Title

Hospital competition, resource allocation and quality of care

Journal

BMC Health Services Research, 2(1)

ISSN

1472-6963

Authors

Mukamel, Dana B
Zwanziger, Jack
Bamezai, Anil

Publication Date

2002-12-01

DOI

10.1186/1472-6963-2-10

BMC Health Services Research

Research article

Hospital competition, resource allocation and quality of care

Dana B Mukamel *[1], Jack Zwanziger [1] and Anil Bamezai [2]

Address: [1]University of Rochester Medical Center, Rochester, New York 14642, USA and [2]RAND, 1700 Main Street, Santa Monica, California 90406, USA

E-mail: Dana B Mukamel* - dana_mukamel@urm.rochester.edu; Jack Zwanziger - jack_zwanziger@urmc.rochester.edu; Anil Bamezai - bzi@mindspring.com

*Corresponding author

Published: 27 May 2002

BMC Health Services Research 2002, **2**:10

Received: 21 December 2001
Accepted: 27 May 2002

This article is available from: http://www.biomedcentral.com/1472-6963/2/10

Abstract

Background: A variety of approaches have been used to contain escalating hospital costs. One approach is intensifying price competition. The increase in price based competition, which changes the incentives hospitals face, coupled with the fact that consumers can more easily evaluate the quality of hotel services compared with the quality of clinical care, may lead hospitals to allocate more resources into hotel rather than clinical services.

Methods: To test this hypothesis we studied hospitals in California in 1982 and 1989, comparing resource allocations prior to and following selective contracting, a period during which the focus of competition changed from quality to price. We estimated the relationship between clinical outcomes, measured as risk-adjusted-mortality rates, and resources.

Results: In 1989, higher competition was associated with lower clinical expenditures levels compared with 1982. The trend was stronger for non-profit hospitals. Lower clinical resource use was associated with worse risk adjusted mortality outcomes.

Conclusions: This study raises concerns that cost reductions may be associated with increased mortality.

Introduction

The last two decades brought about fundamental changes in the organization and delivery of medical services in the United States as payers seek to control the escalation in health care expenditures. Policies addressing these issues have been of two types. The first relies on containing costs through control of the prices paid to providers, beginning with the Prospective Payment System (PPS) for hospitals in 1983, Resource Based Relative Value Units (RBRVUs) payment for physicians in 1992 and the most recently implemented prospective payment for nursing homes. Such prospective payment systems provide the same incentives to cut costs to all providers, irrespective of the markets in which they are located and the competitiveness of their markets. The other relies on changing the focus of competition among health care providers, from quality based competition [1] to price based competition [2].

These policy changes were successful in bringing about a deceleration in hospital revenues and expenditures growth [2,3]. Little is known, however, about what specific strategies hospitals adopted and the impact these strategies may have had on the quality of care patients receive. Previous studies [4] found that hospitals increased efficiency in all clinical services following selective contracting in California. California hospitals also tended to

specialize and differentiate themselves from similar hospitals in response to competitive pressures [5]. A similar response, of increased specialization, was observed for a national sample of hospitals following implementation of PPS [6].

In this paper we study another potential strategy that hospitals may adopt and which has not been addressed in the literature to-date. We investigate the hypothesis that hospitals in an increasingly price competitive environment, shift resources from activities related to clinical services, which are not easily observed and evaluated by patients, into hotel services which are easily observed. We study hospitals in California, comparing resource allocation during a regime dominated by quality competition and a regime dominated by price competition. We then examine the association between risk adjusted excess hospital mortality and resource use in clinical services, to investigate the potential impact on quality of medical care and health outcomes.

Competition in California in the 1980s: a case study

The implementation of selective contracting in California in 1982 offers a unique natural experiment to study the response of hospitals to changes in the nature of competition. Unlike other health care markets, in which the change from quality to price based competition was gradual, driven by continuously increasing penetration of managed care, and often time confounded by other secular trends, the California legislation changed market conditions very rapidly for all hospitals in the state by permitting all health plans for the first time to contract with only a subset of hospitals. It thus allows a pre/post study design: hospitals resource allocation decisions during the quality competition regime (pre period) can be compared to decisions made during the price competition regime (post period). This natural experiment allows us to test the hypothesis that changes in the nature of competition are more likely to be associated with a shift of resources from clinical to hotel activities (and a concomitant deterioration in mortality outcomes) in more competitive hospital markets. As the level of hospital competition has not changed during the period (the Herfindahl-Hirschman Index (HHI) remained stable in all markets), this test is limited to the change in the *nature* of competition and is not confounded by the impact of changes in the level of competition on resource allocation decisions.

During the same time period, California hospitals were also subject for the first time to price regulation, due to implementation of the Medicare PPS. While PPS also provided hospitals with incentives to lower their costs, it did so in a distinctively different manner than price competition. The PPS set the price per discharge hospitals were paid, thus creating incentives to lower costs, irrespective of market structure (7). The intensity of price based competition, on the other hand, is highly sensitive to the competitiveness of the hospital market. The analytical strategy of this paper is based on this distinction.

Hospital competition, quality, resource allocation and health outcomes

Competition focused on prices, as is often the case in markets dominated by managed care, creates incentives to increase efficiency and possibly curtail resource use. With the exception of possible increases in administrative activities designed to contain costs in other areas (e.g. billing and utilization review) or to increase marketing efforts, such incentives to cut costs are likely to affect all aspects of hospital activities.

Hospitals may also compete on quality, both quality of medical services and quality of hotel services and amenities. The importance of competition for quality is likely to be greater in markets in which hospitals compete for patients directly, as they do for all fee-for-service patients and for those enrolled in HMOs that offer a choice of hospitals within their market. Furthermore, to the extent that HMOs make their contracting decisions based on beneficiary hospital preferences, perceptions of quality are important competitive tools.

Competition for quality [1], unlike competition for price [2], may lead to increased costs. Furthermore, it may affect clinical and hotel services differently. In markets where patients' choice of hospitals are increasingly important, hospitals are likely to compete more on quality attributes that patients observe and value. Given the difficulty that patients have in directly determining the quality of medical care they receive, and the relative ease with which they can evaluate the quality of hotel services (e.g. condition of the facility, quality of food) hospitals face incentives to shift resources from clinical activities to amenities. On the other hand, if patients rely on their physician's recommendations in choosing hospitals [8], and to the degree that physicians can assess clinical quality, albeit imperfectly, hospitals are faced with counter incentives, incentives that would promote resource use in clinical activities rather than hotel services. As a result, hospitals may face conflicting incentives: incentives to maintain or enhance the quality of hotel services on the one hand, and incentives to maintain activities that contribute to the quality of clinical care and health outcomes on the other. The actual choices that hospitals make about resource allocation depend on the relative strength of these opposing incentives.

A model of changes in resource allocation

As the main hypothesis of interest is that the change in the nature of competition was associated with changes in hos-

pital resource allocations, the model we hypothesize allows the marginal effects of market and hospital characteristics (X_t) on resource allocation (Y_t), as measured by the coefficients in a regression model (β_t), to vary over time:

$$(1) \qquad Y_t = \alpha_t + \beta_t X_t + \varepsilon_t$$

The models we estimated were difference models of the form

$$(2) \qquad \Delta Y = \Delta\alpha + \Delta\beta * X_0 + \beta_t * \Delta X + \Delta\varepsilon$$

where Δ is the difference between year t and the base year, indicated by t = 0. From (2) it follows that β_t, the vector of coefficients multiplying the change variables, measures the marginal effect of the variable in the end year, while $\Delta\beta$, the vector of coefficients multiplying the level variables, measures the change in the marginal effect. The marginal relationship in year 0 is given by $\beta_0 = \beta_t - \Delta\beta$..

Methods

Sample

The initial sample included all 338 acute care hospitals in California that were in operation during both 1982 and 1989. Of those, 18 (5.3%) were excluded from the resource allocation analyses and 8 (2.4%) were excluded from the mortality analyses, because of incomplete data.

Data sources

Financial, ownership and utilization data were obtained from the Hospital Annual Financial Disclosure Reports, filed annually by all California hospitals with the Office of Statewide Health Planning and Development (OSHPD). Risk adjusted mortality data were obtained from the Medicare Hospital Information Report published by the Health Care Financing Administration [9].

Variable definitions

I. Resource allocation variables

Resource allocation was measured by expenditures per adjusted discharge. Adjusted discharges are a composite measure of input designed to account for both inpatient discharges and outpatient visits, using the methodology developed by the American Hospital Association.

Expenditures per adjusted discharge were calculated separately for three categories: clinical, hotel and administrative services. Expenditures were aggregated by cost center, with each cost center assigned to one of the three services. The table in the Additional File: Appendix lists all hospital cost centers and their assignment to hotel, clinical and administrative categories. The dependent variables in the resource allocation analyses were defined as the differences in expenditures per adjusted discharge, between 1989 and 1982, for each of the three categories.

II. Quality variables

The dependent variables for the analyses of quality of clinical care were excess death rates from all causes and from 4 specific medical conditions that have relatively high death rates: acute myocardial infarction, congestive heart failure, pneumonia and stroke. We included in the analyses measures based on cause specific mortality in addition to overall mortality because prior studies [10] have shown that these measures tend to be uncorrelated, and that hospitals performing well in one clinical area do not necessarily perform well in others. Measures based on overall mortality may therefore be biased towards zero, showing less variation compared with cause specific measures.

Excess mortality was defined as the difference between the observed mortality rate for the hospital and a predicted, risk adjusted mortality rate. Observed and predicted mortality rates were obtained from the Medicare Hospital Reports [9]. They are based on Medicare discharges and include all deaths within 30 days of admission, irrespective of the location of death. The risk adjustment methodology used by the Health Care Financing Administration, incorporates individual patients' age, gender, specific diagnoses and comorbidities, admission source, emergency or elective admission and the patient's risk group based on hospitalizations during the preceding 6 months [9].

III. Independent variables

Competition was measured by the Herfindahl-Hirschman Index (HHI), defined as the sum of squared market shares of all hospitals competing in the same area. Hospital market areas and the HHI were calculated based on all payer zip code level patient flows, as described in Zwanziger et al. [11].

To control for financial pressures hospitals may have been experiencing in addition to competition, we included variables measuring bad debt and charity as percent of total revenues and percent occupancy. To control for potential economies of scale the estimated models included total clinical standard units of measures reported in the California Financial Disclosure Reports. Ownership indicator variables included for-profit, not-for profit public, and not-for profit district ownership. The omitted category was private not-for profit hospitals. Teaching status was defined as hospitals with some residents. All payer DRG-based case mix index was included to account for differences in patients' severity. Median family income measured for the hospital's zip code area was included to capture demand effects and as a proxy for cross sectional wage variations.

Analyses

We estimated regression models in which change in expenditures per adjusted discharge and excess mortality in 1989 were the dependent variables. Because all models were heteroskedastic, all reported tests of significance are based on White's robust standard errors [12]. The Ramsey RESET test for specification errors [13] was applied to all models to rule out the need for non-linear and interaction terms.

The mortality models were weighted by the inverse of the standard error for the predicted mortality rate, to account for differences across hospitals in the accuracy of the excess mortality measures, which are due to differences in sample sizes [14].

Since initial analyses indicated different associations (different βs) for for-profit and non-profit hospitals, we estimated fully interacted models, in which all variables were interacted with for-profit status. The hypotheses of significant marginal effect were therefore tested for the non-profit hospitals by a t test of the main effect and for the for-profit hospital by an F test of the linear restriction that the sum of the coefficients of the main and interaction effect are zero.

Results

Description of sample hospitals

Table 1 presents descriptive statistics for the hospitals included in the study. The majority of hospitals (52.6%) were private non-profit with the second largest group (26.0%) being for-profit institutions. Fifteen point four percent were teaching hospitals. The average hospital size did not change significantly over the 1982–1989 period, remaining at 190–200 beds. Occupancies declined significantly, from an average of 62.3% to 55.2%, and inpatient case mix increased significantly from 1.17 to 1.27, indicating that hospitals were treating sicker and more expensive patients at the end of the period. Both total expenditures and expenditures per adjusted discharge increased significantly.

The degree of competition among hospitals has not changed between 1982 and 1989. The HHI of around 0.3 suggests that competition was limited. (Markets with HHI values below 0.18 are considered moderately or very competitive [15]). The large variation in the HHI, however, indicates that many hospitals were located in competitive markets, with 25% of hospitals in markets with HHI below 0.17.

Overall mortality rates averaged 10%. Average observed and predicted rates were very similar, but the variation in rates was higher for the observed rates compared with the predicted rates, suggesting substantial variations in excess mortality and quality across the sample.

Table 1: Descriptive Statistics

	Mean	Standard Deviation
Beds		
1982	193	154
1989	199	150
Expenditures ('000)		
1982	16,323	16,901
1989	28,210***	30,221
Expenditures per adjusted discharge		
1982	2,568	898
1989	4,214***	1,547
Occupancy (%)		
1982	62.3	15.2
1989	55.2***	16.9
Inpatient all payers case mix index		
1983	1.17	0.22
1989	1.27***	0.28
Ownership (%)		
For profit	26.0	
Non profit	74.0	
private	52.6	
public	6.6	
district	14.8	
Teaching (%)	15.4	
Mortality – all causes 1989		
Observed rate	10%	3%
Predicted rate	10%	2%
AMI mortality 1989		
Observed rate	28%	14%
Predicted rate	27%	4%
CHF mortality 1989		
Observed rate	16%	7%
Predicted rate	15%	2%
Pneumonia mortality 1989		
Observed rate	16%	7%
Predicted rate	16%	2%
Stroke mortality 1989		
Observed rate	21%	10%
Predicted rate	21%	3%
Competition (HHI)		
1982	0.31	0.16
1989	0.30	0.16

Significantly different from 1982: *$0.05 \le p < 0.1$, **$0.001 \le p < 0.05$, ***$p < 0.001$

Resource allocation changes

Table 2 reports the mean values for the dependent and independent variables included in the multivariate regressions. Table 3 reports results by ownership – for-profit and non-profit. These results are based on a fully interacted model estimated over pooled data by ownership. All

Table 2: Means and standard deviations of variables included in the multivariate analyses

Dependent Variables	Mean Value	Standard Deviation
Change in expenditures/adjusted discharge		
Clinical services	1030.27	698.44
Hotel services	222.62	233.40
Administrative services	393.18	316.90
Excess mortality: (1989)		
All causes	0.67	1.9
AMI	1.44	13.6
CHF	0.50	7.1
Pneumonia	0.57	6.4
Stroke	0.78	9.5
HHI (1982)	0.306	0.164
Change in HHI (1989–1982)	-0.002	0.044
% bad debt and charity (1982)	3.90	4.46
Change in % bed	5.06	9.04
% occupancy (1982)	62.3	15.2
Change in % occupancy	-7.05	13.5
Case mix index (1983)	1.17	0.22
Change in case mix index	0.10	0.14
SUMs (1982) ('000)	184	173
Change in SUMs	-11.4	49.8
Median family income ('000)	38.2	9.5

models were highly significant ($p < 0.01$). The clinical services model explained 51% of the variation in expenditures per adjusted discharge, while the hotel and administrative services models explained 24% and 26% respectively.

Effect of competition

Table 5 presents the marginal effect of competition, calculated from the regression results and using equations 2 and 3, for 1982 and 1989, as well as the change in these coefficients between the two years. (Note that the regression coefficients for the HHI variable were multiplied by -1 in table 5, such that a positive association means that expenditures per discharge increase with increased competition.)

Non-profit hospitals in more competitive areas had higher expenditures per adjusted discharge in all three categories in all years. The marginal effect was highest in clinical areas and lowest in administrative services. It declined significantly over time in both clinical and hotel services, but not in administrative services. The decline was almost three times as large in the clinical services compared with hotel services. By 1989, while the marginal effect of competition on expenditures in these services was still positive, it was no longer significantly different from zero. These findings are consistent with the hypothesis that the focus of competition on quality in 1982 has diminished significantly over the seven-year period we studied.

The results for for-profit hospitals present a different picture. First, the association between expenditures per adjusted discharge and competition was statically significant only for administrative services. This association was also by far the strongest. It was negative, indicating that hospitals in more competitive markets spent less per discharge on administrative activities. The marginal effect was slightly smaller in 1989, suggesting that hospitals in more competitive areas may have reallocated resources into administrative services. They may have, for example, invested in better information and management systems that would allow them to better control costs.

The association between competition and resource use was negative in clinical services and positive in hotel services. This is consistent with the hypothesis that for-profit hospitals compete on quality in those areas that can be easily observed by patients, namely hotel services, and cut back on resources in clinical services, where quality is more difficult for patients to evaluate directly. The change over the 1982 through 1989 period is also consistent with this hypothesis: the negative association between competition and clinical resources increased in 1989 as did the positive association between hotel resources and competition. The lack of significance of the associations may reflect the smaller number of for-profit hospitals in the sample and the resulting lower statistical power. (There were 83 for-profit hospitals and 13 independent variables, compared with 237 non-profit hospitals.)

Other hospital and market characteristics

The strongest and most consistent relationship was between all payer case mix and expenditures per adjusted discharge in all categories (see table 3). The association was substantially stronger for the clinical category and in non-profit compared with for-profit hospitals.

Most other variables either exhibited no significant associations or no clear patterns. There were no significant differences in resource allocations by ownership. Teaching status was positively associated with clinical and hotel expenditures among the non-profit hospitals but exhibited a negative association among the for-profit hospitals. Percent bad debt and charity and percent occupancy had no significant relationship with expenditures among the non-profit but were associated with lower clinical and administrative expenditures among the for-profit hospitals. Median family income was associated with higher expenditure levels for all services among the non-profit hos-

Table 3: Expenditures per adjusted Discharge – Multivariate regression results

	Clinical		Hotel		Administrative	
A: Main effects	**Coefficient**	**P value**	**Coefficient**	**P value**	**Coefficient**	**P value**
HHI – 1982	436**	0.018	151**	0.026	-43	0.636
Change in HHI	-676	0.222	-291	0.176	-252	0.405
Case mix – 1983	863***	0.000	114**	0.026	193***	0.009
Change in case mix	2483***	0.000	642***	0.000	609***	0.000
For profit	515	0.350	209	0.281	207	0.511
Public	-9.8	0.932	-21	0.630	-19	0.738
District	1.3	0.986	11	0.691	18	0.504
Teaching	33	0.665	46*	0.098	95*	0.058
SUM – 1982 ('000)	1.0***	0.000	-0.02	0.741	0.1	0.213
Change in SUM ('000)	1.7***	0.002	-0.3	0.849	0.03	0.909
Occupancy – 1982	-3.0	0.214	0.1	0.863	-0.5	0.643
Change in occupancy	-0.05	0.985	-0.2	0.826	-1.1	0.340
Bad debt & charity – 1982	1.3	0.874	-1.1	0.492	-3.4	0.195
Change in bad debt & charity	2.7	0.589	-0.1	0.967	-0.6	0.721
Median family income	13.4***	0.000	4.3***	0.000	3.7***	0.008
	Clinical		**Hotel**		**Administrative**	
B: For-profit interaction effects	**Coefficient**	**P value**	**Coefficient**	**P value**	**Coefficient**	**P value**
HHI – 1982	-333	0.411	-275*	0.074	-103	0.677
Change in HHI	1014	0.346	-369	0.593	1900**	0.036
Case mix – 1983	-225	0.341	-48	0.609	17	0.899
Change in case mix	-506	0.218	-224	0.216	-398*	0.088
Teaching	-292	0.145	-235**	0.016	-28	0.783
SUM – 1982 ('000)	-0.7	0.392	-0.4	0.275	0.2	0.624
Change in SUM ('000)	-2.8	0.130	-0.5	0.475	-0.8	0.341
Occupancy – 1982	-0.8	0.891	2.1	0.336	-4.5	0.221
Change in occupancy	-3.9	0.505	1.1	0.669	-10***	0.001
Bad debt & charity – 1982	-7.9	0.751	-18.4	0.197	24*	0.078
Change in bad debt & charity	-46	0.004***	1.1	0.866	-16*	0.079
Median family income	1.4	0.812	-1.8	0.530	-0.5	0.887
N	322		319		320	
F value	13.5***		4.8***		5.1***	
Adjusted R^2	0.51		0.24		0.26	

*Significant at the 0.1 level **Significant at the 0.05 level ***Significant at the 0.01 level

pital, but only with the clinical services among the for-profits.

Risk adjusted excess mortality

Table 4 reports the results of the regressions modeling the association between excess mortality (defined as the difference between observed and predicted mortality rate) and clinical expenditures per adjusted discharge, competition, ownership, and teaching status. The models explained between 1% and 5% of the variation in excess mortality. In all cases there was a negative association between clinical expenditure levels and excess mortality, implying that increased resources were associated with better mortality outcomes. This relationship was present for mortality from all causes as well as from the four specific causes, and was statistically significant at the 0.10 level or better.

Table 6 shows the increase in excess mortality that is associated with a decrease of 1 standard deviation (SD) in clinical expenditures per adjusted discharge, based on the estimated regression coefficients. For comparison, the ta-

Table 4: Risk adjusted excess mortality – Multivariate Regression Results

	All Cases		AMI		Congestive Heart Failure		Pneumonia		Stroke	
	Coefficient	P value	Coefficient	P value	Coefficient	P value	Coefficient	P value	Coefficient	P value
Expenditures per adjusted discharge – 1989 ('000)	-0.47***	0.000	-2.1**	0.026	-1.1***	0.009	-0.43	0.332	-1.4**	0.026
HHI – 1989	-0.39	0.646	-3.9	0.482	2.6	0.406	-4.5*	0.077	-4.1	0.304
For Profit	-0.15	0.498	5.4***	0.006	-0.94	0.274	-0.40	0.653	-1.6	0.152
Public	0.73	0.187	2.2	0.530	-1.9	0.306	-0.36	0.862	8.1	0.174
District	-0.34	0.479	-3.6	0.111	-0.04	0.980	-2.2*	0.060	-1.0	0.556
Teaching Hospitals	-0.03	0.899	-1.5	0.457	-0.81	0.355	0.51	0.661	-2.5	0.286
N	330		326		329		329		328	
F value	4.54***		2.71**		2.44**		1.33		1.57	
Adjusted R^2	0.05		0.05		0.03		0.01		0.05	

*Significant at the 0.1 level **Significant at the 0.05 level ***Significant at the 0.01 level

Table 5: Marginal effect of competition on Expenditures per adjusted discharge (Positive values indicate increase with increased competition)

Non profit hospitals			
	Clinical	Hotel	Administration
1982	1112*	442*	209
1989	676	291	252
Change 1989–1982	-436**	-151**	43
For profit hospitals			
	Clinical	Hotel	Administration
1982	-235	536	-1794**
1989	-338	660	-1648*
Change 1989–1982	-103	124	146

*Significant at the 0.1 level **Significant at the 0.05 level ***Significant at the 0.01 level

ble also provides the magnitude of 1 SD in excess mortality among the study hospitals. In all cases, the effect of a 1 SD in resources was less than a 1 SD in excess mortality. As expected due to the potential bias towards zero in the measures based on all causes, the associations were larger for the cause specific measures.

As discussed earlier, we hypothesized that competition may affect quality, including clinical quality, not only through its impact on resource use but also due to incentives to compete on quality. If indeed hospitals were competing on clinical quality, the association between the HHI and excess mortality, controlling for resource use, should have been positive and significant. In all cases, except for pneumonia, we did not find a significant relationship. In most cases there was also no significant relationship between ownership or teaching status and excess mortality.

Discussion

In this paper we present a test of the hypothesis that changes in the nature of competition among California hospitals, resulting from selective contracting, were associated with changes in hospitals' resource allocation decisions. We find empirical evidence to suggest that resources have been shifted from clinical activities (which are not observed by patients) and into hotel services (which are more readily observable). These changes in resource allocation tended to be larger in hospitals located in more competitive areas. As the level of competition has not changed during the study period, the change in hospital behavior is likely to be a response to the change in the nature of competition.

Table 6: Increase in excess mortality rates associated with 1 standard deviation decrease in clinical expenditures per adjusted discharge

	All Causes	AMI	CHF	Pneumonia	Stroke
Increase in excess mortality rate due to 1 SD decrease in clinical expenditures/ adjusted discharge (Deaths per 100 discharges)	0.82	3.28	1.96	1.16	1.44
1 SD in excess mortality rate in sample hospitals (Deaths per 100 discharges)	1.87	13.6	7.06	6.42	9.52

The relationship between resource allocation and competition differed by ownership. For-profit hospitals in more competitive areas had lower expenditures levels compared with those in less competitive areas. Among non-profit hospitals, we found the opposite – clinical expenditures per adjusted discharge increased with competition. The trend over time, however, even though it was much stronger among the non-profit hospitals, was the same for both types. For both, the change in the marginal effect of competition ($\Delta\beta$) was negative. As a result, the positive association between competition and clinical resource use among non-profit hospitals diminished and the negative association among the for-profit hospitals increased.

The analyses of excess mortality demonstrate that clinical quality, at least as measured here, is positively associated with the amount of resources used in producing clinical services. Therefore, policies that create incentives for hospitals to limit resource use are likely to have an impact on health outcomes. Furthermore, as clinical quality is not easily observable by consumers, leading to disparity in incentives to provide hotel and clinical quality, more competitive areas are likely to experience a larger relative decline in resources allocated to clinical activities and hence worse mortality outcomes.

The impact on health outcomes in non-profit hospitals may not be as large as it might have been because expenditure levels were curtailed not only in clinical areas, but in hotel services as well, although to a much lesser degree. This strategy spread the burden of cost containment efforts beyond clinical activities. If non-profit hospitals would have concentrated all their cost cutting efforts in clinical services, as did the for-profit hospitals, the impact on costs, and potentially on mortality outcomes, would have been 35% higher (see table 4).

The generalizability of the findings presented here is limited in several ways. First, quality was measured only in terms of excess mortality. While this is an important aspect of quality, it is likely to be an insensitive measure. Because measures based on mortality do not tend to be correlated with measures based on other outcomes [16], such as complications, one cannot deduce from this study that other aspects of clinical quality have been affected similarly by the changes in competition during the period. Furthermore, the mortality models we estimated, unlike the expenditures models, were cross sectional and are therefore subject to the usual concerns about potential bias due to omitted hospital specific effects. It should be noted, however, that the models did include the variables most likely to be associated with excess mortality – patient level risks, expenditures, competition, ownership and teaching status. It should also be noted that while our findings with respect to changes in resource allocation are based on total expenditures, thus reflecting care for all patients, the mortality outcomes are based on the experience of Medicare patients only. Prior studies, however, suggest that patient care given by same provider does not vary by payer status [17–19].

A more important generalizability question arises due to the sample selected for this study – namely hospitals located only in California during the 1980s. Can the behavior of hospitals observed in this local and during this time period be assumed to generalize to other markets and other times? While the magnitude of the effects we measure in this study are clearly not generalizable, the directions of the effects are likely to transcend time and place, as they reflect basic behavioral responses to market incentives in accordance with theory. While this sample selection may be viewed as a limitation of this study, it is also its strength. By focusing on a period in which levels of competition were stable and where the change in the nature of competition can be traced to a specific legislative act, this study is able to test for the differential impact of price vs. quality competition, without confounding by other factors.

Conclusion

In summary, the results of this study should be viewed as raising a cautionary question: are the hospital cost reductions that have been observed in California [20] and nationally [21] associated with increased mortality?

Authors' Contributions

DM designed the study, performed the analyses, and wrote the manuscript. AB prepared the data set, and JZ participated in the design and analyses.

Competing interests

None declared.

Additional material

Additional file

Appendix: Assignment of cost centers to clinical, hotel and administrative categories
Click here for file
[http://www.biomedcentral.com/content/supplementary/1472-6963-2-10-S1.doc]

Acknowledgement

The authors gratefully acknowledge funding from the Agency for Health Care Policy and Research (grant No. HS09545).

References

1. Robinson JC, Luft HS: **Competition and the cost of hospital care, 1972 to 1982.** *JAMA* 1987, **257 23:**3241-5
2. Zwanziger J, Melnick GA, Bamezai A: **Cost and Price Competition in California Hospitals. 1980–90.** *Health Affairs* 1994, **13:**118-126
3. Melnick GA, Zwanziger J: **State health care expenditures under competition and regulation, 1980 through 1991 [see comments].** *American Journal of Public Health* 1995, **85:**1391-1396
4. Zwanziger J, Melnick GA, Mann J, Simonson L: **How Hospitals Practice Cost Containment With Selective Contracting and the Medicare Prospective Payment System.** *Medical Care* 1994, **32:**1153-1162
5. Zwanziger J, Melnick GA, Simonson L: **Differentiation and specialization in the California hospital industry 1983 to 1988.** *Medical Care* 1996, **34:**361-372
6. Farley DE, Hogan C: **Case-mix specialization in the market for hospital services.** *Health Services Research* 1990, **25:**757-83
7. Coulam RF, Gaumer GL: **Medicare's prospective payment system: a critical appraisal.** *Health Care Financing Review Annual Supplement* 1991, 45-77
8. Luft HS, Garnick DW, Mark DH, Peltzman DJ: **Does Quality Influence Choice of Hospital?** *JAMA* 1990, **263:**2899-2906
9. Health Care Financing Administration: **Medicare Hospital Information Report.** *Washington, D.C.: U.S. Government Printing Office* 1992
10. Rosenthal GE: **Weak Association between Hospital Mortality Rates for Individual Diagnoses: Implications for Profiling Hospital Quality.** *American Journal of Public Health* 1997, **87:**429-433
11. Zwanziger J, Melnick GA: **The Effects of Hospital Competition and the Medicare PPS Program on Hospital Cost Behavior in California.** *Journal of Health Economics* 1988, **7:**301-320
12. White H: **A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity.** *Econometrica* 1980, **48:**817-838
13. Ramsey JB: **Tests for Specification Errors in Classical Linear Least Squares Regression Analysis.** *Journal of the Royal Statistical Society 31: series B,* 1969, **series B:**350-371
14. Hartz AJ, Krakauer H, Kuhn EM, Young M, Jacobsen SJ, Gay G, *et al*: **Hospital characteristics and mortality rates [see comments].** *New England Journal of Medicine* 1989, **321:**1720-1725
15. Blair RD: *The McGraw-Hill Encyclopedia of Economics. McGraw-Hill, New York* 1994
16. Silber JH, Rosenbaum PR: **A Spurious Correlation Between Hospital Mortality and Complication Rates: The Importance of Severity Adjustment.** *Medical Care* 1997, **35:**OS77-OS92
17. Tussing AD, Wojtowycz MA: **Health maintenance organizations, independent practice associations, and cesarean section rates.** *Health Services Research* 1994, **29:**75-93
18. Herbert P, Maciejewski M, McBean M: **The Spillover Effect of Managed Care Market Penetration on the Quality of Care Provided to Medicare Beneficiaries with Diabetes Mellitus.** *Association for Health Services Research, 16th Annual Meeting, Abstract* 1999
19. Mukamel DB, Zwanziger J, Tomaszewski KJ: **HMO Penetration, Competition and Risk Adjusted Hospital Mortality.** *Health Services Research, Forthcoming* 2001
20. Zwanziger J, Melnick GA, Bamezai A: **The Effect of Selective Contracting on Hospital Costs and Revenues.** *Health Services Research* 2000, **35:**849-867
21. Bamezai A, Zwanziger J, Melnick GA, Mann JM: **Price Competition and Hospital Cost Growth in the United States (1989–94).** *Health Economics* 1999, **8:**233-243

Pre-publication history

The pre-publication history for this paper can be accessed here:

http://www.biomedcentral.com/1472-6963/2/10/prepub