

Analysis of the Attorney General's Report Titled "Examination of Health Care Cost Trends and Cost Drivers"

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Executive Summary. Health Care costs in Massachusetts are increasing at an unsustainable rate. The Massachusetts legislature mandated that the Attorney General produce a report to identify, understand, and explain the reasons behind these cost increases. After analyzing the Attorney General's Report, this analysis finds that many of its conclusions are incorrect and that its approach is fundamentally flawed. Our specific findings are as follows:

1. Much of the Report's Analytical Approach is conceptually flawed: The Report uses cross sectional analyses to answer historical questions. Cross sectional analysis cannot answer historical questions.
2. The report uses inappropriate or inadequate methodologies to reach its conclusions: The Report uses a series of univariate analyses to show that price is unrelated to a series of potential explanatory variables. Using a more appropriate approach to univariate analysis we have found, in contrast to the Report, that price is in fact related to case mix, teaching hospital status, Medicaid/Medicare census, case mix, and cost.
3. A multivariate approach to price variation produced an explanatory model that accounted for slightly over half the observed variation in price.
4. The concept of "leverage" as a price driver as presented in the Report could not be validated using a data set that included all hospitals, rather than just six hospitals, as described in the Report.
5. An analysis of the Report's finding that volume shifted towards higher price hospitals in the period from 2005-2008 shows that this shift accounts for only 0.6% of the increase in costs during these years.
6. In contrast to the Report's finding that Massachusetts hospitals do not vary significantly in quality, we have shown that MA hospitals exhibit variation in quality that is comparable to the variation in price presented in the Report.

Each of this finds is documented in the following analysis. We conclude by recommending an alternative approach for future work.

About the Author:

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Health care costs are increasing at an unsustainable rate. They consume an ever increasing percentage of GDP, and if current trends were to continue, they would consume the entire GDP of the United States at some future point. These facts are well known, as is the fact that Massachusetts has the highest per capita health care costs in the US. The Attorney General, in response to a legislative mandate in Chapter 305 of the Acts of 2008, has produced a report, titled "Examination of Health Care Trends and Cost Drivers ("the Report")," that attempts to "identify, understand, and explain the reasons behind escalation of costs." While the Attorney General is to be commended for attempting to address this crucially important issue, we shall see that this attempt does not succeed at achieving its stated goal. As the following analysis will show, the report is replete with both conceptual and methodological problems that prevent it from reaching valid conclusions. This analysis focuses on hospital rather than physician payment issues, and proceeds according to the following outline:

1. General conceptual and methodological issues with the report.
2. Problems with market share analyses
3. Issues in the Report's treatment of quality
4. Summary and Conclusions

We begin with a discussion of several major conceptual problems with the report.

1. Much of the Report's Analytical Approach is conceptually flawed.

- A. The legislative mandate is to understand the reasons for the escalation in health care costs. The report attempts to address this historical problem with an analysis that is primarily cross-sectional in nature. Cross sectional analyses cannot produce answers to historical questions.**

The summary of key findings in the Executive Summary makes this problem explicit. The summary lists seven key findings (labeled A-G). Five of these seven are based on finding – or failing to find -- correlations between hospital price variation and some other variable of interest using data sets collected at the same point in time. Findings A-D and G are all based on cross –sectional analyses. Only two findings -- E and F -- examined trends over time to reach conclusions.

An example of the problem. Finding B reports that price variations are not correlated to quality of care. Assuming for the moment that this finding is valid what implication does it have for understanding increases in health care costs over time? Does it mean that increases in quality play no part in the increases costs that have occurred in recent decades? From a strictly statistical point of view, such a conclusion would be invalid.

A Thought Experiment. Assume that twenty years ago the distribution of price and quality scores across hospitals was identical to today's distribution. Twenty years ago we would have seen no correlation between quality and price, just as today we see no correlation between quality and price. Then assume that all hospitals increased the quality of their care by the same incremental amount, and that those hospitals increased spending by the same incremental amount to pay for the increase in quality. In this scenario, both costs and quality would increase over time, but a cross sectional analysis at any single point in time would continue to find no relationship between costs and price. The cross sectional analysis would completely miss the quality driven increase in costs. **Cross sectional analyses cannot produce answers to historical questions.**

B. The Report's focus on price assumes the importance of price as a driver of health care costs, when in fact; the importance of price must be established through analysis.

The Report states the issue as follows: "The Legislature instructed the AGO to examine cost drivers in the Massachusetts health care market. As a starting point, it was essential to understand how prices are established for health services." The essentiality of understanding price setting needs to be established through analysis, rather than assumed a priori. Prices in any given year could be – in the aggregate – a reflection of the underlying costs of providing care in that year. If this were the case, then a focus on variation in price across hospitals in a given year would miss whatever factors were driving costs over time. Price variation could be an independent driver of costs over time, but this fact needs to be established through historical analysis.

2. Methodological Issues.

The report uses inappropriate or inadequate methodologies to reach its conclusions. Some examples follow.

A. The report is insensitive to distinctions among hospitals that may influence conclusions.

Small Isolated Hospitals. Nantucket Cottage Hospital – on the island of Nantucket -- receives by far the highest price index from BCBS (index value of 2.1, where the next highest value is less than 1.5), and has the third highest price index value from HPPC. This hospital has an average daily census of less than 6, an occupancy rate of 30%, and its patient load is highly seasonal. These highly exceptional characteristics are nowhere noted in the report, and perhaps should lead to its exclusion. Other small, isolated hospitals have similar high index values (Fairview, Martha's Vineyard). Nowhere does the report address this issue.

Teaching Hospitals. The report treats all teaching hospitals as if they were the same, ignoring that fact that some hospitals support a single residency program with one or two residents, while other teaching hospitals support as many as 50 residency programs with over five hundred residents.

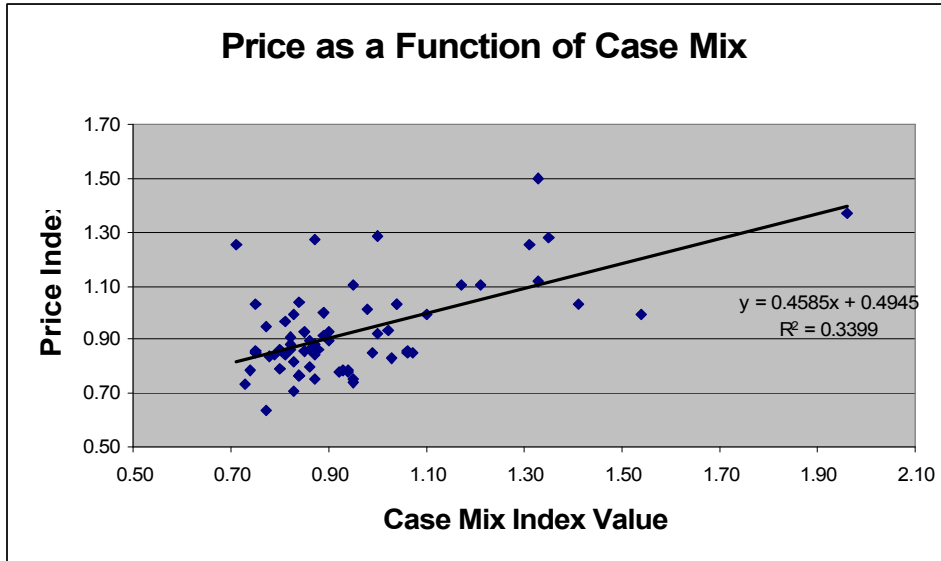
The implications of these factors are discussed in the following section.

B. The report examines relationships using univariate approaches, and many of these univariate approaches are inappropriate or misleading. Finding B reports that prices are uncorrelated with quality, case mix, teaching status, Medicare/Medicaid census, and costs, but, as the following examples show, the methodologies used to reach this conclusion are often insufficient, leading to incorrect conclusions.

The general approach is to assess a number of potential correlates of price and then to determine that each, independently, is not an important factor in price variation. This finding opens the way to an alternative set of explanations based on market share leverage and historical case mix change. As we shall see, the analytical approaches that lead to the variable by variable conclusions are inadequate, and the entire enterprise is compromised by the failure to develop a multivariate approach.

Case Mix. The relationship between price and case mix index (CMI) is portrayed in the Report by superimposing case mix scores on a price index bar chart, and then by asserting that "The highest paid hospitals do not have the highest CMIs and some hospitals with a

CMI above 1.0 are paid less than dozens of hospitals with CMIs below 1.0.”¹ The appropriate way to graph the relationship between price and case mix is with a scatter plot. The following graph shows hospital price indices (averaged across the three payers) as a function of case mix indices. Each data point is a hospital, and Nantucket Cottage Hospital is omitted because of its unique status.



From inspection of the graph the relationship between case mix and price is immediately apparent – hospitals with higher case mix index values tend to have higher price indices. The graph also shows the quantitative estimate of the relationship – the $R^2 = 0.3399$ indicating a moderate relationship between the two variables. Case mix is related to price.²

Teaching Status. As with case mix, the relationship between price and teaching hospital status is portrayed by color coding teaching hospitals on a price index bar chart, and then by asserting that “Insurers do not consistently pay higher prices to hospitals that provide academic teaching and research services.”³ As discussed previously, all teaching hospitals are not the same, but the report does not distinguish a hospital such as Mt. Auburn, with 2 specialty programs with 65 residents from a hospital such as BI Deaconess, with 38 residency programs and 515 residents.

Even given this oversight, the data shown in the report tell a story that differs from the conclusions in the report. The BCBS chart identifies 15 teaching hospitals. Four of these hospitals have price indices below 1, 2 have price indices of almost exactly 1 and 9 have price indices greater than 1. More quantitatively, the mean price index of non-teaching hospitals (0.922) is statistically significantly lower than the mean price index of the teaching hospitals (1.067, T-Test one tailed, $p < 0.05$). Teaching hospitals – even as inappropriately categorized in the report, have higher price indices than non teaching hospitals.

The following graph shows the relationship between the price index (averaged across the three payers) and the number of residency programs at the fourteen Massachusetts hospitals accredited by the Accreditation Council for Graduate Medical Education (ACGME).⁴ The graph shows that hospitals with a greater number of residency programs tend to have higher

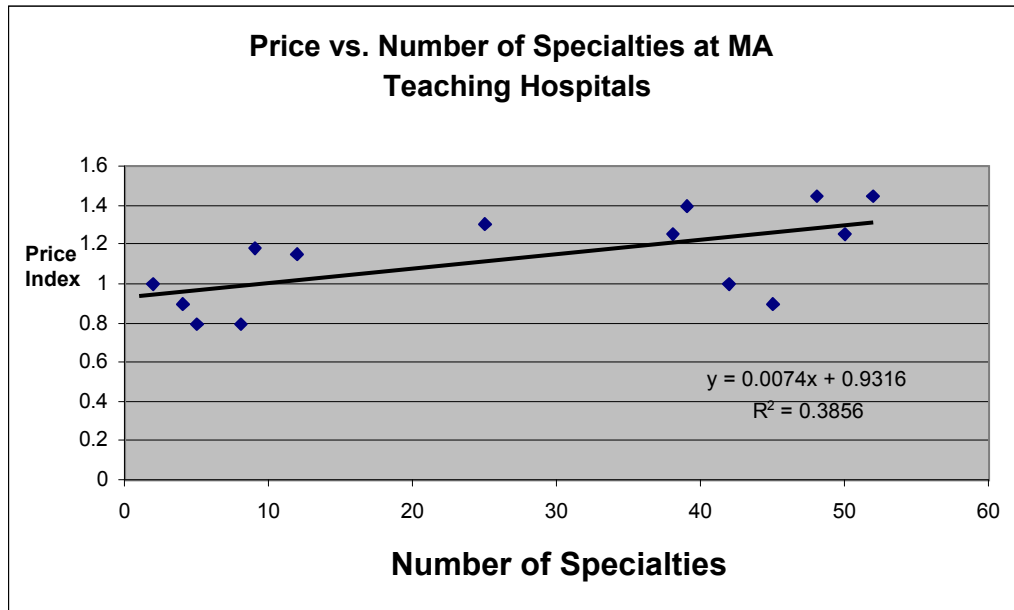
¹ See charts pp 18-20

² The appropriateness of omitting Nantucket Cottage is certainly worthy of discussion. With the inclusion of this hospital the R^2 drops to .14. What is not debatable is the necessity to consider these issues.

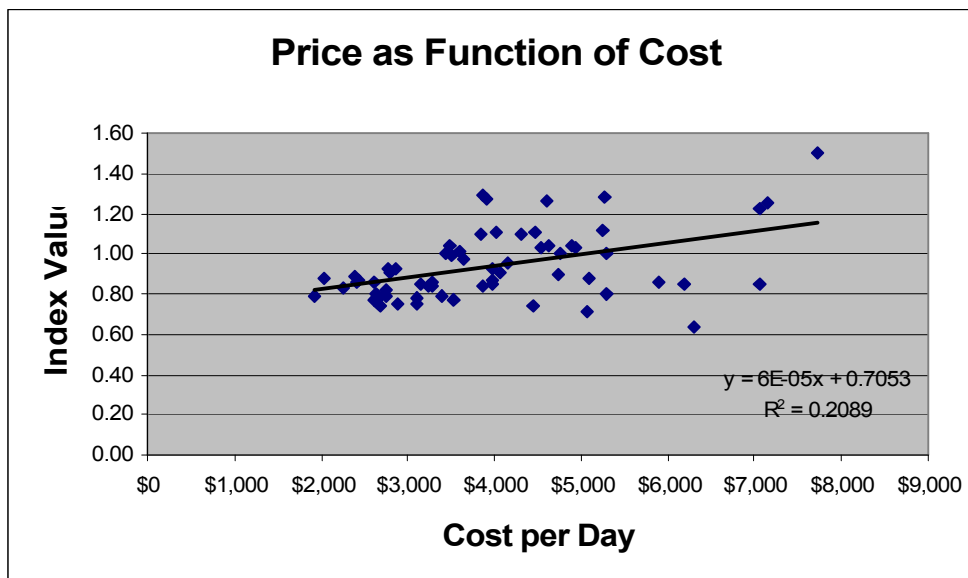
³ See charts pp 24-25

⁴ From the ACGME web site <http://www.acgme.org/acWebsite/home/home.asp>

price indices than hospitals with fewer numbers of residency programs. The $R^2 = .386$, indicating a moderate relationship between the number of residency programs and the price index.



Costs. The Report asserts that “Disparities in hospital prices are not adequately explained by differences in hospital unit costs.⁵” Again, the Report uses vague terms such as ‘not adequately explained’, with no sense that a quantitative assessment is necessary. The approach that purports to demonstrate the lack of relationship is to array costs per case mix adjusted admission at academic medical centers and to show that they vary. That they do vary is no surprise, but the question is, is this variation related to price. In fact, as the following now familiar scatter plot shows, costs are indeed related to price, with a modest but statistically significant R^2 of 0.21.



⁵ Report, p. 26

Medicare/Medicaid Census. The report concludes that “Wide disparities in prices are not explained by the extent to which a provider cares for a large portion of patients on Medicare or Medicaid.”⁶ This conclusion is particularly confusing, because in discussing the usual presentation of the data in bar graphs, with DSH hospitals color coded, the report notes that “hospitals identified by DHCFC as DSH (shown in red) (are) generally on the lower end of the payment spectrum.”⁷ The report goes on to note that prices at non-DSH hospitals are typically 9% to 26% higher than at DSH hospitals!

The Need for a Multivariate Approach. What is going on here? How can the Report find that non-DSH hospitals are paid 9% to 26% more than DSH hospitals, and yet conclude that that “Wide disparities in prices are not explained by the extent to which a provider cares for a large portion of patients on Medicare or Medicaid.”

The answer to this question suggests two underlying problems with the report. First, the report identifies wide variation in pricing, which it attempts to explain through a series of univariate analyses – price vs. case mix, price vs. teaching status, price vs. DSH status, price vs. costs, and finally, price vs. quality. The authors of the report seem to believe that only perfect correlations count as explanatory – thus a statistically significant relationship between DSH status and price is discounted because the relationship is not large enough. The second, and related problem, is that the authors fail to recognize that a series of moderately correlated variables may be combined in a multivariate model with considerable explanatory power.

We have created such a multiple linear regression model using data from the Report, the publically available RSC403 file from the Division of Health Care Finance and Policy, and the ACGME. The model uses the following variables to predict the price index average of the three payers:

DSH Dummy	A dummy coded variable indicating a hospital's DSH Status
GEO Dummy	A dummy coded variable indicating a hospitals status as small and geographically isolated (ADC <20, 20 miles or more to next hospital)
# Specialty Teaching Programs	From the ACGME, the number of accredited specialty teaching programs, or 0 if the hospital has no teaching program
Cost Per Day	From the RSC 403, total patient expenses including capital divided by total patient days
Case Mix Index	From the Report

This five variable model has an $R^2 = 0.525$, ($F=13.26$, $p<.01$) which means that it accounts for slightly over half the variation in the price index. The number of specialty teaching programs and the Cost per Day are statistically significant in the model.

The point of this statistical excursion is not to develop a sophisticated model of hospital pricing, but to show instead the inadequacy of the Report's variable by variable approach. The Reports Finding B states that “Price variations are not correlated to (1) quality of care, (2) the sickness of the population served or complexity of the services provided, (3) the extent to which a provider cares for a large portion of patients on Medicare or Medicaid, or (4) whether a provider is an academic teaching or research facility. Moreover, (5) price variations are not

⁶ Report, p 21

⁷ Ibid, p. 21

adequately explained by differences in hospital costs of delivering similar services at similar facilities.”

This finding is incorrect. We would assert instead, that price variation in Massachusetts Hospitals can be successfully modeled, with the most significant variables being status as a teaching hospital and costs/per day.

2. Market Leverage as a Price Driver.

This section of the analysis will discuss the Report’s treatment of market leverage as a price driver. The Report finds that “Price variations are correlated to market leverage – the relative market position of the hospital or provider group compared with other hospitals or provider groups within a geographic region or within a group of academic medical centers.⁸” It goes on to state that there is a strong correlation between the price insurers pay to providers and providers’ market leverage.

Although this is an intriguing hypothesis, several factors raise concerns.

1. Correlations are measured by correlation coefficients, and in the entire discussion of market leverage as a price driver not a single correlation coefficient is to be found. This failure renders the entire discussion vague and imprecise.

2. In the discussion of leverage as a function of provider size, the analysis is limited to six academic medical centers (AMCs), which the Report states are all have “(1) extensive research and teaching programs and (2) extensive resources for tertiary and quaternary care, and are (3) principal teaching hospitals for their respective medical schools and (4) full service hospitals with a case mix intensity greater than 5% above the statewide average.⁹” In fact, one of the AMCs (Boston Medical Center) is a DSH hospital. DSH hospitals, as the Report itself notes, have lower prices for reasons that have nothing to do with “leverage.”

3. As others have discussed;¹⁰ the definition of leverage is unconventional. As described in the report, leverage is the total amount of revenue paid by an insurer to a provider system, but this number should be highly correlated with hospital revenue. We have in fact calculated this correlation for the six hospitals discussed in the Report. For the three payers BCBS, HPHC, and Tufts, respectively, the correlations between the Report’s hospital leverage measure and each hospital’s gross patient services revenue (GPSR) taken from the DHCFP 403 file are 0.83, 0.83, and 0.82, respectively. These high correlations suggest that – for the six hospitals included in the analysis, “leverage” may be a proxy for hospital revenue. If ‘leverage’ is a proxy for revenue might revenue itself, as a measure of size, be related to price? We tested this hypothesis by adding GPSR to the multivariate model presented previously. Adding GPSR to the model increased the R² from 0.525 to 0.540, a statistically insignificant increase. If size is a measure of leverage, then leverage is not related to price.

4. The Report discusses an alternative measure of leverage, which it calls the “relative leverage of insurers and providers in a geographic region.” After describing the derivation of the method, the report describes the relationship between this measure and price: “We found that when that insurer has more leverage over a hospital (as compared to other hospitals in the region), the hospital tended to get lower prices compared to other hospitals in the region; and, when a hospital has more leverage over that insurer, it tended to get higher prices.¹¹”

⁸ Report p. 28

⁹ Report, p. 31

¹⁰ AHA Letter to the Attorney General’s Office dated April 29, 2010

¹¹ Report, p. 33

Unfortunately, the Report provides absolutely no information about the nature of this tendency, making the claim impossible to evaluate.

3. Price Drivers Derived from Longitudinal Data

Two of the Report's findings – E and F – are based on longitudinal data, and are therefore conceptually, at least, able to address the charge initially posed to the Attorney General, which is to understand why costs in MA are escalating at a rate greater than inflation. The first finding asserts that “Price increases, not increases in utilization, caused most of the increases in health care costs during the past few years in Massachusetts.¹²” The second finding asserts that “Higher priced hospitals are gaining market share at the expense of lower priced hospitals, which are losing volume.¹³” Each of these findings will be discussed in turn.

Price increases caused the increase in health care costs during the past few years.

This finding is based on interviews with health plans, which raises questions about the objectivity of the data, but the bigger problem with this finding is that it is a tautology that completely begs the question. One might put the finding as follows: cost increases caused most of the increases in health care prices during the past few years in Massachusetts. The Report presents no evidence as to the appropriate causal direction. Did costs drive prices, or did prices drive costs? This is precisely the question that the Attorney General was tasked to answer, but the report presents no historical evidence whatsoever that bears on this point.

It is striking that a report whose purpose is to understand the reasons behind increases in health care costs contains no information at all on the problem to be addressed; that is, it contains no data on cost increases in Massachusetts hospitals over the past several years.

Here is some context—Gross Patient Service Revenues (GPSR) rose from \$31.5 billion in 2005 to \$41.3 billion in 2008,¹⁴ an overall increase of 31.11%, or an annualized rate of increase of 9.45%. This large increase in revenues was indeed achieved in part through the payment of higher prices to hospitals, but the question unanswered in the report is why.

Higher priced hospitals are gaining market share at the expense of lower priced hospitals, which are losing volume. This finding, if meaningful, would indeed provide a mechanism to explain the increase in hospital costs that we been discussing. The Report uses data from the Mass Health Data Consortium to assert that hospitals with low price indices have been losing market share to hospitals with higher price indices. At last we have a mechanism that might explain the observed increase in health care costs – if costly hospitals are increasing market share at the expense of less costly hospitals, then costs will increase over time by virtue of this shift in market share alone.

Unfortunately, the Report fails to assess the potential impact of this shift on observed cost increases. Using the DHCFP data bases it has been possible to model such an impact. As a first step, we attempted to replicate the report's analysis. We have found that the hospitals in the bottom half of the price index distribution did indeed lose market share, although we found a loss of 0.6% rather than 0.9%.

How does this loss of market share translate to costs? We can model the impact by applying the 2005 distribution of patient days in high and low index value hospitals to the patient day costs of those two groups of hospitals as found in 2008. GPSR per day in the

¹² Report, p. 4

¹³ Report, p. 4

¹⁴ DHCFP Public Use Data Files for 2005 and 2008

high index cost hospitals averaged \$11,153.22 in 2008. The equivalent figure for the low index hospitals was \$8,105. If the 2005 utilization pattern had been in place in 2008 (i.e., had there been no change in the distribution of patient volume between high and low index value hospitals), GPSR in 2008 would have been about \$81 million dollars lower. This is a savings of 0.2% over four years. Changing utilization patterns are not the reason that health care costs in Massachusetts have increased so dramatically in recent years.

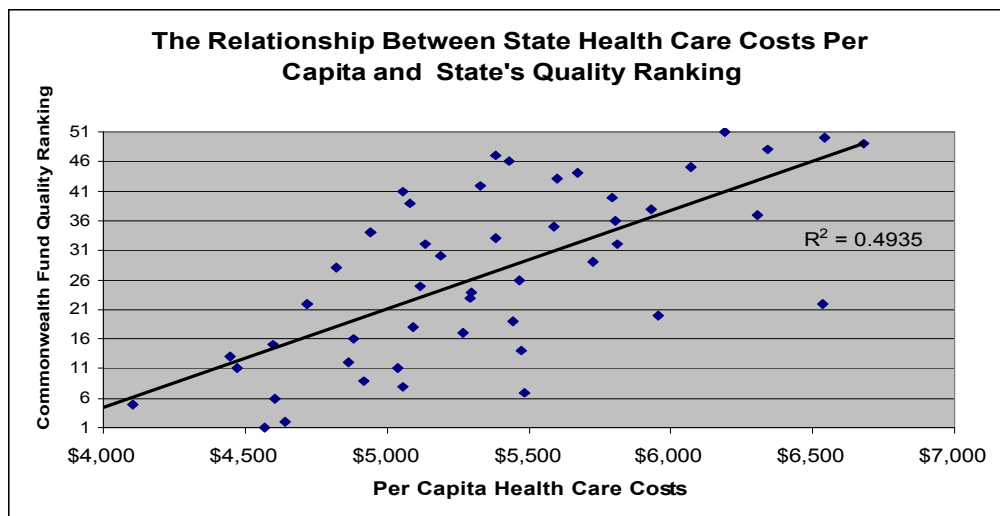
3. Relationships between Quality, Costs, and Price

This section discusses quality from three perspectives:

1. We situate the quality of Massachusetts hospitals in a national context.
2. We examine cost quality relationships in a national context
3. We examine the reports conclusions about variation in the quality of Massachusetts hospitals, and
4. We reexamine the implications of cross sectional cost quality findings with respect to the understanding of historical trends.

1. Massachusetts hospitals perform well on national comparisons. The Commonwealth fund, in its ranking of state health care systems, ranks Massachusetts third among states on its composite quality score¹⁵. Massachusetts similarly ranks 3d in quality on a composite measure¹⁶ developed from a CMS measure of 30 day mortality following admission for Heart Attack, Heart Failure, or Pneumonia, which is discussed below in detail.

2. Quality and Cost are positively correlated in national data sets. The following chart shows the relationship between the Commonwealth Fund composite quality rating for each state and that state's per capita health care costs.¹⁷

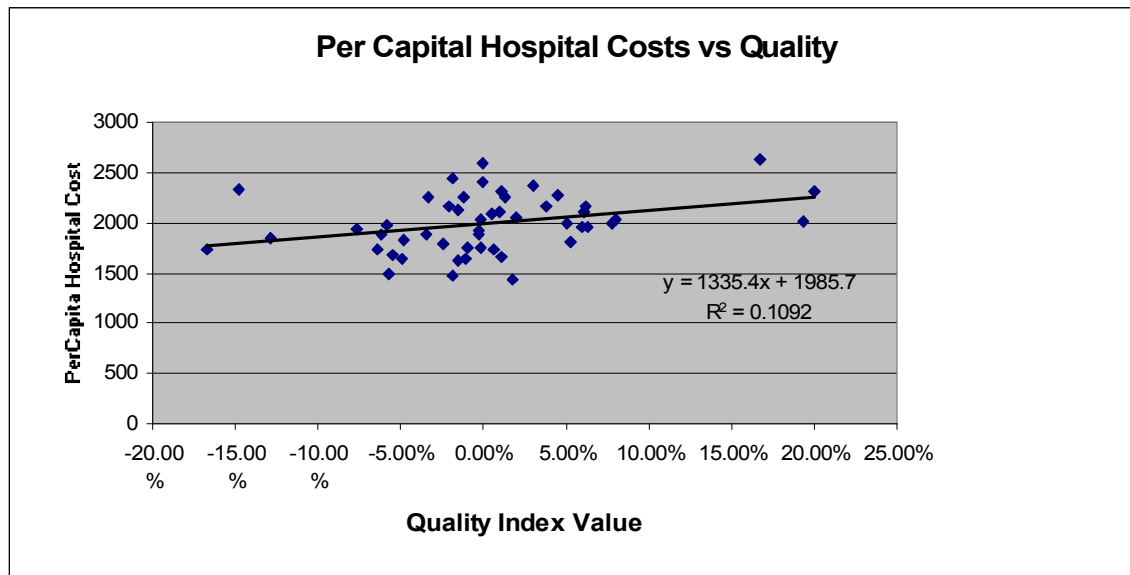


¹⁵ (<http://www.commonwealthfund.org/Content/Publications/Fund-Reports/2007/Jun/Aiming-Higher--Results-from-a-State-Scorecard-on-Health-System-Performance.aspx>)

¹⁶ The following value is calculated for each state for each of the three measures: (%hospitals better than national average - %hospitals worse than national average)/total hospitals. The composite index is the average of these three values.

¹⁷ Health Expenditure Data, Health Expenditures by State of Residence, Centers for Medicare and Medicaid Services, Office of the Actuary, National Health Statistics Group, released September 2007; available at <http://www.cms.hhs.gov/NationalHealthExpendData/downloads/res-us.pdf>

The CMS composite quality rankings are also related to cost, although the relationship is not as strong as the following graph shows. There is a small, but statistically significant tendency for states with higher quality hospitals to have higher costs.



Turning to Massachusetts, similar analyses do not demonstrate a relationship between quality and costs and between quality and price. As discussed in the following section, this lack of a relationship is not due to insufficient variation in the Massachusetts quality measures.

3. Variation in Quality in Massachusetts Hospitals. This section considers the Report's conclusion that "providers in Massachusetts deliver excellent care with little material variation in the quality of care delivered"¹⁸. Given the variation found in most spheres of human endeavor, it would indeed be remarkable if Massachusetts hospitals did not vary in quality. We will examine variation in quality with respect to four measures: Serious Reportable Events (SREs), and Hospital Mortality Rates for three medical conditions. In each case, we will compare variation in the quality measure to variation in prices as described in the "Report". Page 11 of the "Report" presents the approach: prices are normalized to an index value of 1, and compared to each other on the basis of the resulting index value. As the "Report" puts it, "There is roughly a 90% difference in the price this insurer (BCBS) pays to the lowest paid hospital in its network and the price it pays to the *second* highest paid hospital (relative prices of about 0.75 v. 1.4)"¹⁹. The second highest paid hospital is chosen for comparison because, presumably, the highest paid hospital – Nantucket Cottage – is an unusual case, as discussed previously.

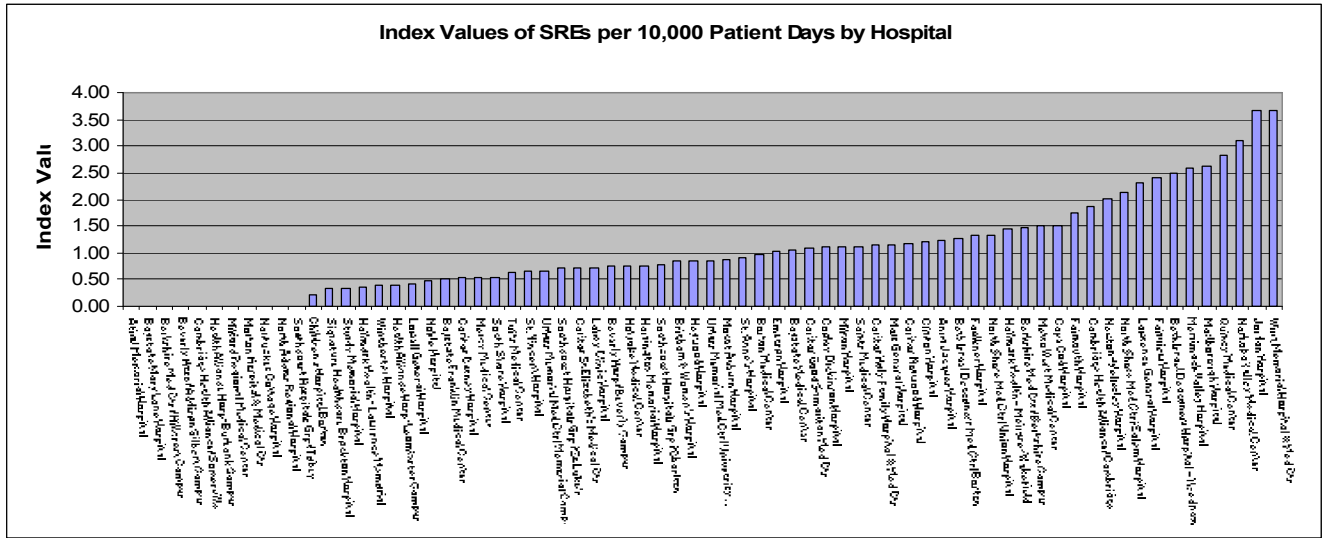
Variation in SREs. The Massachusetts Department of Public Health began collecting hospital reports of SREs in 2008, and has issued reports detailing the experience of Massachusetts hospitals in 2008 and 2009. SREs, as defined by the National Quality Forum, are "adverse events that are of concern to both the public and healthcare professionals and providers; clearly identifiable and measurable, and thus feasible to include in a reporting system; and of a nature such that the risk of occurrence is significantly influenced by the policies and procedures of the healthcare facility."²⁰ Examples include falls, wrong site surgery, and retained objects.

¹⁸ The Report, p. 18

¹⁹ The Report, p. 11

²⁰ NQF website: <http://www.qualityforum.org/projects/completed/sre/>

The following figure shows the conversion of SRE rates from the 2009 report to normalized index values. In this instance, there is roughly a 1400% difference in rate at the lowest non-zero hospital and the rate at the highest hospital.²¹



Variation in SRE rates across hospitals is greater than variation in prices across hospitals.

SREs are a controversial measure of quality, because they rely on the self-report of hospitals. Variation in SRE rates may reflect true variation in the occurrence of the events, but it may also reflect variation in reporting cultures. Whatever the sources of variation, the variation is real, and it is large.

Variation in Hospital Mortality Rates. CMS has recently added to its Hospital Compare Website measures of 30 day post admission mortality for three conditions: heart attack, heart failure, and pneumonia.²² According to the Report, “Since few hospitals are identified as different from average on these measures, they are of limited usefulness and were not used in further analysis.²³” In fact, Massachusetts hospitals exhibit considerable variation on these measures. The following table summarizes the data.

Measure	# Hospitals Included in Measure	# Hospitals Better than National Average	# Hospitals Worse than National Average	Index Value Ratio
Heart Attack Mortality	59	9	0	65%
Heart Failure Mortality	61	11	1	94%
Pneumonia Mortality	61	12	1	108%

²¹ http://www.mass.gov/Eeohhs2/docs/dph/quality/healthcare/sre_report_2009.pdf, the 2008 distribution was similar

²² <http://data.medicare.gov/dataset/Hospital-Outcome-Of-Care-Measures/f24z-mvb9>

²³ The Report, Quality Appendix, p. 6

It is well known that the improvement in AMI death rates has been abetted by the inception of technologies such as thrombolytic medication and angioplasty, and that these technologies come with a cost. It is at this nexus between quality improvement, technological advance, and increased costs that the Report should perhaps have placed its focus.

Summary and Conclusions

The Report makes a fundamental error by attempting to explain a historical process by means of cross sectional analyses. The Report compounds its error by conducting these analyses with inappropriate methodologies that lead to incorrect conclusions. In contrast to the Report's conclusions, we have shown that price variation in Massachusetts hospitals can be successfully modeled using multiple linear regression techniques.

The Report raises interesting hypotheses about the potential impact of market leverage on prices, but fails to demonstrate through appropriate analysis that these hypotheses are valid. The report again fails to recognize that the causal status of price as an explanatory variable must be demonstrated, not assumed.

The Report asserts that Massachusetts hospitals vary insufficiently in quality to allow for the development of relationships between quality and price. We have shown to the contrary that Massachusetts hospitals exhibit levels of variation on a set of quality measures that is equivalent to the variation in price that the Report seeks to understand.

Finally, we note that real gains in hospital quality have occurred in the past decades, and suggest that those quality increases, and their attendant costs, might be a good place for the Attorney General to begin anew.