuals less than age 65, the rates of avoidable hospitalizations decreased for whites and increased for blacks, thus widening the gap between races between 1980 and 1998. In 1980 blacks had 72% more avoidable hospitalizations than whites. In 1998 this gap rose to 131%. For those under age 65 there were no differences in avoidable hospitalizations across payment sources.

When broken down by specific conditions the authors noted an increase in admissions for pneumonia, CHF, cellulitis, ruptured appendix and hypokalemia. There was also noted an increase in the mortality rate indicating that perhaps there has been an increase in the difficulty of treating pneumonia in the elderly. The increased admissions for CHF may be due to the increased survival rate from MI. Admission rates decreased for asthma, perforated or bleeding ulcer and pyelonephritis. There was no change in the rates for diabetics admitted with ketoacidosis or coma, and no change in the rate of admission for patients with malignant hypertension.

The Dartmouth Atlas project found that rates of ACSC discharges per 1000 population vary widely by region. The project found that the variation was not related to supply of primary care doctors but it was related to the supply of hospital beds. Others have suggested that differences in ACSC admission rates may be due to differences in the use of observation units among hospitals (which would not count toward admission).[4]

A study by Benbassat and Taragin, which reviewed recent literature on hospital readmissions, a subset of potentially avoidable admissions, found that most of them were caused by patient frailty and progression of chronic disease. The proportion of those judged on retrospective chart audits to be preventable varied from 9% to 50%. They concluded that global readmission rates are not a useful indicator of quality of care. However, high readmission rates of patients with defined conditions such as asthma and diabetes may identify quality of care issues[xxiv]

In summary, the literature suggests that over the last two decades, ACSC admissions are rising for reasons that vary by type of admission. The causes are complex, and include factors within a hospital's control, such as trying to keep beds full, as well as those external to hospital control, such as lack of pharmaceutical coverage, racial disparities in the delivery or effectiveness of primary care, a rise in antibiotic-resistant pneumonia; and a rise in the incidence of congestive heart failure. These are health system issues that require a coordinated and concerted effort among primary physicians, hospitals, payers, and patient populations to achieve improvement.

Methods and Findings:
We examine our data for ACSC. These include COPD, chronic hypertension, asthma, diabetes, and CHF.

The purpose of our analysis was not to determine what proportion of such patients should be treated outside the inpatient hospital, but rather to identify the direct cost burden of treating those patients on an inpatient basis. It is beyond the scope of our data to estimate the additional ambulatory and pharmaceutical costs that would be incurred to treat these patients on an ambulatory rather than an inpatient basis. To identify potentially unnecessary admissions, we used the 16 ACSC indicators defined by the University of California San Francisco -Stanford Evidence-based Practice Center[xxv]:

[4] Personal communication, Barbara Rothenberg, Excellus, June 2002.

ACSC/Avoidable Hospitalization

Dehydration
Bacterial pneumonia
Urinary infection
Perforated appendix
Angina
Adult asthma
COPD
Congestive heart failure
Diabetes, short-term complications
Diabetes, long term complications
Diabetes, uncontrolled
Lower Extremity Amputation
Hypertension
Low birth weight
Pediatric asthma
Pediatric gastroenteritis

In our sample, we found 2.1 million admissions for ACSC, 0.3 million in teaching hospitals and 1.8 million in community hospitals. ACSC admissions represented 13.7% of admissions overall, 11.1% of admissions for teaching hospitals, and 14.3% for community hospitals. The direct cost of these admissions was $8.2 billion. The top four conditions, representing roughly 2/3 of ASC-related direct cost and days of care required, were bacterial pneumonia, congestive heart failure (CHF), low birth-weight infants, and chronic obstructive pulmonary disease (COPD) as seen in Table VI. 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 impact on hospital costs, accounting for only 8.3% of the admissions but 28.4% of the direct costs.

The inpatient direct cost burden of ACSC admissions is significant. Extrapolated nationwide, direct cost burden could be as high as $18 billion. As mentioned before, the cost burden cannot be directly translated into cost savings as there would be additional spending on outpatient care, prescription drugs, or other community services in order to avoid these types of admissions.

Table VI: Prevalence and Economic Impact of Ambulatory Care Sensitive Conditions

ACSC Indicator	# of Cases	Average LOS	Average Dir Cost	Direct Cost (mil)	% of Cases	% of Dir Cost	% of Days
Bacterial Pneumonia	459,317	6.0	$3,820	$1,754.7	21.5%	21.5%	22.1%
CHF	433,214	5.6	3,934	1,704.2	20.2%	20.9%	19.5%
Low Birthweight	101,496	16.6	11,740	1,191.6	4.7%	14.6%	13.6%
COPD	259,687	5.4	3,457	897.8	12.1%	11.0%	11.4%
Diabetes LT	107,119	6.9	4,540	486.3	5.0%	6.0%	6.0%
UTI	177,220	4.8	2,675	474.1	8.3%	5.8%	6.9%
Dehydration	158,026	4.2	2,238	353.7	7.4%	4.3%	5.3%
Lower Extr Amp	36,746	12.3	8,511	312.7	1.7%	3.8%	3.6%
Adult Asthma	103,614	4.0	2,561	265.4	4.8%	3.3%	3.3%
Perforated Appendix	37,660	6.1	5,184	195.2	1.8%	2.4%	1.9%
Diabetes ST	41,914	4.5	3,474	145.6	2.0%	1.8%	1.5%
Pediatric Asthma	69,894	2.5	1,535	107.3	3.3%	1.3%	1.4%
Angina	53,065	2.2	1,829	97.0	2.5%	1.2%	0.9%
Hypertension	37,313	3.4	2,241	83.6	1.7%	1.0%	1.0%
Diabetes Uncontrolled	24,459	3.8	1,897	46.4	1.1%	0.6%	0.8%
Pediatric Gastroenteritis	39,759	2.2	1,050	41.8	1.9%	0.5%	0.7%
Total	2,140,503	5.8	$3,811	$8,157.4			

The Leapfrog Group Volume Indicators

Background:
The Leapfrog Group (TLG) is a consortium of more than 90 Fortune 500 companies and other healthcare purchasers of health benefits. Combined, they provide benefits to 28 million Americans, spending $52 billion a year. TLG's mission is "to trigger a giant leap forward in quality, customer service and affordability of healthcare of all types." Members of TLG have agreed to purchase healthcare benefits based on a goal of increasing patient safety and implementing healthcare quality initiatives.

TLG's initial recommendations, as presented in November of 2000, include hospitals installing computer physician order entry (CPOE), creating a system for evidence-based hospital referral, and having hospitals employ intensivists in their ICUs. These initial three recommendations were chosen based on four criteria: 'overwhelming' scientific evidence that the measures would improve patient safety; compliance with the measures would be feasible in the near future; the value of the measures would be readily understandable by the consumer; and that consumers, health plans, and purchasers would be able to easily determine which facilities had implemented the measures.

TLG expects tremendous benefit to the patient from instituting these measures. CPOE has been shown to reduce rates of error overall by 55% and to reduce those medication errors classified as 'serious' by 86%[xxvi]. Some studies have shown even greater

reductions in errors up to 70%[xxvii]. TLG estimates that CPOE systems could reduce serious medication errors by over 500,000 a year.[xxviii]

TLG's second measure is to shift complex medical procedures to high volume facilities, which have been shown to improve outcomes. These are listed in Table VII.

Table VII: Evidence-Based Hospital Referral (EHR): Leapfrog High Volume Recommendations

Procedure	Favorable Hospital Volume Characteristic
CABG	≥ 500/year
Angioplasty	≥400/year
AAA repair (nonruptured)	≥30/year
Carotid endarterectomy	≥100/year
Esophageal cancer surgery	≥7/year
Delivery with EFW <1500 g or EGA <32 weeks; or delivery with pre-natal dx of major congenital anomalies	Regional neonatal ICU with average daily census ≥ 15

TLG estimates a savings of 2,581 lives a year[xxix] by shifting complex surgeries to high volume centers. In addition they estimate saving 1,863 babies lives each year .[xxx] While not necessarily cost saving, the result of this move would be a reduction in a patient's mortality risk of more than 30%. However there is considerable concern about the impact of volume shifts on the capacity of hospitals receiving the volume, and on the financial stability and service capacity of those hospitals losing the volume. The highly specialized resources needed to perform these procedures may be needed for other types of procedures in hospitals with low volume for a specific procedure. Also, the use of a specific volume cutoff does not appear to be justified by the relatively small changes in mortality for volumes just below the Leapfrog volume criteria. The cut-off points for volume criteria are arbitrary; a recent NEJM article[xxxi] found that the relationship between volume and mortality is a continuously linear one; hospitals just below the cut-off may do just as well as hospitals just above the cutoff. The biggest differences are between the highest and lowest 10th percentiles.

TLG's final measure is to staff ICUs by intensivists. Having a physician dedicated to the patients in the ICU has been shown to reduce patient mortality by more than 10%. Pronovost et al in 1999 did a review of existing literature on the association between physician staffing in the ICU and outcomes[xxxii]. They found that with increased staffing of intensivists in the ICU there was a consistent decrease in mortality rates. In a review of outcomes in Maryland hospitals doing Abdominal Aortic Surgery, Pronovost et al.[xxxiii] found that there was a 3 fold decrease in the mortality rate at hospitals in which daily rounds were done by a dedicated ICU physician.

TLG recently conducted an online voluntary survey of hospitals in the United States. Of the 241 hospitals that responded, only 3% had computerized medication-ordering systems

and 10% had intensivists in their ICUs for at least 8 hours per day. While these numbers were low, 30% of the hospitals indicated plans to have computerized ordering systems by the year 2004, and 18% planned to have intensivists in that same time frame
.

As TLG initiatives are taking hold, insurance companies have taken notice as well. For instance, a Blue and Cross Blue Shield Plan is offering financial incentives to those meeting TLG's criteria. The Plan will pay a 4% bonus of the hospitals payments if the hospital is using computerized medication ordering systems and using intensivists in their ICUs.

Methods and Findings:
In this study, we analyzed the mortality and cost implications of shifting TLG's five surgical procedures to the hospitals that met the TLG standards. Our data set did not include the information needed to identify hospitals that had a neonatal ICU with an average daily census of 15 or greater, so the cost and mortality implications could not be assessed.

We applied the TLG definitions of the surgical procedures and identified those hospitals that met the volume standard and those that did not. We then calculated the in-hospital mortality rate for each group as well as the average LOS and direct cost per case. This allowed us to estimate the additional deaths seen in hospitals not meeting the volume criteria, and the related LOS and direct cost differences.

Table VIV: Hospitals Meeting and Not Meeting TLG Criteria and their Mortality Rates

TLG 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%

Table VIII indicates that the highest compliance with TLG criteria was for coronary angioplasty, with 43% of hospitals and 80% of cases provided in hospitals with adequate volume. The lowest percentage in compliance was for esophageal cancer, with only 11.1% of hospitals meeting the criteria, representing 51.1%% of cases.

The compliance rates vary widely among states. For example, 58% of the hospitals in Massachusetts performing CABGs meet the criteria, compared with only 8% of the hospitals in Texas and Illinois, and none in Colorado. 95% of coronary angioplasties in New York and Massachusetts were performed in hospitals meeting criteria, while only

70% of the cases performed in Texas, Illinois and California were in hospitals that meet the criteria.

Overall mortality rates between those meeting and not meeting the compliance levels also varied considerably among procedures. For nonruptured abdominal aortic aneurysm repair (AAA), the mortality rate was 56% higher in hospitals not meeting the criteria than for those meeting it: 14.28 versus 9.16%. For esophageal cancer surgery, the mortality rate was 79% higher in those not meeting the criteria: 9.39% versus 5.25%. Likewise, the mortality rate in noncompliant hospitals is 36% higher for coronary angioplasty, but only 10% higher for CABG and 3% higher for carotid endarterectomy.

We quantified the number of deaths attributable to the higher mortality rates and further identified potential direct cost and LOS implications if all patients were treated in hospitals that met the volume criteria (Table IX), for our sample of hospitals.

Table IX: Implications for mortality, cost, and length of stay of a shift in volume to hospitals that meet TLG Volume Criteria

TLG Measure	Decreased mortality (number of deaths)	Cost Reduction or (Increase)	LOS Reduction or (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	(3,155)
Carotid Endarterectomy	7.5	$8.3 million	12,768
Esophageal Cancer Surgery	32.9	($5.0) million	4,585
Total for All Measures	1,060.3	$40.5 million	32,324

In our sample, a total of 1,060 deaths could potentially have been avoided if patients were treated in hospitals meeting volume criteria for the five procedures, primarily driven by the higher mortality rate for AAAs. Extrapolating nationally, 2,356 deaths could be avoided, a number close to the 2,581 deaths estimated by the TLG Group itself.

The most striking mortality reduction would be for AAAs. There were 433 potentially avoidable deaths and 8,383 cases in hospitals not meeting criteria. This compares to CABGs with 424.4 extra deaths from 81,160 cases, and angioplasties with 162 extra deaths from 51,922 cases.

In some cases, hospitals with volumes below TLG volume criteria achieved lower mortality rates than those with volume above the cutoff, as seen with CABGs in the state of Massachusetts, and carotid entarterectomy surgery in the states of Iowa, Illinois, New York and Washington (see Appendix 1-C). This may be because community hospitals have been able to develop a strong team approach that in and of itself has lowered mortality rates separate from volume levels. In addition, TLG fails to consider volumes on a per surgeon level. A solo surgeon at a community hospital may individually have

enough volume to achieve low mortality rates. However, the hospital itself might fail to achieve volume criteria. Also, as mentioned in the background section, the relationship between volume and mortality is linear, so volumes just below the cut-off may achieve just as low mortality as those above it. Thus rather than using the volume criteria to select hospitals for specific procedures or Center of Excellence designations, insurers may choose instead to focus on the mortality rates achieved, using as targets those rates achieved by hospitals at or above the volume cutoffs.

Teaching vs. Community Hospital Setting for Secondary Care

Background:
Most of the patient care that teaching hospitals provide is also provided in community nonteaching hospitals. While recent studies suggest that mortality may be lower for some conditions when care is provided in a large urban teaching hospital[xxxiv], there may be slightly higher rates of morbidity in teaching hospitals, even after adjusting for patient characteristics predictive of morbidity[xxxv]. However the cost of care in a teaching hospital is generally higher than that in a community hospital, even after adjusting for patient characteristics and disease severity[xxxvi].

A recent analysis of surgical procedures done on a national sample of teaching and nonteaching hospitals substantiated the accepted notion that teaching hospitals provide highly specialized procedures that are rarely done in nonteaching hospitals; and they also provide a majority of specialized procedures.[xxxvii] However less specialized procedures represented 91% of major teaching hospital surgical procedures, representing 89% of teaching hospital days and 85% of teaching hospital charges for surgical procedures. Even though the volume of highly specialized and specialized procedures grew dramatically between 1989 and 1995, they still represented less than 10% of the surgical volume of a major teaching hospital. As the authors conclude, "…hospitals also may see in these findings the need to compete with community hospitals for less specialized surgical procedures that constitute the majority of surgical procedures in all types of hospitals. Strategic plans that focus on the specialized surgical procedures and ignore the less specialized procedures are not likely to fill the beds of major teaching hospitals."[xxxviii] The implications of these conclusions are that in some markets, at least, teaching hospitals have sought an increased market share in nonspecialized inpatient treatment.

Methods and Findings:
We identified as major teaching hospitals those that are members of the Council of Teaching Hospitals (COTH); all remaining hospitals were considered community hospitals for purposes of our analysis, with some minor adjustments for non-COTH hospitals that functioned as major teaching hospitals in terms of their case mix. We also excluded those COTH members with few inpatient discharges or those that were highly specialized, such as rehabilitation institutions. Using this definition, teaching hospitals provided 20% of the inpatient discharges in our 10-state sample; their share ranged from 5.2% in Colorado to 42.3% in Massachusetts (see Table X)

Table X: Discharges by state for teaching versus community hospitals

State	Teaching	Community	Total	% Teaching/Total
California *	234,854	1,676,137	1,910,991	12.2%
Colorado	23,317	418,632	441,949	5.2%
Florida	186,555	2,002,999	2,189,554	8.5%
Iowa	24,387	337,106	361,493	6.7%
Illinois	415,592	1,220,454	1,636,046	25.4%
Massachusetts	335,082	457,661	792,743	42.3%
New York	961,757	1,472,653	2,434,410	39.5%
Texas	381,884	2,191,925	2,573,809	14.8%
Virginia	142,551	679,133	821,684	17.3%
Washington	45,226	528,752	573,978	7.9%
Total Discharges	2,751,205	10,985,452	13,736,657	20%

* 6 months

Table XI below shows the proportion of tertiary and secondary care in teaching vs. community hospitals in terms of cases, days, charges and costs. For the purpose of our analysis, we defined secondary care as all non-tertiary inpatient cases. Tertiary cases included 23 DRGs that are performed predominately in a teaching hospital setting. Transplants, open heart surgery and craniotomies are among the tertiary services (see Appendix II for a list of the tertiary DRG's used).

Table XI: Proportion of Tertiary versus Secondary Care

	Teaching Hospitals		Community Hospitals	
	Tertiary	Secondary	Tertiary	Secondary
Cases	7.1%	92.9%	3.4%	96.6%
Days	12.1%	87.9%	5.6%	94.4%
Charges	23.2%	76.8%	14.1%	85.9%
Total Costs	22.5%	77.5%	12.8%	87.2%
Direct Costs	23.8%	76.2%	13.8%	86.2%

While teaching hospitals are the primary providers of tertiary care in most communities, in our sample, over 90% of their inpatient discharges and 76% of their direct costs are for secondary care. To the extent that secondary care in a typical teaching hospital costs more than in a community hospital, negotiating payment rates for secondary care using community hospital costs as the benchmark, could be a promising cost containment strategy, particularly in those states in which teaching hospitals treat a relatively high proportion of secondary cases.

We calculated the cost of secondary care in teaching and community hospitals and quantified the difference in direct cost between the two types of hospitals. In comparing the direct cost of secondary care in teaching and community environments, we adjusted for severity of illness using RDRGs. While using RDRGs may not capture all differences in severity of illness between teaching and nonteaching patients receiving secondary care, the literature suggests that further severity adjustments do not explain most of the difference in cost between teaching and nonteaching hospitals [xxxix].

Table XII: Secondary Care adjusted for severity of illness

Secondary Care	Teaching Hospitals	Community Hospitals	Total Hospitals	% Teaching > Community
Cases	2,774,698	12,228,194	15,002,892	
Average LOS	5.17	4.82	4.90	7.2%
Charge/case	$15,101	$13,045	$13,511	15.8%
Total cost/case	$6,843	$5,226	$5,572	31.0%
Direct cost/case	$3,736	$2,921	$3,101	27.9%

As shown in Table XII secondary care is more expensive to provide in teaching hospitals than in community hospitals. Overall, the average direct cost per case for teaching hospitals was $3,736, 28% higher than community hospitals at $2,921. In addition, average lengths of stay in teaching hospitals were 7% higher.

We also looked at five specialties representing a large portion of admissions to community hospitals: cardiology, general surgery, obstetrics, orthopedics and pulmonary, while excluding tertiary DRGs as previously described. These five specialties account for 47% of community hospitals admissions and 50% of teaching hospital admissions (excluding newborns).

As shown in Table XIII, these specialties are consistently more expensive in the teaching hospitals, ranging from 31% more expensive for pulmonary to 37% more expensive for general surgery. Of the $2.6 billion in cost burden from providing secondary care in teaching hospitals, $1.2 billion or 47% is accounted for by these five specialties. General surgery at $415 million and Orthopedics at $291 million represent the largest cost burden.

Table XIII: LOS, Direct Costs, LOS and Direct Cost Burden by Specialty*

Specialty	Teaching Hospital Cases	LOS Teaching % > Community	Dir cost Teaching % > Community	LOS Burden in Days	Dir Cost Burden in Millions
Cardiology	281,066	-0.5%	34.1%	-5,339	$208.4
General Surgery	249,981	4.1%	37.3%	65,879	415.1
Obstetrics	390,355	14.1%	33.5%	145,335	146.9
Orthopedics	243,594	0.0%	32.4%	-71	291.2
Pulmonary	223,443	-10.4%	31.2%	-110,487	171.5
Subtotal	1,388,439			95,316	$1,233.0
Other Specialties	1,386,259			99,913	1,412.6
All Specialties	2,774,698			195,229	$2,645.6

* Excludes newborns

A strategy to teaching hospitals for secondary care at community hospital rates, could have a large impact on payer expenditures for hospital care.[5]

Best Demonstrated Practice regarding LOS and Utilization

Methods and Findings:
Hospital treatment patterns vary dramatically for similar patients across institutions and across states. These differences in treatment patterns translate into differences in resource utilization as measured by LOS and cost per case. To quantify the magnitude of these differences, we identified the hospitals that fell into the lowest quartile for direct cost per case after adjustment for severity of illness and applied their practice patterns and cost structure to the remaining hospitals.

The analysis was performed separately for the teaching hospitals and community hospitals, by state. We excluded Iowa, Colorado and Washington from the teaching hospital analysis because they each had fewer than four teaching hospitals. We then quantified the direct cost savings that would potentially occur if the other teaching and community hospitals could emulate the best practice in their state. Best Practice was defined by the lowest quartile costs in each state.

[5] There were 30 million available bed-days in community hospitals in our sample; secondary patients in teaching hospitals use roughly 13.3 million bed-days. In our ten states, shifting all of the secondary care out of teaching hospitals and into community hospitals would still leave excess capacity in the community hospitals, assuming a community hospital is "full" at 85% of bed capacity (and not taking into account other capacity constraints such as nurse staffing).

We found that the direct cost per case for the lowest quartile teaching hospitals was 23.8% lower than the other teaching hospitals ($4,320 per case vs. $5,670 per case), ranging from 13.0% lower in Virginia to 29.8% lower in Massachusetts. The extra direct cost burden of teaching hospitals in the more expensive three quartiles was $2.4 billion across the sample, or approximately $5.4 billion nationwide (assuming the same proportion of teaching hospital discharges nationwide). The LOS for the lowest quartile teaching hospitals was 6.4% lower than the other hospitals (5.50 days vs. 5.88 days), ranging from 2.9% higher in Virginia to 13.4% lower in Florida.

The direct cost for the lowest quartile community hospitals was 17.0% lower than the other community hospitals ($2,940 per case vs. $3.542 per case), ranging from 14.5% lower in Iowa to 25.5% lower in Colorado. The extra direct cost burden of community hospitals in the more expensive three quartiles was $2.7 billion across the sample or approximately $6.0 billion nationwide. The LOS for the lowest quartile community hospitals was 4.7% lower than the other hospitals (4.70 days vs. 4.93 days), ranging from 2.8% lower in Illinois to 9.6% lower in Iowa.

Table XV below shows the variation by state within our sample for teaching hospitals after adjustment for severity differences among the teaching hospitals in the state.

Table XV: Teaching Hospital Direct Cost and Length of Stay Variation

Teaching State	Best Quartile Dir Cost	Other Hospitals Dir Cost	% Best Below Others	Dir Cost Burden (Millions)	Best Quartile LOS	Other Hospitals LOS	% Best Below Others	Excess Days (000)
California	$5,046	$6,354	20.6%	$333.2	5.47	5.62	2.6%	37.7
Florida	5,188	7,296	28.9%	278.6	5.34	6.16	13.4%	109.1
Illinois	3,863	5,000	22.7%	286.0	4.82	5.21	7.4%	96.4
Massachusetts	3,656	5,208	29.8%	362.7	5.00	5.01	0.3%	3.3
New York	3,874	5,198	25.5%	834.3	6.32	6.69	5.5%	231.2
Texas	5,413	6,631	18.4%	304.3	5.42	5.74	5.4%	77.8
Virginia	4,073	4,679	13.0%	33.9	4.62	4.49	-2.9%	-7.2
All States	**$4,320**	**$5,670**	**23.8%**	**$2,433.0**	**5.50**	**5.88**	**6.4%**	**548.3**

Table XVI below shows the variation by state within our sample for community hospitals after adjustment for severity differences among the community hospitals in the state.

Table XVI: Community Hospital Direct Cost and Length of Stay Variation

Community State	Best Quartile Dir Cost	Other Hospitals Dir Cost	% Best Below Others	Dir Cost Burden (millions)	Best Quartile LOS	Other Hospitals LOS	% Best Below Others	Excess Days (000)
California	$3,623	$4,562	20.6%	$1,392.5	5.21	5.49	5.1%	418.5
Colorado	3,719	4,989	25.5%	258.8	4.02	4.16	3.3%	28.1
Florida	3,157	3,826	17.5%	929.0	4.67	4.85	3.5%	237.9
Iowa	2,995	3,501	14.5%	91.5	4.17	4.61	9.6%	79.9
Illinois	2,558	3,133	18.4%	444.0	4.50	4.63	2.8%	100.1
Massachusetts	2,178	2,715	19.8%	169.0	4.13	4.47	7.7%	107.6
New York	2,493	3,220	22.6%	738.4	6.11	6.49	5.9%	387.9
Texas	2,012	2,536	20.7%	722.9	3.62	3.89	7.0%	373.8
Virginia	2,775	3,573	22.3%	358.3	4.72	4.91	3.9%	85.7
Washington	3,184	3,808	16.4%	189.7	3.97	4.12	3.8%	47.1
All States	**$2,940**	**$3,542**	**17.0%**	**$2,713.8**	**4.70**	**4.93**	**4.7%**	**1,182.1**

In both the teaching and community hospital groups, the cost variations from the best quartile are not just the result of length of stay differences. In the lowest cost quartile of teaching hospitals, LOS was 6.4% lower but direct cost was 23.8% lower. The comparable figures for community hospitals were 4.7% lower LOS compared with 17.0% lower direct cost.

Other factors accounting for the differences would likely include higher utilization of ancillary services (e.g., lab, radiology, pharmacy, OR) and higher cost per unit of service in routine and ancillary service areas in the hospitals that are not in the lowest cost quartile. Indirect or overhead costs do not explain any of the difference since we are comparing direct costs (i.e., before overhead allocation), rather than total costs.

A comparison of quality differences between the lowest cost quartiles and the other three cost quartiles showed mixed differences in outcomes. Here we used our six quality indicators as described earlier. As indicated in Table XVII, the lowest cost quartile of teaching hospitals had lower incidence rates in two of the six quality indicators (adverse effects and wound infection) and higher incidence rates in three others (pneumonia, pulmonary compromise and urinary tract infection). For community hospitals, the lowest cost quartile had a slightly lower rate of adverse effects and showed minimal differences for the five other quality indicators when compared to the higher cost quartiles.

Table XVII: Quality Comparison of Lowest Cost Quartile Hospitals to Other Hospitals

Quality Indicator	Teaching			Community		
	Lowest Quartile	Other Hospitals	Lowest/ Other	Lowest Quartile	Other Hospitals	Lowest/ Other
Adverse Effects	3.10%	3.51%	0.88	2.43%	2.53%	0.96
Wound Infection	0.35%	0.44%	0.80	0.27%	0.26%	1.02
Pneumonia	1.53%	1.24%	1.23	1.27%	1.27%	1.00
Urinary Tract Infection	3.38%	3.22%	1.05	2.97%	2.95%	1.01
Mechanical Comps	1.31%	1.33%	.98	1.03%	1.02%	1.02
Pulmonary Compromise	2.17%	2.00%	1.09	1.79%	1.80%	0.99

Influence of Changing Population Demographics on Hospital Costs

Background:
According to the Census Bureau, 16.5% of the U.S. population will be over age 65 in 2020[xl]. This compares to 12.7% of the population in 1999. The extent to which the aging population will stress the healthcare system is not well understood. Three of the most recent survey data sources (National Long-Term Survey, Medicare Current Beneficiary Survey and the National Health Interview Survey) show a reduction in disability levels in late 1990s compared to the early 1980s. The improvement of educational attainment in the elderly in recent decades is thought to be a key factor in improving health status[xli].

The 1996 Medical Expenditure Panel Survey (MEPS) showed that 5% of the population accounted for the majority of health expenditures. Half of the U.S. population consumes only 3% of all healthcare resources with an average annual expenditure of $122. Those in the top 1% of spenders account for 27% of aggregate expenditures, an average of $56,459 per person per year. However the high spenders tend to be younger and do not consider themselves to be in fair or poor health. The elderly account for only 46.3% of the top 1% of healthcare spenders[xlii].

The future behavior of the baby boomers is a variable that is hard to predict. The baby boomers comprise a population of 79 million people, with the first million of these reaching age 65 in the year 2011. The baby boomers led the fitness craze and as such are healthier and more educated about their health[xliii]. They are more comfortable questioning their physicians and see the physician-patient relationship more as a partnership than previous generations[xliv]. They are comfortable with technology[xlv]. In the year 2000 there were 52 million health-related hits on the Internet with baby boomers leading the way in using the Internet to educate themselves about their healthcare.[xlvi] They expect and demand good customer service. The baby boomers will be the first large group to benefit from our increased ability to manage chronic conditions.

As a group they educate themselves about the 'new' and the 'best' and demand more expensive drugs and more expensive medical technology. According to the National Institute for Health Care Management in 'Prescription Drug Expenditures in 2001: Another Year of Escalating Costs' the top five prescription drug categories were: Antidepressants, Antiulcerants, Cholesterol Reducers, Broad Antibiotics, and Antiarthritics. Of these, older Americans are the largest users of all but the antibiotics.[xlvii] However prescription drug costs for such chronic conditions are incurred primarily in outpatient care, and they reduce demand for inpatient care for the conditions treated by those drugs.

Methods and Findings:

In our analysis we estimate the cost impact of the change in population age and growth over the next 5 years, and assume that demand by age cohort will not change dramatically in that short time period. Combining 2000 population data with 2000 cost data in our ten sample states, we found that people 80 or older accounted for 2.5% of the population, while accounting for 13.5% of inpatient admissions and 15.6% of direct costs. People 65 to 79 accounted for 8.2% of the population, but 20.7% of inpatient admissions and 28% of direct costs. Those between 45 and 64 used inpatient resources in close proportion to their percentage of the population (23.2% of population, 24.3% of direct costs), while those under 45 used a much smaller proportion of resources (32.2%) than their percentage of the population (66.1%). Due to childbirth, females between 18 and 44 used substantially more resources than males (12.8% vs. 7.6%), although when hospitalized, males cost more per case.

Table XIV: Population, Admissions, Direct Cost by Age Category and Gender

Age Category	% of Population (2000)			% of Admissions			% of Direct Cost		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
Under 18*	13.1%	13.2%	26.2%	9.7%	9.5%	19.2%	6.2%	5.5%	11.7%
18 to 44	19.8%	20.1%	39.9%	7.2%	20.0%	27.2%	7.6%	12.8%	20.5%
45 to 64	10.7%	12.4%	23.2%	9.6%	9.8%	19.4%	12.9%	11.3%	24.3%
65 to 79	4.0%	4.2%	8.2%	9.7%	11.1%	20.7%	13.9%	14.1%	28.0%
80+	1.2%	1.4%	2.5%	4.9%	8.6%	13.5%	6.1%	9.5%	15.6%
Total	**48.8%**	**51.2%**	**100.0%**	**41.0%**	**59.0%**	**100.0%**	**46.7%**	**53.3%**	**100.0%**

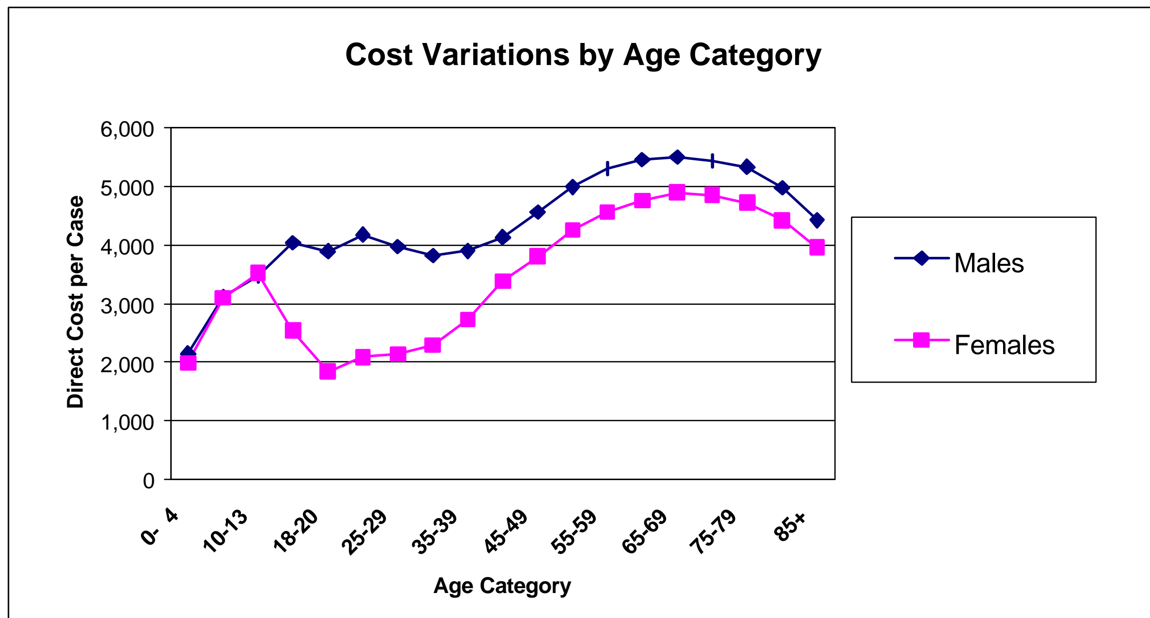
* includes newborns

Assuming no change in hospitalization rates within each age category and holding direct cost per case within each age category at the 2000 level, we estimated the impact on costs of the population size and age mix in 2005. This gives us what the 2005 population size and age mix would have cost in 2000.

We found that for males within our 10 state sample, direct costs would have been higher by 8.20%. Of the 8.20%, 7.04% is due to the increase in population size; only 1.16% is due to changes in the age mix. For females, direct costs would have been higher by 7.42% using the 2005 population size and age mix. Of the 7.42%, 5.87% is due to increase in population size, and only 1.55% due to changes in the age mix.

Thus, the aging of the population does not appear to be a major factor in pushing up healthcare costs, at least over the next five years. The reason for that can perhaps be best understood by viewing Figure 2, which shows how direct costs vary by age group in our sample population.

Figure 2



For males, direct cost per case rises from $4,133 per case at age range of 40 to 44 to a high of $5,494 for 65 to 69 and then declines to $4,421 at 85+. For females, direct cost rises from $3,386 for 40 to 44 to a high of $4,897 at 65 to 69 and then declines to $3,958 at 85+. This decline in cost per case after age 69 mitigates the impact of the general aging of the population on inpatient healthcare costs.

Limitations of this Research

This analysis is a “big picture” analysis based on administrative data from a sampling of hospitals that overrepresent larger, urban hospitals at the expense of small rural hospitals. Thus our findings may not be appropriate to apply to small rural hospitals or to particular local hospital markets. Also, the limitations of administrative data must be acknowledged, particularly in making adjustments for patient socioeconomic characteristics or co-morbidities that may further explain hospital cost or quality outcome variations.

Our definitions of clinical quality (the HCUP indicators) are only six commonly available measures; there are other measures of quality that may or may not have significant cost implications for hospitals. It is also important to remember that the Leapfrog volume criteria are indirect measures of hospital quality; in particular, a single volume cutoff for specific procedures is not consistent with the actual behavior of volume and mortality in other research. Rather, the Leapfrog criteria might be best used as a benchmark for where mortality rates should be (at or below), rather than where surgical volume must be.

It is important to note also that our cost data does not directly translate into amounts that could be saved if steps were taken to achieve better quality and lower costs. The managerial, political, and technical costs of implementation may be significant, although they should be viewed as investments with a high potential for ongoing operational cost payoff in the future.

Key Findings and Implications

The key findings of our analysis are:

- Nursing cost center direct costs constitute roughly 44% of the direct cost of inpatient care; payroll costs are 80% of those direct costs. Thus small increases in nursing payroll costs will have relatively large effects on inpatient hospital costs. Hospital payroll increased 3.7% in hospitals in 2000, which, when applied to inpatient nursing cost center payroll alone, would translate into roughly 47% of the 2.8% increase in inpatient cost in 2000.

- Pharmacy cost center direct costs are 6.8% of inpatient costs. It is unlikely that these costs rose at the 14% rate of total pharmacy costs in 2000, given the stronger purchasing power and formulary controls that hospitals can exert relative to the average consumer. Assuming inpatient pharmacy costs rose at half the overall rate for pharmacy spending, those increases would translate into another 14% of the increase in inpatient cost in 2000. Thus together, nursing and pharmacy cost increases could account for roughly 60% of the 2000 rise in inpatient costs.

- For six common quality indicators for inpatient care, the gross direct cost of poor outcomes is estimated to be $6.4 billion nationally, accounting for 2.3% of total inpatient hospital expenditures [xlviii]. If hospitals were able to reduce the level of unfavorable outcomes for just these six indicators to the incidence rate of the lowest quartile, the gross cost reduction, prior to the added costs of implementing such changes, would be $2.9 billion per year. The change in incidence rates required to achieve error rates of the lowest quartile is roughly equal to the 50% reduction called for by the Institute of Medicine in its 2000 report, To Err is Human[1].

- The gross direct cost burden of ambulatory care sensitive condition admissions is estimated to be $18 billion nationally, based on our sample of approximately 45% of nationwide hospital discharges. This amount represents 6.2% of the inpatient hospital expenditure in 2000. The gross cost burden cannot be reduced without additional ambulatory and pharmaceutical spending, but the net effect would be a significant cost savings.

- Encouraging hospitals to improve mortality rates of major surgical procedures to achieve mortality rates equivalent to those of "high volume" hospitals as defined by The Leapfrog Group (TLG) could substantially reduce patient deaths, by an estimated 2,356 deaths per year. Compliance with the TLG volume criteria varied widely from state to state, both in terms of number of hospitals meeting the criteria and percentage of patients treated in hospitals that meet the criteria. However most hospitals providing the TLG-identified procedures did not meet the volume criteria.

- Approximately one-fifth of secondary care patients are treated in teaching hospitals at a direct cost per case that is 29% higher than in community hospitals, after adjustment for severity of illness. Secondary care represents 93% of the cases and roughly 78% of the total inpatient costs of teaching hospitals. In every state, there exists enough community hospital bed capacity to absorb up to 100% of secondary care provided in teaching hospitals. If payers paid teaching hospitals the community hospital cost for secondary care, the savings could be substantial. However there would need to be an alternative method developed of paying for teaching and underreimbursed research costs, and possibly an increase in rates paid for highly complex care that may be currently subsidized by secondary care in teaching hospitals.

- As long as demand patterns by age cohort do not change significantly, the near term impact of population aging should not be a major factor in the increase in inpatient hospitals costs. However population growth will increase total healthcare costs over the next five years by roughly 7% for males and 6% for females (averaging 1.4% per year and 1.2% per year respectively).

- The gross direct cost burden of patients treated in teaching hospitals at costs above those of the lowest cost quartile of teaching hospitals was $5.4 billion (extrapolated nationwide). For community hospitals, the gross direct cost burden of patients treated in facilities at costs above the lowest quartile was $6 billion, extrapolated nationwide. The combined excess gross cost represents roughly 4% of total inpatient hospital expenditures in 2000. We did not detect systematic quality differences between the lowest cost and other hospitals, either teaching or community.

- The cumulative gross direct cost burden of quality incidence rates in excess of the best quartile, the ACSC burden, the additional cost of secondary care in teaching hospitals, and the costs of care in excess of that provided by the lowest cost quartile hospitals total roughly $41 billion for 2000, or 14% of total inpatient cost. This cost burden represents areas in which payers can exert some influence over hospital inpatient costs in ways that can also improve patient care quality.

Potential Strategies for Controlling Hospital Costs

The findings described above lead to several potential strategies for helping to control hospital costs.

- Reduce hospital admissions for ambulatory care sensitive conditions through introduction of meaningful incentives for hospitals and physicians. These incentives should encourage the development or expansion of disease management or other programs that identify patients with these conditions and provide focused services to avoid hospitalization. Given the importance of these admissions to some hospitals[6], the incentives need to be viewed by the hospitals as well as the providers as having financial benefits. Another intervention that both payers and providers might consider is the provision of pharmacy coverage for chronically ill elders (e.g. hypertension, diabetes), which might be funded from some of the savings that could come from reduced use of inpatient care.

- Lower the rate of adverse quality outcomes in the hospital through rewarding hospitals for improvements in their performance in absolute terms and in relation to their peers. Several health plans are already implementing such initiatives. Critical to success is reviewing quality indicators with hospitals preferably every six months and immediately rewarding improved performance. As our results indicate, improving quality can save a hospital significant resources and could potentially fund a large portion of targeted programs to reduce specific unfavorable outcomes. Health plan emphasis on the importance of quality performance by hospitals with attached financial rewards could have a significant influence.

- Encourage the shift of complex procedures to hospitals that meet the TLG volume criteria; or, alternatively, use the mortality rates of hospitals meeting the volume criteria as the basis for rewarding hospitals that achieve those levels of mortality, regardless of volume. Given that the mortality differences on either side of the TLG cut-off points are not large, the use of a single volume cut-off point is not justifiable. Hospitals should be motivated to achieve the quality levels of higher volume hospitals, however. This may be achievable by having fewer surgeons do more procedures, and/or by improving the care processes used during the patient stay, without having to achieving an institutional level of volume that hits the TLG cutoffs.

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[6] Note that in our other paper, we found that financially distressed hospitals had significantly higher proportions of ACSC discharges than did healthier hospitals.

The development of "Centers of Excellence" for complex procedures in institutions meeting the mortality levels of higher volume hospitals may be an effective way to motivate mortality improvements among all hospitals, especially those with lower volumes. A tiered payment system that recognizes those Centers of Excellence would provide patient incentives to seek surgical care in appropriate places.

- Encourage the shift of volume for less complex secondary care to community hospitals, within the capacity of community hospitals to absorb volume in secondary care. At the same time, for secondary care, payers could adopt the community hospital level of payment as the standard for paying all hospitals. As our results show, community hospitals provide secondary care at a substantially lower cost than teaching hospitals across multiple specialties. The development of tiered networks for secondary care where members have a lower deductible or co-payment at hospitals with lower cost (or offering a community hospital-equivalent rate) could help achieve this change. At the same time, payers need to get involved in public policy discussions of the appropriate funding of medical education. Putting most of the burden of medical education on the patients treated by teaching hospitals is not an equitable method of financing medical education, which benefits all people.

- Even more costs could be saved if the cost and LOS "standards" set by the lowest cost quartile of hospitals in each state, teaching or community, were used as the basis of payment discussions. Further research on how the lowest quartile hospitals achieve their cost structures would be worth pursuing; and appropriate lessons learned could be encouraged for adoption by the higher-cost hospitals.

The ultimate potential of these strategies is not only to slow down increases in hospital costs, but also to significantly improve the care provided and related outcomes for health plan members. Strong and well thought out incentives for providers in conjunction with meaningful information provided on a regular basis will be essential to success.

Appendix I – A
State Variation in Quality Indicator Performance

Quality Indicator	State	Overall Incidence Rate (% of at Risk Population)		Lowest Quartile Incidence Rate (% of at Risk Population)		Direct Cost Savings of Reduction to Lowest Quartile Rate (millions)	
		Teaching	Community	Teaching	Community	Teaching	Community
Adverse Effects	California	3.64%	2.51%	2.56%	1.03%	$46.6	$158.2
	Colorado	5.85%	3.03%	NA	1.25%	$0.0	$34.1
	Florida	4.77%	2.91%	3.45%	1.49%	$14.7	$94.7
	Iowa	8.44%	2.72%	NA	1.12%	$0.0	$15.6
	Illinois	2.96%	2.08%	1.96%	0.88%	$18.9	$44.0
	Massachusetts	4.24%	2.23%	2.88%	1.10%	$22.4	$9.3
	New York	2.91%	2.01%	1.72%	0.94%	$61.2	$42.2
	Texas	2.92%	2.09%	2.25%	0.78%	$18.5	$90.0
	Virginia	3.60%	2.29%	3.06%	1.11%	$4.6	$25.5
	Washington	5.46%	3.54%	3.20%	1.85%	$5.8	$27.5
	Total	**3.44%**	**2.45%**	**2.36%**	**1.09%**	**$192.7**	**$541.2**
Wound Infection	California	0.50%	0.27%	0.32%	0.11%	$19.2	$45.7
	Colorado	0.68%	0.29%	NA	0.18%	$0.0	$4.5
	Florida	0.57%	0.28%	0.31%	0.11%	$9.0	$24.1
	Iowa	0.64%	0.24%	NA	0.14%	$0.0	$1.8
	Illinois	0.33%	0.21%	0.25%	0.10%	$3.6	$7.0
	Massachusetts	0.44%	0.29%	0.37%	0.13%	$2.7	$3.1
	New York	0.38%	0.27%	0.20%	0.10%	$21.2	$16.5
	Texas	0.42%	0.26%	0.28%	0.12%	$5.2	$15.7
	Virginia	0.42%	0.25%	0.41%	0.11%	$0.2	$6.4
	Washington	0.79%	0.29%	0.58%	0.13%	$1.9	$4.9
	Total	**0.43%**	**0.26%**	**0.29%**	**0.12%**	**$63.1**	**$129.6**
Pneumonia After Surgery	California	1.39%	1.19%	0.67%	0.51%	$9.5	$27.8
	Colorado	0.87%	1.13%	NA	0.59%	$0.0	$3.4
	Florida	1.27%	1.06%	0.54%	0.50%	$2.5	$10.4
	Iowa	3.08%	1.90%	NA	1.41%	$0.0	$1.3
	Illinois	2.08%	2.34%	1.52%	1.36%	$3.2	$5.5
	Massachusetts	1.43%	1.38%	1.17%	0.56%	$2.1	$1.8
	New York	0.96%	1.16%	0.52%	0.47%	$7.8	$7.0
	Texas	1.08%	0.84%	0.72%	0.47%	$2.7	$9.8
	Virginia	1.03%	1.06%	0.78%	0.62%	$0.6	$2.2
	Washington	3.23%	1.25%	1.80%	0.69%	$1.9	$3.9
	Total	**1.37%**	**1.26%**	**0.89%**	**0.65%**	**$30.4**	**$73.0**
Urinary Tract Infection	California	2.09%	2.10%	1.27%	0.98%	$5.3	$19.1
	Colorado	2.28%	2.35%	NA	1.35%	$0.0	$2.4
	Florida	3.03%	3.29%	1.72%	1.87%	$2.0	$3.5
	Iowa	4.10%	3.92%	NA	3.02%	$0.0	$0.8
	Illinois	4.40%	4.98%	2.70%	2.97%	$3.6	$1.7
	Massachusetts	2.62%	2.90%	1.69%	1.78%	$2.1	$1.2
	New York	4.23%	3.34%	2.00%	1.32%	$6.7	$4.7
	Texas	2.46%	2.55%	1.83%	1.34%	$1.3	$5.9

Quality Indicator	State	Overall Incidence Rate (% of at Risk Population)		Lowest Quartile Incidence Rate (% of at Risk Population)		Direct Cost Savings of Reduction to Lowest Quartile Rate (millions)	
		Teaching	Community	Teaching	Community	Teaching	Community
Urinary Tract Infection (cont.)	Virginia	2.38%	2.84%	1.92%	1.67%	$0.3	$0.8
	Washington	4.10%	2.47%	3.47%	1.41%	$0.4	$1.7
	Total	**3.26%**	**2.91%**	**1.96%**	**1.57%**	**$21.6**	**$41.8**
Mechanical Complications	California	1.35%	1.02%	0.73%	0.46%	$2.4	$12.9
	Colorado	1.97%	1.11%	NA	0.36%	$0.0	$3.4
	Florida	1.66%	1.01%	0.76%	0.48%	$2.1	$5.5
	Iowa	2.70%	1.00%	NA	0.78%	$0.0	$0.6
	Illinois	1.88%	1.45%	0.96%	0.74%	$5.0	$3.5
	Massachusetts	1.30%	0.77%	0.91%	0.33%	$2.1	$0.9
	New York	0.95%	0.75%	0.43%	0.34%	$5.8	$3.2
	Texas	1.36%	0.95%	1.17%	0.47%	$0.4	$2.3
	Virginia	1.12%	0.87%	0.93%	0.51%	$0.4	$1.3
	Washington	3.49%	1.21%	3.48%	0.68%	$0.0	$2.4
	Total	**1.39%**	**1.02%**	**0.86%**	**0.50%**	**$18.3**	**$36.1**
Pulmonary Compromise	California	2.07%	1.96%	1.16%	0.93%	$14.7	$49.3
	Colorado	2.50%	1.87%	NA	0.81%	$0.0	$7.5
	Florida	4.30%	2.10%	2.93%	1.12%	$3.5	$15.8
	Iowa	11.92%	2.07%	NA	1.06%	$0.0	$3.9
	Illinois	2.61%	2.50%	1.91%	1.29%	$2.9	$4.9
	Massachusetts	1.67%	1.07%	0.82%	0.35%	$5.5	$2.8
	New York	1.55%	1.44%	0.85%	0.60%	$10.9	$9.6
	Texas	1.70%	1.17%	1.09%	0.60%	$4.5	$17.3
	Virginia	1.75%	1.62%	1.18%	0.65%	$1.1	$6.4
	Washington	6.23%	1.37%	3.02%	0.60%	$4.8	$3.6
	Total	**2.25%**	**1.78%**	**1.43%**	**0.86%**	**$48.0**	**$121.2**

Appendix I – B
State Variation in Ambulatory Care Sensitive Conditions

ACSC Indicator	# of Cases	Avg. LOS	Total Days	Avg. Dir Cost	Direct Cost (mil)	% of Cases	% of Days	% of Dir Cost
California								
Adult Asthma	20,660	3.9	80,037	$ 4,114.1	$85.0	4.1%	2.8%	3.4%
Angina	12,318	2.0	24,513	2,514	31.0	2.5%	0.9%	1.2%
Bacterial Pneumonia	121,440	6.2	749,528	5,077	616.5	24.4%	26.5%	24.7%
CHF	93,990	5.2	491,850	5,131	482.2	18.9%	17.4%	19.3%
COPD	57,506	5.6	320,021	4,995	287.3	11.5%	11.3%	11.5%
Dehydration	35,432	3.6	126,209	2,782	98.6	7.1%	4.5%	3.9%
Diabetes LT	24,926	6.1	150,952	5,535	138.0	5.0%	5.3%	5.5%
Diabetes ST	9,618	4.2	40,848	4,784	46.0	1.9%	1.4%	1.8%
Diabetes Uncontrolled	4,448	3.6	16,115	2,791	12.4	0.9%	0.6%	0.5%
Hypertension	6,466	4.0	26,174	2,923	18.9	1.3%	0.9%	0.8%
Low Birthweight	24,496	15.5	379,027	13,844	339.1	4.9%	13.4%	13.6%
Lower Extr Amp	7,970	11.4	90,810	10,631	84.7	1.6%	3.2%	3.4%
Pediatric Asthma	15,512	2.4	37,477	1,834	28.4	3.1%	1.3%	1.1%
Pediatric Gastroenteritis	11,982	2.1	25,510	1,284	15.4	2.4%	0.9%	0.6%
Perforated Appendix	11,384	5.8	66,118	6,018	68.5	2.3%	2.3%	2.7%
UTI	40,220	4.4	178,537	3,655	147.0	8.1%	6.3%	5.9%
Total	**498,368**	**5.7**	**2,823,753**	**$ 5,048.3**	**$ 2,499.1**			
Colorado								
Adult Asthma	2,206	3.1	6,870	$2,228.0	$4.9	4.8%	2.8%	2.5%
Angina	952	1.7	1,640	1,617	1.5	2.1%	0.7%	0.8%
Bacterial Pneumonia	10,600	4.5	47,892	3,479	36.9	23.0%	19.6%	18.4%
CHF	7,028	4.7	33,091	3,929	27.6	15.2%	13.6%	13.8%
COPD	5,250	4.2	22,246	3,370	17.7	11.4%	9.1%	8.8%
Dehydration	3,006	3.0	8,874	1,931	5.8	6.5%	3.6%	2.9%
Diabetes LT	2,150	5.8	12,406	5,378	11.6	4.7%	5.1%	5.8%
Diabetes ST	1,304	3.4	4,485	3,322	4.3	2.8%	1.8%	2.2%
Diabetes Uncontrolled	258	3.2	817	1,850	0.5	0.6%	0.3%	0.2%
Hypertension	697	2.5	1,709	2,052	1.4	1.5%	0.7%	0.7%
Low Birthweight	4,369	16.3	71,050	13,928	60.9	9.5%	29.1%	30.4%
Lower Extr Amp	680	10.4	7,088	10,091	6.9	1.5%	2.9%	3.4%
Pediatric Asthma	1,675	2.1	3,569	2,102	3.5	3.6%	1.5%	1.8%
Pediatric Gastroenteritis	845	2.1	1,786	1,238	1.0	1.8%	0.7%	0.5%
Perforated Appendix	1,431	5.5	7,891	5,072	7.3	3.1%	3.2%	3.6%
UTI	3,719	3.4	12,722	2,259	8.4	8.1%	5.2%	4.2%
Total	**46,170**	**5.3**	**244,136**	**$4,373.6**	**$200.2**			

ACSC Indicator	# of Cases	Avg. LOS	Total Days	Avg. Dir Cost	Direct Cost (mil)	% of Cases	% of Days	% of Dir Cost
Florida								
Adult Asthma	13,384	4.1	54,363	$2,233.7	$29.9	4.2%	3.1%	2.7%
Angina	7,795	2.2	17,051	1,667	13.0	2.5%	1.0%	1.2%
Bacterial Pneumonia	57,508	5.8	330,765	3,423	196.8	18.2%	18.9%	18.0%
CHF	76,030	5.3	402,453	3,525	268.0	24.0%	23.0%	24.5%
COPD	46,737	5.2	242,273	2,962	138.4	14.8%	13.9%	12.6%
Dehydration	22,103	4.0	88,022	2,130	47.1	7.0%	5.0%	4.3%
Diabetes LT	14,457	6.5	93,884	4,162	60.2	4.6%	5.4%	5.5%
Diabetes ST	5,588	4.4	24,813	2,990	16.7	1.8%	1.4%	1.5%
Diabetes Uncontrolled	4,039	3.7	14,787	1,758	7.1	1.3%	0.8%	0.6%
Hypertension	6,509	3.0	19,467	2,051	13.4	2.1%	1.1%	1.2%
Low Birthweight	12,433	17.7	220,497	12,927	160.7	3.9%	12.6%	14.7%
Lower Extr Amp	5,069	11.1	56,305	7,689	39.0	1.6%	3.2%	3.6%
Pediatric Asthma	9,069	2.6	23,892	1,576	14.3	2.9%	1.4%	1.3%
Pediatric Gastroenteritis	5,131	2.2	11,425	1,012	5.2	1.6%	0.7%	0.5%
Perforated Appendix	4,675	6.6	30,733	5,257	24.6	1.5%	1.8%	2.2%
UTI	26,000	4.5	116,644	2,365	61.5	8.2%	6.7%	5.6%
Total	**316,527**	**5.6**	**1,747,374**	**$3,490.7**	**$1,095.8**			
Iowa								
Adult Asthma	1,670	3.5	5,785	$1,876.5	$3.1	3.3%	2.2%	2.0%
Angina	1,581	2.0	3,222	1,475	2.3	3.1%	1.2%	1.5%
Bacterial Pneumonia	13,549	5.1	68,686	2,721	36.9	26.9%	26.1%	23.8%
CHF	9,694	5.1	49,790	3,220	31.2	19.3%	18.9%	20.1%
COPD	6,990	4.8	33,420	2,645	18.5	13.9%	12.7%	11.9%
Dehydration	3,610	3.7	13,224	1,770	6.4	7.2%	5.0%	4.1%
Diabetes LT	2,045	6.6	13,530	4,212	8.6	4.1%	5.1%	5.6%
Diabetes ST	792	3.6	2,865	2,321	1.8	1.6%	1.1%	1.2%
Diabetes Uncontrolled	388	3.6	1,380	1,562	0.6	0.8%	0.5%	0.4%
Hypertension	718	4.0	2,846	2,082	1.5	1.4%	1.1%	1.0%
Low Birthweight	1,790	19.2	34,345	14,421	25.8	3.6%	13.1%	16.6%
Lower Extr Amp	689	11.9	8,208	7,232	5.0	1.4%	3.1%	3.2%
Pediatric Asthma	921	2.2	2,029	1,184	1.1	1.8%	0.8%	0.7%
Pediatric Gastroenteritis	984	2.0	1,957	821	0.8	2.0%	0.7%	0.5%
Perforated Appendix	888	5.8	5,109	4,194	3.7	1.8%	1.9%	2.4%
UTI	4,045	4.0	16,364	1,923	7.8	8.0%	6.2%	5.0%
Total	**50,354**	**5.3**	**262,760**	**$3,102.2**	**$155.2**			

ACSC Indicator	# of Cases	Avg. LOS	Total Days	Avg. Dir Cost	Direct Cost (mil)	% of Cases	% of Days	% of Dir Cost
Illinois								
Adult Asthma	13,897	3.5	48,472	$2,097.5	$29.1	5.8%	3.9%	3.9%
Angina	6,080	2.3	13,698	1,543	9.4	2.5%	1.1%	1.3%
Bacterial Pneumonia	49,492	5.3	262,865	3,091	153.0	20.7%	21.4%	20.5%
CHF	51,415	5.2	266,871	3,247	166.9	21.5%	21.7%	22.4%
COPD	27,718	4.8	133,698	2,766	76.7	11.6%	10.9%	10.3%
Dehydration	17,497	3.9	67,588	1,890	33.1	7.3%	5.5%	4.4%
Diabetes LT	10,479	6.0	62,651	3,783	39.6	4.4%	5.1%	5.3%
Diabetes ST	4,325	4.1	17,599	2,635	11.4	1.8%	1.4%	1.5%
Diabetes Uncontrolled	3,895	3.5	13,744	1,493	5.8	1.6%	1.1%	0.8%
Hypertension	4,931	2.8	14,044	1,782	8.8	2.1%	1.1%	1.2%
Low Birthweight	10,650	14.6	155,344	10,319	109.9	4.4%	12.6%	14.8%
Lower Extr Amp	3,498	11.0	38,447	7,343	25.7	1.5%	3.1%	3.4%
Pediatric Asthma	8,290	2.2	18,595	1,350	11.2	3.5%	1.5%	1.5%
Pediatric Gastroenteritis	3,960	1.8	7,231	838	3.3	1.7%	0.6%	0.4%
Perforated Appendix	3,503	5.9	20,610	4,710	16.5	1.5%	1.7%	2.2%
UTI	19,960	4.4	87,682	2,218	44.3	8.3%	7.1%	5.9%
Total	**239,590**	**5.2**	**1,229,139**	**$3,129.8**	**$744.7**			

ACSC Indicator	# of Cases	Avg. LOS	Total Days	Avg. Dir Cost	Direct Cost (mil)	% of Cases	% of Days	% of Dir Cost
Massachusetts								
Adult Asthma	5,980	3.7	22,097	$1,979.1	$11.8	5.3%	3.6%	3.2%
Angina	2,276	2.2	4,942	1,500	3.4	2.0%	0.8%	0.9%
Bacterial Pneumonia	26,691	5.4	144,030	3,038	81.1	23.8%	23.4%	22.0%
CHF	23,308	5.0	116,995	2,928	68.2	20.7%	19.0%	18.5%
COPD	16,038	5.2	82,675	2,822	45.3	14.3%	13.4%	12.2%
Dehydration	8,829	4.1	35,854	1,998	17.6	7.9%	5.8%	4.8%
Diabetes LT	5,013	6.5	32,367	3,960	19.9	4.5%	5.3%	5.4%
Diabetes ST	1,760	4.2	7,443	2,737	4.8	1.6%	1.2%	1.3%
Diabetes Uncontrolled	595	3.8	2,245	1,726	1.0	0.5%	0.4%	0.3%
Hypertension	927	3.2	3,009	1,984	1.8	0.8%	0.5%	0.5%
Low Birthweight	5,030	17.2	86,550	13,621	68.5	4.5%	14.0%	18.5%
Lower Extr Amp	2,177	9.9	21,592	6,432	14.0	1.9%	3.5%	3.8%
Pediatric Asthma	2,325	2.3	5,256	1,405	3.3	2.1%	0.9%	0.9%
Pediatric Gastroenteritis	766	2.2	1,665	1,345	1.0	0.7%	0.3%	0.3%
Perforated Appendix	1,564	6.2	9,621	4,708	7.4	1.4%	1.6%	2.0%
UTI	9,069	4.4	40,085	2,233	20.2	8.1%	6.5%	5.5%
Total	**112,348**	**5.5**	**616,426**	**$3,319.0**	**$369.4**			

ACSC Indicator	# of Cases	Avg. LOS	Total Days	Avg. Dir Cost	Direct Cost (mil)	% of Cases	% of Days	% of Dir Cost
New York								
Adult Asthma	24,579	4.6	111,874	$2,201.0	$54.1	6.9%	4.4%	4.2%
Angina	11,724	2.7	31,740	1,492	17.5	3.3%	1.3%	1.3%
Bacterial Pneumonia	73,538	7.5	548,985	3,606	265.2	20.7%	21.7%	20.4%
CHF	70,054	7.2	506,883	3,658	256.3	19.7%	20.0%	19.7%
COPD	38,247	6.8	261,794	3,139	120.1	10.8%	10.3%	9.2%
Dehydration	25,379	6.1	155,476	2,481	63.0	7.1%	6.1%	4.8%
Diabetes LT	19,873	9.2	183,101	4,494	89.3	5.6%	7.2%	6.9%
Diabetes ST	6,890	6.1	42,301	3,343	23.0	1.9%	1.7%	1.8%
Diabetes Uncontrolled	5,601	4.5	25,059	1,845	10.3	1.6%	1.0%	0.8%
Hypertension	6,943	3.9	26,911	2,037	14.1	2.0%	1.1%	1.1%
Low Birthweight	14,290	18.1	257,969	14,473	206.8	4.0%	10.2%	15.9%
Lower Extr Amp	6,234	18.5	115,519	10,088	62.9	1.8%	4.6%	4.8%
Pediatric Asthma	14,146	2.6	37,217	1,230	17.4	4.0%	1.5%	1.3%
Pediatric Gastroenteritis	6,168	2.3	14,013	870	5.4	1.7%	0.6%	0.4%
Perforated Appendix	4,927	7.1	35,041	4,336	21.4	1.4%	1.4%	1.6%
UTI	26,917	6.5	175,802	2,717	73.1	7.6%	6.9%	5.6%
Total	**355,510**	**7.2**	**2,529,685**	**$3,694.5**	**$1,299.9**			
Texas								
Adult Asthma	12,119	3.8	45,507	$2,185.1	$26.5	3.6%	2.3%	2.3%
Angina	6,073	2.1	12,765	2,011	12.2	1.8%	0.6%	1.0%
Bacterial Pneumonia	69,038	5.7	393,171	3,618	249.8	20.3%	19.9%	21.3%
CHF	64,788	5.5	356,723	4,226	273.8	19.1%	18.1%	23.4%
COPD	38,042	5.2	197,248	3,249	123.6	11.2%	10.0%	10.5%
Dehydration	27,910	3.9	109,184	1,939	54.1	8.2%	5.5%	4.6%
Diabetes LT	19,279	7.0	134,008	4,282	82.6	5.7%	6.8%	7.0%
Diabetes ST	7,416	4.3	31,844	3,496	25.9	2.2%	1.6%	2.2%
Diabetes Uncontrolled	3,631	3.9	14,041	1,639	6.0	1.1%	0.7%	0.5%
Hypertension	7,610	3.2	23,972	2,416	18.4	2.2%	1.2%	1.6%
Low Birthweight	19,626	17.3	339,059	5,942	116.6	5.8%	17.2%	9.9%
Lower Extr Amp	6,991	10.9	76,349	6,859	47.9	2.1%	3.9%	4.1%
Pediatric Asthma	11,865	2.6	30,920	1,670	19.8	3.5%	1.6%	1.7%
Pediatric Gastroenteritis	6,961	2.4	16,456	996	6.9	2.1%	0.8%	0.6%
Perforated Appendix	5,655	6.2	35,310	5,275	29.8	1.7%	1.8%	2.5%
UTI	32,349	4.9	157,378	2,417	78.2	9.5%	8.0%	6.7%
Total	**339,353**	**5.9**	**1,973,935**	**$3,510.1**	**$1,172.2**			

ACSC Indicator	# of Cases	Avg. LOS	Total Days	Avg. Dir Cost	Direct Cost (mil)	% of Cases	% of Days	% of Dir Cost
Virginia								
Adult Asthma	6,184	4.0	24,773	$2,352.2	$14.5	5.2%	3.8%	3.7%
Angina	2,698	2.0	5,412	1,611	4.3	2.3%	0.8%	1.1%
Bacterial Pneumonia	22,486	5.6	126,689	3,228	72.6	19.0%	19.2%	18.5%
CHF	24,848	5.6	140,333	3,689	91.7	21.0%	21.3%	23.4%
COPD	15,892	5.4	85,107	3,052	48.5	13.5%	12.9%	12.4%
Dehydration	10,057	4.2	42,597	1,986	20.0	8.5%	6.5%	5.1%
Diabetes LT	6,073	6.4	39,077	3,775	22.9	5.1%	5.9%	5.8%
Diabetes ST	2,794	4.2	11,837	2,705	7.6	2.4%	1.8%	1.9%
Diabetes Uncontrolled	1,251	3.8	4,732	1,657	2.1	1.1%	0.7%	0.5%
Hypertension	1,863	3.0	5,583	2,066	3.8	1.6%	0.8%	1.0%
Low Birthweight	5,226	14.9	77,735	9,682	50.6	4.4%	11.8%	12.9%
Lower Extr Amp	2,265	12.3	27,793	7,980	18.1	1.9%	4.2%	4.6%
Pediatric Asthma	3,658	2.2	7,911	1,310	4.8	3.1%	1.2%	1.2%
Pediatric Gastroenteritis	1,746	1.8	3,181	766	1.3	1.5%	0.5%	0.3%
Perforated Appendix	1,837	6.1	11,164	4,615	8.5	1.6%	1.7%	2.2%
UTI	9,205	4.8	44,224	2,285	21.0	7.8%	6.7%	5.4%
Total	**118,083**	**5.6**	**658,148**	**$3,352.7**	**$392.3**			

ACSC Indicator	# of Cases	Avg. LOS	Total Days	Avg. Dir Cost	Direct Cost (mil)	% of Cases	% of Days	% of Dir Cost
Washington								
Adult Asthma	2,935	3.4	10,122	$ 2,162.2	$ 6.3	4.6%	3.3%	2.8%
Angina	1,568	1.6	2,568	1,514	2.4	2.4%	0.8%	1.0%
Bacterial Pneumonia	14,975	4.4	66,501	3,069	46.0	23.3%	21.8%	20.1%
CHF	12,059	4.2	50,069	3,167	38.2	18.8%	16.4%	16.7%
COPD	7,267	4.2	30,594	2,997	21.8	11.3%	10.0%	9.5%
Dehydration	4,203	3.2	13,443	1,928	8.1	6.5%	4.4%	3.5%
Diabetes LT	2,824	5.5	15,487	4,855	13.7	4.4%	5.1%	6.0%
Diabetes ST	1,427	3.3	4,769	2,808	4.0	2.2%	1.6%	1.8%
Diabetes Uncontrolled	353	2.9	1,040	1,689	0.6	0.5%	0.3%	0.3%
Hypertension	649	2.5	1,622	2,231	1.4	1.0%	0.5%	0.6%
Low Birthweight	3,586	17.1	61,433	14,668	52.6	5.6%	20.2%	23.0%
Lower Extr Amp	1,173	8.5	9,956	7,321	8.6	1.8%	3.3%	3.8%
Pediatric Asthma	2,433	2.2	5,254	1,421	3.5	3.8%	1.7%	1.5%
Pediatric Gastroenteritis	1,216	2.0	2,445	1,095	1.3	1.9%	0.8%	0.6%
Perforated Appendix	1,796	5.0	9,016	4,240	7.6	2.8%	3.0%	3.3%
UTI	5,736	3.5	20,221	2,184	12.5	8.9%	6.6%	5.5%
Total	**64,200**	**4.8**	**304,540**	**$ 3,598.5**	**$ 228.6**			

Appendix I - C
State Variation in TLG Volume Compliance

TLG Measure	State	% of Hospitals		% of Cases		Mortality Rate	
		Criteria Met	Criteria Not Met	Criteria Met	Criteria Not Met	Criteria Met	Criteria Not Met
AAA	California	11.4%	88.6%	38.6%	61.4%	9.32%	13.04%
	Colorado	20.0%	80.0%	49.8%	50.2%	9.85%	11.96%
	Florida	20.6%	79.4%	58.5%	41.5%	9.53%	15.63%
	Iowa	28.0%	72.0%	72.8%	27.2%	9.60%	12.14%
	Illinois	12.7%	87.3%	48.0%	52.0%	8.14%	13.67%
	Massachusetts	16.1%	83.9%	58.9%	41.1%	8.54%	15.34%
	New York	15.6%	84.4%	61.7%	38.3%	9.77%	18.73%
	Texas	14.7%	85.3%	56.1%	43.9%	9.11%	12.85%
	Virginia	16.3%	83.7%	59.8%	40.2%	8.32%	14.60%
	Washington	14.9%	85.1%	41.8%	58.2%	7.88%	11.98%
	Total AAA	**15.4%**	**84.6%**	**53.3%**	**46.7%**	**9.16%**	**14.28%**
CABG	California	10.6%	89.4%	33.4%	66.6%	2.77%	4.13%
	Colorado	0.0%	100.0%	0.0%	100.0%	0.00%	3.24%
	Florida	33.3%	66.7%	60.4%	39.6%	3.88%	4.25%
	Iowa	7.1%	92.9%	16.4%	83.6%	2.96%	3.29%
	Illinois	8.5%	91.5%	27.8%	72.2%	3.18%	3.47%
	Massachusetts	58.3%	41.7%	79.0%	21.0%	3.21%	1.53%
	New York	41.9%	58.1%	75.8%	24.2%	3.51%	4.07%
	Texas	8.0%	92.0%	29.8%	70.2%	4.13%	4.09%
	Virginia	1.9%	98.1%	17.2%	82.8%	0.19%	0.91%
	Washington	27.8%	72.2%	54.1%	45.9%	3.13%	3.93%
	Total CABG	**15.5%**	**84.5%**	**44.6%**	**55.4%**	**3.46%**	**3.82%**
Carotid	California	13.7%	86.3%	41.2%	58.8%	0.67%	0.72%
	Colorado	3.6%	96.4%	16.6%	83.4%	0.53%	1.28%
	Florida	30.0%	70.0%	68.1%	31.9%	0.79%	0.79%
	Iowa	18.5%	81.5%	50.7%	49.3%	0.97%	0.50%
	Illinois	10.6%	89.4%	35.3%	64.7%	1.16%	0.94%
	Massachusetts	13.2%	86.8%	39.2%	60.8%	0.41%	0.52%
	New York	15.9%	84.1%	55.0%	45.0%	1.05%	0.72%
	Texas	19.2%	80.8%	55.2%	44.8%	0.59%	0.94%
	Virginia	14.8%	85.2%	53.5%	46.5%	0.61%	0.98%
	Washington	17.0%	83.0%	44.5%	55.5%	0.47%	0.30%
	Total Carotid	**17.0%**	**83.0%**	**51.1%**	**48.9%**	**0.76%**	**0.78%**

TLG Measure	State	% of Hospitals: Criteria Met	% of Hospitals: Criteria Not Met	% of Cases: Criteria Met	% of Cases: Criteria Not Met	Mortality Rate: Criteria Met	Mortality Rate: Criteria Not Met
Angioplasty	California	36.8%	63.2%	68.1%	31.9%	1.58%	1.68%
	Colorado	57.9%	42.1%	79.8%	20.2%	1.52%	1.57%
	Florida	52.9%	47.1%	90.5%	9.5%	1.31%	1.77%
	Iowa	50.0%	50.0%	77.0%	23.0%	1.87%	2.16%
	Illinois	37.9%	62.1%	70.5%	29.5%	1.40%	1.92%
	Massachusetts	55.6%	44.4%	95.5%	4.5%	1.60%	1.82%
	New York	55.8%	44.2%	96.7%	3.3%	0.67%	0.95%
	Texas	36.1%	63.9%	70.2%	29.8%	1.52%	1.83%
	Virginia	44.4%	55.6%	86.0%	14.0%	1.03%	1.73%
	Washington	33.3%	66.7%	72.8%	27.2%	1.57%	2.31%
	Total Angioplasty	**42.7%**	**57.3%**	**80.0%**	**20.0%**	**1.32%**	**1.79%**
Esoph Cancer	California	12.0%	88.0%	42.6%	57.4%	5.80%	9.68%
	Colorado	0.0%	100.0%	0.0%	100.0%	0.00%	2.56%
	Florida	5.6%	94.4%	26.4%	73.6%	5.41%	11.65%
	Iowa	8.3%	91.7%	54.8%	45.2%	0.00%	0.00%
	Illinois	14.9%	85.1%	51.8%	48.2%	6.98%	7.50%
	Massachusetts	15.0%	85.0%	65.9%	34.1%	3.53%	9.09%
	New York	18.0%	82.0%	71.6%	28.4%	6.70%	9.86%
	Texas	3.4%	96.6%	39.0%	61.0%	0.00%	10.47%
	Virginia	20.0%	80.0%	64.5%	35.5%	10.00%	12.12%
	Washington	15.0%	85.0%	65.0%	35.0%	1.49%	11.11%
	Total Esoph Cancer	**11.1%**	**88.9%**	**51.1%**	**48.9%**	**5.25%**	**9.39%**

Appendix I – D
State Variation in Tertiary vs. Secondary Care

	Teaching Hospitals			Community Hospitals		
	Tertiary	Secondary	% Tertiary	Tertiary	Secondary	% Tertiary
California						
Cases	27,680	442,028	5.9%	111,928	3,240,346	3.3%
Average LOS	8.9	5.0	10.1%	8.1	5.1	5.3%
Charge/Case	96,616	21,620	21.9%	85,214	17,200	14.6%
Total Cost/Case	30,645	7,132	21.2%	25,701	5,382	14.2%
Direct Cost/Case	17,905	4,103	21.5%	15,497	3,144	14.5%
Colorado						
Cases	1,510	21,807	6.5%	15,731	402,901	3.8%
Average LOS	8.6	4.3	12.1%	7.2	3.8	6.9%
Charge/Case	64,296	13,542	24.7%	56,731	11,299	16.4%
Total Cost/Case	32,765	7,466	23.3%	30,370	5,871	16.8%
Direct Cost/Case	19,762	4,545	23.1%	17,363	3,288	17.1%
Florida						
Cases	16,034	170,521	8.6%	100,704	1,902,295	5.0%
Average LOS	8.4	5.1	13.6%	7.7	4.6	8.0%
Charge/Case	61,735	16,110	26.5%	56,927	14,429	17.3%
Total Cost/Case	24,281	7,540	23.2%	18,688	5,345	15.6%
Direct Cost/Case	15,079	4,516	23.9%	11,570	3,032	16.8%
Iowa						
Cases	2,142	22,245	8.8%	14,210	322,896	4.2%
Average LOS	8.2	5.2	13.1%	6.9	4.2	6.8%
Charge/Case	51,320	14,776	25.1%	35,847	7,756	16.9%
Total Cost/Case	21,911	6,707	23.9%	18,179	4,266	15.8%
Direct Cost/Case	13,937	4,043	24.9%	11,972	2,591	16.9%
Illinois						
Cases	25,469	390,123	6.1%	34,652	1,185,802	2.8%
Average LOS	8.2	4.6	10.5%	7.6	4.4	4.8%
Charge/Case	59,683	14,085	21.7%	54,073	11,458	12.1%
Total Cost/Case	24,389	6,052	20.8%	20,672	4,858	11.1%
Direct Cost/Case	14,128	3,374	21.5%	11,671	2,549	11.8%

	Teaching Hospitals			Community Hospitals		
	Tertiary	Secondary	Tertiary	Secondary	Tertiary	Secondary
Massachusetts						
Cases	30,092	304,990	9.0%	3,495	454,166	0.8%
Average LOS	8.6	4.7	15.1%	8.6	4.7	1.4%
Charge/Case	56,339	13,256	29.5%	40,235	8,681	3.4%
Total Cost/Case	25,605	6,527	27.9%	21,284	5,157	3.1%
Direct Cost/Case	15,340	3,575	29.7%	12,782	2,664	3.6%
New York						
Cases	64,204	897,553	6.7%	34,834	1,437,819	2.4%
Average LOS	11.1	6.0	11.7%	11.3	6.0	4.4%
Charge/Case	51,026	14,624	20.0%	39,114	9,927	8.7%
Total Cost/Case	27,607	7,479	20.9%	20,699	5,123	8.9%
Direct Cost/Case	15,115	3,667	22.8%	12,540	2,603	10.5%
Texas						
Cases	27,255	354,629	7.1%	78,385	2,113,540	3.6%
Average LOS	8.5	4.8	12.1%	7.7	4.7	5.8%
Charge/Case	54,740	12,444	25.3%	55,545	12,618	14.0%
Total Cost/Case	23,087	6,104	22.5%	19,695	5,341	12.0%
Direct Cost/Case	14,527	3,561	23.9%	12,439	2,975	13.4%
Virginia						
Cases	14,134	128,417	9.9%	17,915	661,218	2.6%
Average LOS	8.4	4.5	17.0%	9.0	4.6	5.0%
Charge/Case	45,709	10,400	32.6%	50,028	9,545	12.4%
Total Cost/Case	21,656	5,259	31.2%	21,853	4,872	10.8%
Direct Cost/Case	14,041	3,265	32.1%	14,111	2,817	12.0%
Washington						
Cases	2,841	42,385	6.3%	21,541	507,211	4.1%
Average LOS	7.9	4.8	9.9%	6.3	3.8	6.5%
Charge/Case	47,238	13,208	19.3%	41,154	8,853	16.5%
Total Cost/Case	27,330	7,849	18.9%	19,699	5,072	14.2%
Direct Cost/Case	18,660	5,011	20.0%	12,559	2,922	15.4%

Appendix I – E
State Variation in Population Demographics

Age Category	State	% of Population (2000)			% of Admissions			% of Direct Cost		
		Males	Females	Total	Males	Females	Total	Males	Females	Total
Under 18*	CA	13.4%	13.4%	26.8%	11.2%	11.6%	22.8%	7.2%	6.8%	14.0%
	CO	12.6%	13.8%	26.4%	10.7%	10.6%	21.3%	7.6%	6.4%	14.0%
	FL	11.8%	11.6%	23.5%	7.7%	7.4%	15.1%	4.8%	4.1%	8.9%
	IO	13.0%	13.2%	26.2%	8.6%	8.2%	16.7%	5.2%	4.2%	9.4%
	IL	13.5%	13.3%	26.8%	8.8%	8.5%	17.3%	5.4%	4.7%	10.1%
	MA	12.4%	11.7%	24.0%	8.2%	7.7%	15.9%	5.5%	4.8%	10.3%
	NY	12.9%	12.2%	25.1%	8.6%	8.0%	16.6%	5.4%	4.7%	10.1%
	TX	13.9%	15.0%	28.9%	11.2%	11.0%	22.1%	7.0%	6.2%	13.2%
	VA	12.1%	12.7%	24.8%	8.9%	8.5%	17.4%	4.9%	4.2%	9.1%
	WA	12.6%	13.5%	26.1%	10.4%	9.8%	20.2%	6.4%	5.5%	11.8%
18 to 44	CA	20.7%	21.4%	42.1%	6.9%	19.9%	26.8%	7.5%	13.4%	20.9%
	CO	19.1%	21.4%	40.5%	7.6%	23.6%	31.2%	9.1%	14.2%	23.3%
	FL	17.6%	18.2%	35.8%	6.8%	17.1%	23.9%	7.1%	10.9%	18.0%
	IO	18.9%	17.8%	36.7%	6.1%	18.1%	24.2%	6.3%	10.8%	17.0%
	IL	19.8%	19.3%	39.1%	7.8%	20.2%	28.0%	7.7%	13.2%	20.9%
	MA	20.4%	20.3%	40.7%	7.4%	18.7%	26.1%	7.8%	12.9%	20.7%
	NY	20.0%	19.2%	39.2%	9.3%	19.7%	28.9%	8.9%	12.2%	21.1%
	TX	19.6%	20.4%	40.1%	5.8%	22.4%	28.2%	6.9%	13.5%	20.3%
	VA	20.6%	21.1%	41.7%	7.3%	20.6%	28.0%	7.2%	13.0%	20.2%
	WA	19.4%	20.2%	39.7%	6.7%	21.9%	28.6%	8.2%	14.7%	22.9%
45 to 64	CA	9.9%	11.8%	21.7%	9.1%	9.2%	18.4%	12.4%	10.7%	23.1%
	CO	11.7%	12.6%	24.3%	9.4%	9.8%	19.2%	13.9%	11.8%	25.7%
	FL	10.8%	13.2%	24.0%	10.0%	10.0%	20.0%	12.9%	11.0%	23.9%
	IO	11.6%	12.6%	24.2%	9.0%	9.1%	18.0%	12.7%	10.8%	23.5%
	IL	11.0%	12.6%	23.6%	9.8%	9.9%	19.8%	13.0%	11.6%	24.6%
	MA	11.3%	12.5%	23.8%	9.7%	9.4%	19.1%	13.1%	10.8%	23.9%
	NY	11.5%	13.0%	24.5%	10.6%	10.2%	20.8%	13.4%	11.4%	24.8%
	TX	10.3%	12.0%	22.3%	8.6%	10.1%	18.7%	12.7%	12.1%	24.8%
	VA	11.3%	13.0%	24.3%	10.5%	10.9%	21.5%	14.3%	12.7%	27.0%
	WA	11.2%	12.8%	24.0%	9.6%	10.0%	19.6%	14.2%	12.3%	26.5%

Age Category	State	% of Population (2000)			% of Admissions			% of Direct Cost		
		Males	Females	Total	Males	Females	Total	Males	Females	Total
65 to 79	CA	3.6%	3.6%	7.2%	9.0%	10.2%	19.2%	13.2%	13.7%	26.8%
	CO	3.2%	3.5%	6.8%	8.2%	9.4%	17.6%	12.9%	12.3%	25.2%
	FL	6.0%	6.6%	12.6%	12.2%	12.8%	25.0%	16.6%	15.1%	31.7%
	IO	4.7%	4.8%	9.5%	11.2%	12.1%	23.3%	16.0%	15.2%	31.1%
	IL	3.9%	4.1%	8.0%	9.4%	11.4%	20.8%	13.7%	14.5%	28.2%
	MA	4.4%	4.3%	8.7%	10.8%	11.8%	22.6%	14.6%	14.0%	28.6%
	NY	4.3%	4.2%	8.5%	9.4%	10.8%	20.2%	13.5%	13.9%	27.4%
	TX	3.2%	3.5%	6.7%	8.7%	10.9%	19.6%	13.2%	14.4%	27.7%
	VA	3.7%	3.6%	7.3%	9.5%	11.6%	21.1%	14.1%	15.3%	29.4%
	WA	3.6%	4.2%	7.8%	9.0%	10.1%	19.0%	12.9%	12.5%	25.4%
80+	CA	1.1%	1.1%	2.2%	4.8%	8.0%	12.8%	6.1%	9.1%	15.2%
	CO	0.9%	1.1%	2.0%	3.9%	6.8%	10.7%	4.8%	7.0%	11.8%
	FL	1.9%	2.3%	4.2%	6.3%	9.8%	16.0%	7.4%	10.2%	17.6%
	IO	1.6%	1.9%	3.5%	6.4%	11.3%	17.7%	7.4%	11.5%	18.9%
	IL	1.2%	1.3%	2.5%	4.8%	9.3%	14.1%	6.0%	10.3%	16.3%
	MA	1.4%	1.4%	2.8%	5.7%	10.6%	16.3%	6.4%	10.1%	16.5%
	NY	1.3%	1.4%	2.7%	4.6%	8.8%	13.4%	6.2%	10.4%	16.6%
	TX	0.8%	1.1%	2.0%	3.9%	7.5%	11.4%	5.1%	8.9%	14.0%
	VA	0.9%	1.0%	1.9%	4.1%	8.0%	12.1%	5.2%	9.2%	14.3%
	WA	1.1%	1.3%	2.5%	4.9%	7.7%	12.6%	5.6%	7.7%	13.3%
Total	CA	48.7%	51.3%	100.0%	41.1%	58.9%	100.0%	46.4%	53.6%	100.0%
	CO	47.5%	52.5%	100.0%	39.9%	60.1%	100.0%	48.3%	51.7%	100.0%
	FL	48.1%	51.9%	100.0%	42.9%	57.1%	100.0%	48.7%	51.3%	100.0%
	IO	49.8%	50.2%	100.0%	41.3%	58.7%	100.0%	47.5%	52.5%	100.0%
	IL	49.4%	50.6%	100.0%	40.7%	59.3%	100.0%	45.7%	54.3%	100.0%
	MA	49.8%	50.2%	100.0%	41.7%	58.3%	100.0%	47.3%	52.7%	100.0%
	NY	50.1%	49.9%	100.0%	42.6%	57.4%	100.0%	47.4%	52.6%	100.0%
	TX	48.0%	52.0%	100.0%	38.1%	61.9%	100.0%	44.9%	55.1%	100.0%
	VA	48.6%	51.4%	100.0%	40.3%	59.7%	100.0%	45.7%	54.3%	100.0%
	WA	48.0%	52.0%	100.0%	40.5%	59.5%	100.0%	47.4%	52.6%	100.0%

* includes newborns

Appendix I – F
State Variation in Cost/Quality Comparison

State	Quality Indicator	Teaching			Community		
		Lowest Cost Quartile	Other Hospitals	Lowest/ Other	Lowest Cost Quartile	Other Hospitals	Lowest/ Other
California	Adverse Effects	2.88%	4.52%	0.64	2.72%	2.39%	1.14
	Wound Infection	0.42%	0.58%	0.73	0.28%	0.26%	1.04
	Pneumonia	1.31%	1.49%	0.88	1.31%	1.12%	1.18
	Urinary Tract Infection	2.07%	2.22%	0.93	2.22%	2.08%	1.06
	Mechanical Comps	1.12%	1.50%	0.75	0.97%	1.05%	0.93
	Pulmonary Compromise	1.70%	2.32%	0.73	2.30%	1.91%	1.20
Colorado*	Adverse Effects				2.97%	2.84%	1.05
	Wound Infection				0.30%	0.34%	0.90
	Pneumonia				0.95%	1.14%	0.83
	Urinary Tract Infection				2.16%	2.61%	0.83
	Mechanical Comps				1.15%	1.12%	1.02
	Pulmonary Compromise				1.34%	1.77%	0.75
Florida	Adverse Effects	3.29%	5.19%	0.64	2.84%	2.97%	0.96
	Wound Infection	0.29%	0.65%	0.45	0.28%	0.29%	0.96
	Pneumonia	1.31%	1.26%	1.04	1.07%	1.05%	1.01
	Urinary Tract Infection	1.85%	3.30%	0.56	3.46%	3.20%	1.08
	Mechanical Comps	1.17%	1.77%	0.66	1.00%	1.01%	0.99
	Pulmonary Compromise	2.49%	4.72%	0.53	1.91%	2.17%	0.88
Iowa*	Adverse Effects				2.88%	2.96%	0.97
	Wound Infection				0.22%	0.25%	0.87
	Pneumonia				1.62%	1.91%	0.85
	Urinary Tract Infection				3.29%	4.02%	0.82
	Mechanical Comps				0.94%	1.07%	0.88
	Pulmonary Compromise				1.27%	2.49%	0.51
Illinois	Adverse Effects	3.12%	2.89%	1.08	1.84%	2.17%	0.85
	Wound Infection	0.32%	0.34%	0.93	0.18%	0.22%	0.84
	Pneumonia	2.25%	2.01%	1.12	2.14%	2.41%	0.89
	Urinary Tract Infection	5.24%	4.04%	1.29	4.69%	5.09%	0.92
	Mechanical Comps	1.99%	1.83%	1.09	1.48%	1.44%	1.03
	Pulmonary Compromise	3.01%	2.46%	1.22	2.28%	2.59%	0.88

State	Quality Indicator	Teaching			Community		
		Lowest Cost Quartile	Other Hospitals	Lowest/ Other	Lowest Cost Quartile	Other Hospitals	Lowest/ Other
Massachusetts	Adverse Effects	4.35%	4.21%	1.03	2.07%	2.30%	0.90
	Wound Infection	0.37%	0.46%	0.79	0.25%	0.30%	0.85
	Pneumonia	1.50%	1.42%	1.06	1.42%	1.38%	1.03
	Urinary Tract Infection	2.99%	2.54%	1.18	2.62%	2.96%	0.88
	Mechanical Comps	1.38%	1.28%	1.08	0.89%	0.75%	1.20
	Pulmonary Compromise	2.16%	1.56%	1.38	0.82%	1.12%	0.73
New York	Adverse Effects	2.78%	2.96%	0.94	2.44%	1.90%	1.28
	Wound Infection	0.30%	0.41%	0.75	0.29%	0.26%	1.10
	Pneumonia	1.30%	0.85%	1.52	1.00%	1.21%	0.83
	Urinary Tract Infection	3.78%	4.36%	0.87	3.29%	3.36%	0.98
	Mechanical Comps	0.98%	0.94%	1.04	0.75%	0.75%	1.01
	Pulmonary Compromise	1.81%	1.47%	1.23	1.46%	1.43%	1.02
Texas	Adverse Effects	3.03%	2.95%	1.03	2.16%	2.11%	1.02
	Wound Infection	0.42%	0.40%	1.06	0.23%	0.26%	0.90
	Pneumonia	1.53%	0.92%	1.66	0.96%	0.84%	1.15
	Urinary Tract Infection	3.78%	1.88%	2.01	2.91%	2.35%	1.24
	Mechanical Comps	1.39%	1.35%	1.03	0.88%	0.97%	0.91
	Pulmonary Compromise	2.53%	1.42%	1.78	1.23%	1.15%	1.07
Virginia	Adverse Effects	3.30%	4.00%	0.83	2.47%	2.25%	1.10
	Wound Infection	0.40%	0.45%	0.88	0.28%	0.25%	1.12
	Pneumonia	1.23%	0.74%	1.65	1.16%	1.01%	1.15
	Urinary Tract Infection	2.35%	2.41%	0.98	3.55%	2.60%	1.36
	Mechanical Comps	1.18%	1.04%	1.13	0.93%	0.85%	1.09
	Pulmonary Compromise	2.14%	1.30%	1.64	1.10%	1.79%	0.61
Washington*	Adverse Effects				3.04%	3.86%	0.79
	Wound Infection				0.26%	0.31%	0.85
	Pneumonia				1.18%	1.27%	0.93
	Urinary Tract Infection				2.57%	2.39%	1.08
	Mechanical Comps				1.16%	1.24%	0.94
	Pulmonary Compromise				1.27%	1.42%	0.89

* Insufficient number of teaching hospitals for quartile determination

Appendix II
Tertiary Diagnosis Related Groups

DRG Code	Description
001	Craniotomy, Age Greater than 17 Except for Trauma
103	Heart Transplant
104	Cardiac Valve Procedures and Other Major Cardiothoracic Procedures with Cardiac Catheterization
105	Cardiac Valve Procedures and Other Major Cardiothoracic Procedures without Cardiac Catheterization
106	Coronary Bypass with PTCA
107	Coronary Bypass with Cardiac Catheterization
108	Other Cardiothoracic Procedures
109	Coronary Bypass without Cardiac Catheterization
112	Percutaneous Cardiovascular Procedures
116	Other Permanent Cardiac Pacemaker Implant or PTCA with Coronary Artery Stent Implant
191	Pancreas Liver and Shunt Procedures with CC
192	Pancreas Liver and Shunt Procedures without CC
302	Kidney Transplant
353	Pelvic Evisceration, Radical Hysterectomy and Radical Vulvectomy
480	Liver Transplant
481	Bone Marrow Transplant
483	Tracheostomy Except for Face, Mouth and Neck Diagnoses
484	Craniotomy for Multiple Significant Trauma
495	Lung Transplant
504	Extensive Third Degree Burns with Skin Graft
505	Extensive Third Degree Burns without Skin Graft
506	Full Thickness Burn with Skin Graft or Inhalation Injury with CC or Significant Trauma
507	Full Thickness Burn with Skin Graft or Inhalation Injury without CC or Significant Trauma

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[iii] Institute of Medicine 2000, 2001

[iv] assumes that inpatient expenditures are roughly 70% of total hospital expenditures

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