Can Hospital Competition Really Affect Hospital Behavior or Not? An Empirical Study of Different Competition Measures Comparison in Taiwan

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Abstract

Different approaches to measure the hospital competition index might lead to inconsistent results of the effects of hospital competition on innovation adoption. The purpose of this study is to adopt a different approach to define market area and measure the level of competition to examine whether hospital competition has a positive effect on hospital behavior, taking quality indicator projects participation as an example. A total of 238 hospitals located in Taipei, Taichung, and Kaohsiung were recruited in this study. Competition index was used as the independent variable, and participation lists of Taiwan Clinical Performance Indicator and Taiwan Healthcare Indicator Series in 2012 were used as dependent variables. All data used in this study were retrieved from the 2012 national hospital profiles and the participation list of the 2 quality indicator projects in 2012; these profiles are issued by the Taiwan Ministry of Health and Welfare annually. Geopolitical boundaries and 4 kinds of fixed radiuses were used to define market area. Herfindahl-Hirschman Index and hospital density were used to measure the level of competition. A total of 12 competition indices were produced in this study by employing the geographic information system, while max-rescaled R^2 was used to evaluate and compare the models on goodness of fit. The results show that the effects of hospital competition on quality indicator projects participation were varied, which mean different indicators for market competition might reveal different conclusions. Furthermore, this study also found the Herfindahl-Hirschman Index at 5-km radius was the optimum competition index.

Keywords

hospital competition index development, quality indicator project, model comparison, GIS, hospital behavior

Introduction

Quality improvement has become a central tenet in health care. It is no longer the preserve of enthusiastic volunteers but instead a part of the daily routine of all those involved in delivering health care. It has also become a statutory obligation in many countries.[1] In response to the growing demands for quality transparency, costs control, and reduced variations in clinical practices, assessing the quality of health care has become increasingly important for different stakeholders, including health care providers, decision makers, and purchasers of health care services.[2] However, quality cannot be improved without a measurement baseline. The Quality-of-Care Framework (Structure-Process-Outcome) proposed by Donabedian is the most important model for assessing the quality of care.[3] To assess the quality of care and to develop the measurement instruments, researchers have used this model along with quality indicators.

The Taiwan National Health Insurance Scheme was launched in 1995. Since then, it has not only increased the accessibility of health care for Taiwanese citizens but also increased the level of competition among hospitals. Hospitals are looking for any means to achieve an advantage, such as purchasing high-tech and expensive equipment, or implementing new quality improvement activities, such as participating in quality indicator projects.[4] The quality indicator has been used in Taiwan since the 1980s. It was an innovative topic, and only a few hospitals adopted it at that time[2];

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nowadays, however, it has become one of the most commonly seen quality improvement activities in Taiwan.[5] Besides, quality indicator is a major tool for assessing hospital performance. It has been used extensively in the medical industry since the last decade; not only was it used for internal organization improvement but it has also been used for payment,[6,7] report cards,[8,9] accreditation schemes,[10] and other external applications.

Many studies have discussed the effects of hospital competition on quality improvement activities adoption,[11-13] but these studies have demonstrated inconclusive and sometimes contradictory findings on the effects of hospital competition.[14] For example, Sethi et al[15] found hospitals located in a higher competitive environment were prone to adopt new technology for endovascular aneurysm repair treatment. However, Weiner et al[16] found that market competition is negatively associated with quality improvement implementation scope. In addition to the difference of contextual factors and organizational characteristics, most existing studies have usually adopted a single approach and definition to measure hospital market competition. The variations in indicator measurement methods might lead to different results, which included the approaches to define market area and to measure level of competition.[17,18] According to the review by Wong et al,[19] there are 6 approaches to define market area, including geopolitical boundaries, fixed radius, variable radius, patient flow, cross elasticity of demand, and Elzinga-Hogarty. Regarding level of competition, there are 3 indicators for measuring the level of competition, including the number of hospitals, the Herfindahl-Hirschman Index (HHI), and concentration ratio. Wong et al also found geopolitical boundaries, fixed radius, variable radius, and patient flow are most commonly used for defining market area, and the number of hospitals and the HHI are most frequently used for measuring hospital competition within market areas.

A brief summary of the most common approaches to define market area and to measure level of competition is as follows: Geopolitical boundary is the most common approach to define the market area because of its ease of implementation, but this approach might not be consistent with daily life operations in practice. For example, for 2 hospitals located on both sides of a boundary, they would be providing service to the same community and population, but each belongs to different market areas. Although a fixed and variable radius approach can overcome this disadvantage of geopolitical boundary approach, defining the optimal radius is still a major challenge.[20,21] Patient flow is the most sophisticated approach to depict market area, and it is also the most difficult approach to employ. As for measuring the level of competition, the number of hospitals has the advantages of being intuitive and easy to implement. However, the disadvantage of this measure is that it does not reflect differences in market share. The HHI was the sum of squared market shares for all the hospitals in the market. In the context of hospital competition, a hospital's market share is frequently calculated as the number of discharges from that hospital divided by the total number of discharges from all hospitals in the market.[22]

Although the lack of consensus to measure the level of market competition might be a problem, comparative studies on the effect of hospital competition indicators are limited. Therefore, the purpose of this study is to adopt a different approach to define the market area and measure the level of competition, to examine whether hospital competition has a positive effect on quality indicator project participation or otherwise. Due to the characteristics of the data, we only used geopolitical boundaries and fixed radius to define market areas, and adopted the number of hospitals and the HHI for measuring hospital competition within market areas in this study.

Methods

Data Source

There were 2 data sources used in this study. The first was the 2012 national hospital profile issued by the Taiwan Ministry of Health and Welfare annually. It includes information on variables relevant to medical services, such as hospital size, number of all kinds of medical staff, inpatient and outpatient services, and patients' length of stay. We used these data to obtain the characteristics of hospitals and the calculation of the hospital competition index. The second data source was the quality indicator project participant list in 2012, which includes the 2 major quality indicator projects in Taiwan, namely, Taiwan Clinical Performance Indicator (TCPI) and Taiwan Healthcare Indicator Series (THIS).[23]

In 1999, the Taiwan Joint Commission on Hospital Accreditation introduced the International Quality Indicator Project (IQIP), named Taiwan Quality Indicator Project (TQIP). After a 10-year cooperation with IQIP, the Taiwan Joint Commission on Hospital Accreditation used this experience to develop TCPI that can further meet hospitals' demand. Unlike TQIP, the THIS was developed by local experts, the Taiwan College of Healthcare Executives, launched in 2001.[23] Both TCPI and THIS were voluntary quality indicator projects. Hospitals submit their data regularly, where either Taiwan Joint Commission on Hospital Accreditation or Taiwan College of Healthcare Executives will provide feedback periodically. Besides, both of them are the largest and most important quality indicator projects in Taiwan. Most hospitals select either TCPI or THIS to participate.

In addition, we selected the 3 major cities Taipei, Taichung, and Kaohsiung as our study area. Taiwan is a mountainous island shaped like a leaf that is narrow at both ends. The terrain in Taiwan is divided into 2 parts: the flat to gently rolling plains in the west and the mostly rugged forest-covered mountains in the east. Around 90% of the population in Taiwan lives in the west coastal plain, which is also where

most hospitals are located, especially in Taipei, Taichung, and Kaohsiung. For homogeneity, hospitals located in these cities were included in our study.

Independent Variable: Competition Index

We adopted geopolitical boundaries and the fixed radius approach to define the market area. The geopolitical boundaries were set from both the town and county boundaries and the following radius circles: 1, 5, 10, and 25 km. In the absence of sufficient data from local studies, the chosen distances were based on the results of expert panel meeting. The level of market competition was measured by hospital density and the HHI. We used hospital density to reflect the number of hospitals in an area because it was easier to interpret than the number of hospitals per se. The HHI values ranged from 1/N to 1, where N is the number of hospitals in the market. A high HHI value means high market concentration. The advantage of the HHI is that it reflects both the number of hospitals and their relative market share. We employed the geographic information system (ArcGIS 9.3) to describe the market and calculate the hospital density and HHI within an area. A total of 12 competition indices were produced in this study.

Dependent Variable: Quality Indicator Project Participation

The quality indicator project participation was used as the dependent variable. If a hospital participated in TCPI or THIS and updated data routinely (at least twice per year), then it would be identified as a participating hospital, otherwise a nonparticipating hospital.

Control Variables

In addition to competition index and quality indicator project participation, this study also collected ownership, size, and ratio of discharge to number of health care professionals (i.e., physicians, nurses, administrative staff). In some capacity, it is necessary to input resources when implementing quality improvement activities; sufficient manpower/workload is one of the key successful factors in literature.[24] Therefore, we used these 3 variables to represent the proxy of workload, and these 3 professional indexes are usually highly participative in quality improvement activities. Besides, these 3 workload variables were categorized into 3 groups, using the first and third quartiles (Q1 and Q3) as cutoff points.

Statistical Analysis

All statistical analyses were performed using SAS (version 9.4; SAS Institute Inc, Cary, North Carolina). In statistical testing, frequency and percentage were used to present the hospital characteristics. In bivariate analysis, potential predictors of quality indicator projects were examined by using the chi-square test. Logistic regression was used to assess project participation, and max-rescaled R^2 was used to evaluate and compare the models on goodness of fit.[25]

Results

The descriptive analysis of sample hospitals, and comparison among participating hospitals and nonparticipating hospitals is demonstrated in Table 1. A total of 238 hospitals were included in this study, most of which are medium-sized hospitals (50-300 beds); two-thirds of the sample were private hospitals, while the percentage of public and not-for-profit hospitals were 16% and 18%, respectively. In terms of comparison of participating hospitals and nonparticipating hospitals, larger sized hospitals, nonprivate hospitals, and higher ratio of discharge to the number of health care professionals were prone to participate in quality indicator projects.

Table 2 shows the results of model comparison, where model 0 represents the base model, which only included all control variables. Twelve competition indices were then placed into the baseline model respectively. The results showed the effects of hospital competition on quality indicator projects participation were varied, which means different definitions of market competition indicator might lead to different conclusions.

Furthermore, the results also revealed the model fit of distance-based market area models (models 5-12) was better than geopolitical boundary models (models 1-4), and the effect of competition index in models 1 to 4 was not significant. The results of this study also demonstrated the competition indices that used geopolitical boundaries to define market area could only improve the model fit slightly, and most of them were not significant. Finally, we also found model 10 had the best-fitting model among all models, which meant a 5-km radius with HHI was the best competition index to examine the effects on quality indicator projects participation.

Discussion

Competition drives the quality of care in many health care systems, in addition to the more altruistic motivations that health care workers often report. This is true not only in Taiwan but also in many developed countries, including the United States and the United Kingdom, as health care organizations worldwide urgently search for ways to improve both quality and cost-effectiveness.[26] Such competition shapes hospital strategies implemented to adapt to the market environment and needs, which can lead to a medical arms race.[27] In this study, we examined the effect of competition on quality indicator projects participation by using geopolitical boundaries and fixed radius to define market area, and hospital density and HHI to measure the level of competition. The results show that the effects of hospital competition on quality

Table 1. Descriptive Statistics of Study Objects.

Characteristics	All hospitals (N = 238)	Nonparticipating hospitals (n = 99)	Participating hospitals (n = 139)	P value
Size, n (%)				<.0001
≥300	60 (25.21)	5 (5.05)	55 (39.57)	
299-51	120 (50.42)	56 (56.57)	64 (46.04)	
≤50	58 (24.37)	38 (38.38)	20 (14.39)	
Ownership, n (%)				<.0001
Public	38 (15.97)	4 (4.04)	34 (24.46)	
Not for profit	42 (17.65)	10 (10.10)	32 (23.02)	
Private	158 (66.39)	85 (85.86)	73 (52.52)	
Discharges/physician, n (%)				.001
≥209 (≥Q3)	59 (24.79)	27 (27.27)	32 (23.02)	
209-52 (Q3-Q1)	120 (50.42)	37 (37.37)	83 (59.71)	
≤52 (≤Q1)	59 (24.79)	35 (35.35)	24 (17.27)	
Discharges/pharmacists, n (%)				.0050
≥530 (≥Q3)	59 (24.79)	19 (19.19)	40 (28.78)	
530-121 (Q3-Q1)	120 (50.42)	45 (45.45)	75 (53.96)	
≤121 (≤Q1)	59 (24.79)	35 (35.35)	24 (17.27)	
Discharges/nursing staffs, n (%)				.0004
≥45 (≥Q3)	61 (25.63)	29 (12.18)	32 (13.45)	
45-13 (Q3-Q1)	116 (48.74)	34 (14.29)	82 (34.45)	
≤13 (≤Q1)	61 (25.63)	36 (15.13)	25 (10.50)	
Discharges/administration staffs, n (%)				
≥76 (≥Q3)	59 (24.79)	24 (24.24)	35 (25.18)	.0022
76-17 (Q3-Q1)	119 (50.00)	39 (39.39)	80 (57.55)	
≤17 (≤Q1)	60 (25.21)	36 (36.36)	24 (17.27)	

Note. Q = quartile.

indicator projects participation were varied, meaning the variations in competition indicator measurement methods may lead to different results. And this study also found 5 km was the optimum radius to define the market area.

Furthermore, 3 issues merit further discussion. First of all, which approach is appropriate for defining market area? Previous researchers usually used geopolitical boundaries to define hospital market areas. Although measures of these boundaries are easy to calculate and are linked to demographic data, they do not take account of hospitals' competitiveness or how they are affected by the so-called neighborhood factors that are geographical rather than geopolitical. For example, 2 nearby hospitals that happen to be on different sides of a geopolitical boundary may compete with each other fiercely. The results of this study demonstrated the competition indices that were using geopolitical boundary to define market area could only improve the model fit slightly, and most of them were not significant. Along with computer technology development, defining the market area has become easier today. For instance, GPS can be employed to implement the radius-based approach, which we adopted in the present study. However, the selection of an optimal radius is another challenge. According to the original definition of this approach, a radius is determined by the catchment area in which 75% to 90% of a hospital's patients

reside.[28] Nevertheless, this study could not obtain such information; therefore, we modified the fixed radius approach by replacing the standard coverage rate with 4 different radii which were determined by an expert panel.

Second, which approach is appropriate to measure the level of competition? Both hospital density and the HHI are most commonly used in hospital competition studies; the pros and cons of these are described above. Which one is better in measuring the level of hospital competition? According to the definition, the HHI should better represent the level of hospital competition; however, our findings did not support this. In terms of improving model fit, 2 models showed that hospital density was better than the HHI (models 3 and 11 vs models 1 and 12), which used the same market area. In contrast, there were also 4 models that showed the HHI was better than hospital density (models 2, 5, 8, and 10 vs models 4, 6, 7, and 9). The findings were not consistent; therefore, we are unable to determine which one is better. The phenomenon might be explained by the fact that hospital behavior is affected not only by hospital competition but also by internal factors such as leaders' values, attitudes, and educational background[14,29] and resource availability.[12,24] This information was not available in this study and is therefore also a major limitation.

Finally, regarding the relationship between hospital competition and quality indicator project participation.

Table 2. The Comparison Among Odds Ratio and Competition Model Fitting.

	Model 0	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Competition measures													
HHI_County		1.00											
HHI_Town			1.00										
Density_County				7.02									
Density_Town					1.69								
Density_25km						1.37**							
HHI_25km							1.00						
Density_10km								5.12**					
HHI_10km									1.00**				
Density_5km										1.78**			
HHI_5km											1.03***		
Density_1km												1.08**	
HHI_1km													1.00
Max-rescaled R^2	0.3002	0.3005	0.3087	0.3053	0.3023	0.3315	0.3074	0.3369	0.3503	0.3305	0.3692	0.3353	0.3126

Note. All models are adjusted for ownership, size, and ratio of discharge to number of health care professionals. HHI = Herfindahl-Hirschman Index.
*P < .05. **P < .01. ***P < .001.

Although the findings of this study were varied, at least, there was no negative effect of hospital competition on quality indicator project participation. However, why does hospital competition drive hospitals to take the same action? The adoption of similar actions within a given institutional environment can be explained by organizational isomorphism[30] and institutional theory.[31] These theories illustrate that organizations experience pressure to conform to their institutional environment because of the operation of coercive pressures from political institutions, normative pressures from occupational and professional constituencies, and mimetic pressures from other organizations with which they compare themselves with.

In summary, the results of this study have several contributions. In terms of theoretical contribution, except the relationship between hospital competition and quality indicator projects participation were varied, our findings also showed there was no negative relationship between hospital competition and quality indicator projects participation when various hospital competition indicators were used. Therefore, our findings might prove that hospitals would change their behavior due to mimetic pressures or normal pressures, which are components of the institutional theory. Regarding practical management/policy implications, the results also imply that health authorities should pay more attention on defining market area and, for hospitals located in low competition areas, for example, providing incentives to encourage the more adoption of quality improvement activities. For future research, selecting an appropriate approach and definition to define market area and to measure the level of competition is an important issue for future study. Nowadays, researchers define market area more precisely by employing geographic information systems. The appropriateness of using geopolitical boundary to define market area should be considered in future studies.

Altogether, this study applied a geopolitical boundary and fixed radius approach to define market area, and also adopted HHI and hospital density to measure the level of competition. A total of 12 hospital competition indices were produced in this study and were also used to examine whether hospital competition had positive effect on quality indicator projects participation. However, even with these advantages, the study was still subject to 2 major limitations as described below:

1. The information of patients' residences is not available. It is not possible for our study to adopt the patient flow approach to define market area. Furthermore, a variable radius approach is also inapplicable because of the lack of data mentioned above. The expert meeting which we held in this study attempted to alleviate this limitation.
2. A cross-sectional study design might hinder the explanation of the results. This study demonstrated various approaches and definitions to measure hospital competition that could lead to inconsistent results. However, the causal effects between hospital competition and quality indicator project participation should be explored by a longitudinal study instead of a cross-sectional study.

Conclusions

In summary, our study adopted the geopolitical boundaries and fixed radius to define market area, while the HHI and hospital density were used for measuring the level of competition. A total of 12 competition indicators were produced in this study. After applying them to examine the relationship between hospital competition and quality indicator project participation, we found the results varied by different competition indicators. Our findings demonstrated that the inconsistent findings of existing hospital competition studies might be caused by various measurement methods of competition. Policy makers and further studies should take this issue into account.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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