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Full Length Research paper

Enhancing quality of healthcare under the national health insurance system: Identification of factors reducing quality of care in Taiwan

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This study examines whether the quality of community health in Taiwan has improved after the establishment of the National Health Insurance (NHI); to identify what the related factors are that affect the quality, and to find the possible ways to improve key drivers of healthcare quality. Data were collected from the National Health Insurance Annual Statistics Information Database and the Taipei Health Information Indices Database in the form of unbalanced panel of 153 hospital-years from 1989 to 2002 in 13 Taipei public hospitals within different districts. In addition, panel data analysis with fixed effects model was conducted to identify what factors affected the quality of healthcare before and after the advent of the NHI. After the NHI, quality of care improved insignificantly. The elderly, market competition, new technology, average length of stay (LOS), scale, physician density and nurse to patient ratio were all major factors affecting quality. Moreover, lower doctor density, longer LOS and increased in the number of elderly led to deterioration in the quality of care. The government could improve quality of elder-care by encouraging the re-building of three-generation family values. Policymakers should also permit public hospitals to institute the incentive programs for their professional staffs. In addition, quality could be improved by having hospital managers who enhance efficiency by decreasing the LOS.

Key words: Quality, drivers of quality, national health insurance.

INTRODUCTION

The amount of money expended in most developed countries on improving the quality of care is a matter of individual policy (Anderson et al., 2000). Unfortunately, this often gives rise to a cost containment problem (Younis et al., 2005). How to improve quality, while simultaneously limiting cost, is a tough challenge. Porter and Teisberg (2006) suggested a new approach to this problem – to focus on value for patients (value quality) rather than the traditional cost containment strategies, because the value quality will reduce the incidence of failed or unnecessary treatment, leading to better cost containment. In other words, the best way to truly reduce healthcare costs is to strive for excellence in terms of patient healthcare, not to sacrifice the quality of care (cut costs).

Taiwan's National Health Insurance scheme (NHI) was implemented in 1995. Its goals of better cost containment and improved quality were to be achieved by means of increased competition (Chiang, 1997). Under this competition, policymakers expected that hospitals would be forced to improve both the quality and cost containment for survival. Unfortunately, the NHI continues to suffer from a financial deficit, because of increased healthcare costs (Hung and Chang, 2008). Therefore, cost containment is more important than improved quality in this health reform.

The questions that need to be addressed seem to be: "whether cost containment is more important than quality of care" and "whether we can reduce healthcare spending and still maintain the same level of quality." Cheng (2003) argues that the solution of the NHI's problem is to improve quality rather than cost containment. However, before we answer the stated questions, policymakers and hospital managers have to first identify what drives true improvements in quality. Because quality in hospitals is affected by market, operational and financial factors (Waldman and Gopalakrishman, 1996; McCue et al., 2001). Eventually, we may figure out that improved quality will lead to better cost containment.

There is, however, little in the literature on the quality of health services in developing countries (Reerink and Sauerborn, 1996; Webster et al., 2007). Also, there is little information available on the determinants of hospital quality which would be helpful to improve cost containment (Haddad and Fournier, 2002). There have also been few studies on the evaluation of what affects quality in individual hospitals as related to healthcare reform. In addition, this study adopts panel data analysis, not a single cross-section to handle the data base on the same individual hospital, and uses the unique samples which covered the periods before and after the NHI (Chang, 2011).

The main purposes of this paper are as follows: 1) to examine whether the quality of healthcare improved after the NHI; 2) to identify what factors affect the quality before and after the NHI; 3) to identify which factors deteriorate the quality after the NHI; 4) to find the possible solutions to improve key drivers of quality for enhancing healthcare quality in Taiwan. In particular, we look at the Taiwan situation, where public hospitals and not-for-profit hospitals are the norm, but where quality of care in public hospitals is worse than that in not-for-profit hospitals (Chang et al., 2004). In other words, public hospitals are in urgent need of improvement. It is our justification that if public hospitals are successful in improving their quality of care, increased health spending and government financial deficits will be released. Mean-while, not-for-profit hospitals will face the "peer pressure" to enhance advanced quality. Therefore, it is important to attain an understanding of what drives quality of care in public hospitals. This will be the first step to aid hospital managers and policymakers to find the best solutions for improving both quality of care and cost containment.

METHODS

What is quality?

The definition of quality used in this study is the degree to which health services for populations increase the expected health outcomes and are consistent with current professional knowledge (Lohr, 1990). Most studies of healthcare quality in Taiwan used hospital mortality rates, the number of services to acces, and the patient satisfaction, as indictors of quality (Cheng et al., 2002, 2003; Liu et al., 2002; Chen et al., 2003, 2004, 2007; Chuang et al., 2005; Chou et al., 2005; Lin, 2006; Lien et al., 2008). Unfortunately, database in Taiwan does not cover longitudinal data of patient satisfaction. Therefore, we select hospital inflection rates to replace it (Cheng, Ho and Chung, 2002).

Hospitals with lower mortality (inflection) rates are thought to provide better quality of clinical care (Bulger et al., 2002; Peterson et al., 2002; Mohammed et al., 2005). Further, as a quality of care indicator, mortality rates and inflection rates are more reliable and accountable (Aiken et al., 2002; Picone et al., 2003; Treurniet et al., 2004). More importantly, adopting mortality rates and inflection rates as indicators of quality may provide a patient's point of view, offering a simple index of quality to direct quality of care in low income and developing countries (Cheng et al., 2002).

The determinants of quality of care

Identifying the factors of quality is an important process to improve quality. According to our literature review and statistical methods, we extract the following seven major variables representing quality drivers as follows:

1) Aging population is frequently associated with high mortality rates (Zimmer et al., 2005). The norm is that as we age, our health becomes worse (Seshamani and Gray, 2004). Therefore, an aging population is negatively associated with quality.
2) Competition is an evolutionary process that produces superior performance (Hunt and Morgan, 2004). Free choice by patients and selective contracting for health plans (purchasers) are part of the natural selection system. Hospitals are forced to offer higher quality services to be selected by the patient (Propper et al., 2004). Therefore, competition is positively related to hospital quality.
3) Advanced technology: increased usage of advanced technology leads to better medical treatments (Chou et al., 2004). New technology can also help to reduce medical errors and improve clinical decisions (Peterson and Noskin, 2001). It contributes to improved quality (Casalino et al., 2003). Thus, new technology is positively associated with quality of care. Thus, new technology is positively linked to quality of care.
4) Average length of stay (LOS): A shorter LOS represents higher efficiency and effectiveness; efficient, effective and appropriate treatment leads to high quality (Brownell and Roos, 1995; Chang et al., 2005). Therefore, LOS is negatively related to quality, because a shorter LOS is consistent with more rapid, ordered and systematic care (Clarke, 2002).
5) Scale (number of beds): A hospital can improve efficiency by increasing its scale. A larger scale hospital has more resources available (for example, new technology and better staff) which leads to better quality than is possible in a smaller sized facility (Aiken et al., 2002). Large hospitals also have stronger market power to achieve better quality (Ferlie and Shortell, 2001). Therefore, size is positively related to quality (Sochalski, 2004).
6) Physician density (physician-to-patient ratio): A higher physician to patient ratio also means that doctors have more time to spend with individual patients and, ultimately, the quality of patient care is improved (Chang, Liang and Ransom, 2005). Thus, professional density is positively linked to quality. 7) Nurse density (nurse-to-patient ratio): Nurses directly take care of patients, combining curing, warming and reading functions (Thomas-Hawkins et al., 2008). In other words, they are more likely to impact the patient's health (Coll de Tuero et al., 2004). Thus, a higher nurse-to-patient ratio is associated with superior patient outcomes.

Data and empirical model

The sample was collected from the National Health Insurance Annual Statistics Information Database and the Taipei Health Information Indices Database for 2005, published by the Department of Health in Taiwan and the Bureau of Health in Taipei City, respectively. These databases carry all market, mission, operational, and financial information on Taipei public hospitals. The sample included the following hospitals: Renai, Yangming, Zhong Xiao, Heping, Wanfang, Zhongxing, Women's and Children's, Guan Du, Chronic Diseases, Songde, Traditional Medicine, Venereal Diseases Control and Taipei Shuang Ho hospitals - 13 hospitals in total. Each Taipei public hospital is located in a different geographic area, thereby facing different kinds of competition and having varied population demographics. This sample included 13 Taipei public hospitals from 1989 to 2002, totaling 153 (Table 1). Moreover, we divided the sample into two groups (from 1989 to 1994 and from 1996 to 2002) to test the changes for drivers of quality which are which included averaged number of clinical departments (18), total

Table 1. Distribution of hospitals in the sample from 1989 to 2002.

Year	Number of hospitals[1]	Percentage of hospitals in sample to total
1989	10	6.53
1990	10	6.54
1991	10	6.54
1992	10	6.54
1993	10	6.54
1994	10 60 (from 1989 to 1994)	6.54
1995	10	6.54
1996	11	7.19
1997	11	7.19
1998	11	7.19
1999	12	7.84
2000	12	7.84
2001	13	8.49
2002	13 83 (from 1996 to 2002)	8.49
Total	140 153 (from 1989 to 2002)	100.00

[1]The Traditional Medicine hospital commenced official operation in 1996, the Wan Fang hospital began official operation in 1999 and the Gan Dau hospital was officially began operation in 2001. Other hospitals were established before 1989.

averaged number of inpatients (11,517) and total averaged number of dead of inpatient (808).

This study used panel data analysis with fixed effects model to indicate the determinants of quality before and after the NHI (from 1989 to 2002) following the framework of Zimmer et al. (2004) related to old-age mortality rates to patients' mortality and inflection rates. The models to be estimated were presented in two stages. In the first stage, we used the principal component method to extract the following 7 major variables In addition, we excluded family size (FP), teaching status (TEA), occupancy rates (OR), subsidies (SUB), household income (FI), the number of family member (FN), medical expenses of family (FH) and education level of family member (Fedu) from our independent variables. In the second stage, the statistical models were used to investigate the relationship between mortality/infection rates - the dependent variables - and independent variables (McCue, 1997; Cheng et al., 2002). As in McCue et al. (2001), the remains of independent variables were classified into market, mission, operational and financial factors. A lagged design was adopted in model 1 (for testing purposes 1 and 2) and model 2 (for testing purpose 3) to improve the strength of causal inferences (Muth and Donaldson, 1998).

Model 1: Full sample

$$MR_{i,t}\ (IR)_{i,t} = \alpha_{i,0}+\alpha_{i,1}\ AP_{i,t-1} + \alpha_{i,2}\ MS_{i,t-1}\ \alpha_{i,3}\ NT_{i,t-1} + \alpha_{i,4}\ LOS_{i,t-1} + \alpha_{i,5}\ BED_{i,t-1} + \alpha_{i,6}\ DOC_{i,t-1} + \alpha_{i,7}\ NUR_{i,t-1} + \alpha_{i,8}\ DB_{i,t-1} + \alpha_{i,9}\ TC_{i,t-1} + \alpha_{i,10}\ BA_{i,t} + \varepsilon_{i,t} \quad (1)$$

Model 2: Seperated sample

$$MR_{i,t}\ (IR)_{i,t} = r_{i,0}+r_{i,1}\ AP_{i,t-1} + r_{i,2}\ MS_{i,t-1} + r_{i,3} NT_{i,t-1} + r_{i,4}\ LOS_{i,t-1} + r_{i,5}\ BED_{i,t-1} + r_{i,6}\ DOC_{i,t-1} + r_{i,7} NUR_{i,t-1} + r_{i,10}\ DB_{i,t-1} + v_{i,t} \quad (2)$$

Definition of variables

The dependent variable is quality. We use the mortality rates (MR) (outcome dimension), and infection rates (IR) (process dimension) to represent quality (Donabedian, 1966; Cheng et al., 2002). MR is defined as, risk-adjusted mortality rate with 30 days which is adjusted by age, sex, degree of illness severity and degree of service of specialization; IR is represented to, risk-adjusted inflection rate with 30 days which is also adjusted by age, sex, degree of illness severity and degree of service of specialization (Chang et al., 2004; Eggleson et al., 2010).

Independent variables separate into market, and operational factors. Market factors are more detailed and include aging population (AP) which is the demand index of the market factor (defined as the number of individuals aged 65 and over/total population), and market share (MS) which is an inverse of competition index (individual hospital's patient days/all hospitals' patient days in one district). Finally, operational factors include: new technology (NT) which is an index of innovation (net medical equipment/net total fixed assets); average length of stay (LOS) which is an index of efficiency (the log of the total number of inpatient days/the log of total number of admissions); the number of beds (BED) which is an indicator of hospital scale (the log number of hospital beds); doctors density (DOC) which is defined as the ratio of the total number of doctors in an individual hospital to total patients in an individual hospital; and nurses density (NUR) which is indicated as the total number of nurses in an individual hospital to the total number of patients in an individual hospital.

The following control variables are utilized in the model: debt ratios (DB) indicate the ratio of total debts to total assets; total costs (TC) which is a cost containment index (total costs and expenses of at individual hospital adjusted by CPI/total sales of individual hospital adjusted by CPI); and a dummy variable the period - before and after the advent of the NHI (BA) (years after adopting the NHI = 1; years before = 0).

RESULTS

Descriptive results: Comparison groups

Univariate analysis was used to determine how the

Table 2. Distribution of hospitals in the sample from 1989 to 2002.

Hospitals	Department of hospitals	Total number of inpatients (times)	Total number of inpatient dead[1]
Renai hospital	30	22,016	1,457
Zhongxing hospital	18	10,777	685
Heping hospital	34	18,376	1,380
Women's and children's hospital	16	14,450	916
Yangming hospital	22	16,989	1,401
Zhong Xiao hospital	17	15,134	1,052
Chronic diseases hospital	5	2,230	104
Songde hospital	9	2,415	150
Wanfang hospital	23	20,144	1517
Traditional medicine hospital	16	4,254	310
Guan Du hospital	20	10,864	691
Venereal diseases control hospital	6	597	55
Taipei Shuang Ho hospital	17	11,487	785
The averaged number	18	11,518	808

[1]Do not adjust by age, sex, degree of illness severity and degree of service of specialization.

hospital quality and other variables change under the NHI. The descriptive statistics related to quality and other independent variables for Taipei public hospitals before and after the NHI are presented in Table 2. An examination of Table 3 reveals several obvious differences. First, quality showed a tendency to insignificantly improve, in the post-NHI period; both the mean (median) ratios of MR and IR were lower after the NHI than before. This shows that quality has not improved after the NHI. Second, there is a significant increase in the means (or medians) of NT, NUR, LOS and BED; MS and DOC significantly decrease (decreased MS shows strong competition). Interestingly, a longer LOS and lower DOC were inconsistent with our expectation. It may imply that inefficient expansion (decreased occupancy rates) and inappropriate FFS push hospitals to extend longer LOS (Chang and Lan, 2010). Also, the poorer salary incentive programs in Taipei public hospitals caused relatively lower physician density, because incentives are too low to attract professionals (Chu et al., 2002).

Multivariate results: Panel data regression analysis

Panel data analysis with fixed effects model was applied in a longitudinal observational study to determine the factors influencing changes in hospital quality from 1989 to 2002. The results provided us with 7 independent variables: AP, MS, NT, LOS, BED, DOC and NUR. In Table 4, it can be seen that all coefficients of AP, MS and LOS are significantly positive; the coefficients of NT, BED, DOC, and NUR are significantly negative. Additionally, the coefficients of BA were insignificantly negative, indicating that the results show that quality has not improved after the advent of the NHI. The relationship between MR (IR) and TC is negative, which is inconsistent with Porter and Teisberg's (2006) suggestion. This implies that hospitals in Taiwan may have to refocus on quality, not cost containment, to address problems with health waste and inappropriate treatment (Cheng, 2003; Shen, 2003).

To take the analysis one step further for investigating the reasons why the BA coefficient was insignificant, we examined the change from drivers affecting quality before (from 1989 to 1994) and after the NHI (from 1996 to 2002), respectively. In Table 5, the coefficients of AP and MS are significantly positive after the NHI, but insignificantly positive before the NHI. In the AP aspect, this could be because there was a major increase in insured AP after the NHI and as noted earlier the elderly suffer from poorer health than the general population which induced lower quality (Chi and Hsin, 1999). In terms of the MS side, increased competition after the NHI pushed hospitals to improve quality of care. The relationship between NT and MR (IR) was significantly negative in the post-NHI period, but insignificantly positive in the pre-NHI period. The results indicate that, after the NHI, competition encourages hospitals to pursue advanced technology for better quality of care. The LOS coefficients were mostly significantly positive both before and after the NHI. It means that longer LOS leads to higher mortality rates. All coefficients of BED were negative, but only those after the NHI were significantly so. This implies that competition leads to the expansion in hospital size (scale); large scale could provide more resources for the patients. The coefficients of NUR were significantly both negative before and after the NHI, but those of DOC were insignificant after the NHI. It illustrates that, after the NHI, affected by the NHI. In addition, Table 2 shows detailed sample data only the number of increased nurses (not doctors) could match the increase in the number of

Table 3. Univariate analysis (before and after the NHI).

Variable	Panel A : Sample descriptive statistics (before and after the NHI) (Levels)											
	Before the NHI (n = 60)					After the NHI (n = 83)					Difference	
	Mean	Median	S.D.	Min.	Max.	Mean	Median	S.D.	Min.	Max.	t value	z value
Dependent variables												
1. Mortality rate	0.0686	0.0280	0.0168	0.0100	0.0800	0.0640	0.0261	0.0108	0.0100	0.0700	-0.5382	-1.1615
2. Infection rate	0.0196	0.0300	0.0182	0.0100	0.0400	0.0174	0.0290	0.0022	0.0040	0.0500	-0.9784	-0.6953
Independent variables												
Market factors												
3. Market share	0.3544	0.3237	0.1053	0.2100	0.5400	0.3296	0.3177	0.0847	0.1600	0.4600	-1.6051	-1.4302**
4. Population aged 65 and over	0.0626	0.0833	0.0355	0.0400	0.1000	0.0860	0.1026	0.0344	0.0700	0.1200	9.5000***	3.5254***
5. Household income	6.0093	6.0150	0.0517	5.8500	6.1500	6.1352	6.1500	0.1259	5.1600	6.2600	6.6642***	3.9276***
6. Total number of family	4.7965	4.8238	0.1502	4.4900	5.0500	4.8175	4.8404	0.1411	4.5100	5.0400	0.7844	1.3396*
7. Size of family	3.9926	3.9000	0.1763	3.6000	4.4000	3.6875	3.6900	0.2213	3.3300	4.3000	-6.7247***	-3.2168***
8. Education of family	0.1135	0.1023	0.0589	0.0400	0.2000	0.1428	0.1370	0.0864	0.0500	0.2900	3.4972***	2.1113***
9. Medical exp. of family	0.0526	0.0650	0.0671	0.0200	0.0800	0.0844	0.0780	0.0399	0.0400	0.2300	11.4835***	3.9142***
Operational factors												
10. Beds	2.5637	2.5900	0.2709	1.9200	2.9500	2.5948	2.6450	0.4666	1.1100	2.9300	1.0601	1.3636**
11. Occupancy rate	0.7942	0.8041	0.2294	0.3200	0.9500	0.6586	0.7141	0.1867	0.2100	0.9400	-1.1114	-0.9614
12. Average length of stay	1.1174	1.0505	0.3021	0.7200	1.8600	1.1325	1.0723	0.3581	0.6600	2.0900	1.7856*	1.9734*
13. New Technology	0.2339	0.2279	0.1719	0.0100	0.8200	0.6902	0.7834	0.2570	0.0200	0.9600	4.776***	2.7906***
14. Doctors' density (1,000 patients)	0.4220	0.4185	0.2021	0.1000	0.9600	0.3282	0.2796	0.2647	0.0800	0.5700	-2.3113**	-2.0534***
15.Nurses to beds	0.9012	0.8964	0.2386	0.4800	3.2400	1.1869	1.1956	0.6938	0.5000	3.4500	2.5014***	1.6153**
16.total operational costs / total sales	0.8728	0.8749	0.0329	0.8200	0.9200	0.9087	0.9134	0.0628	0.8200	0.9800	7.3624***	2.8707***
Financial factors												
17. Debt structure (%)	0.4338	0.4382	0.0334	0.3200	0.5700	0.6528	0.7045	0.1814	0.3200	0.9700	10.5213***	3.8214***
18. Subsidy / sales (%)	0.3360	0.3348	0.0676	0.1100	0.6700	0.1402	0.1788	0.3859	0.0000	0.4600	-2.6274***	-0.2535***

* Significant at the 0.10 level, ** Significant at the 0.05 level, and *** Significant at the 0.01 level; T- testing is used to obtain the t value; the Komogorov-Smirnov test is adopted to obtain the z value; Difference represents the net amount between variables after the NHI and variables before the NHI.

insured patients in Taipei public hospitals. The major reasons for this could be: first, the flat salary is not linked to performance, which makes it difficult for public hospitals to attract professional staff (Chu et al., 2002); second, financial deficits in the Taipei City Government (the major sponsor) have forced mu-nicipal hospitals to make budget cuts (decrease subsidies), and reduce payments to doctors (Chu et al., 2003). As a result, the relationship between DOC and quality after the NHI is not significant.

Overall, the empirical results suggest that: first,

Table 4. Panel data regression analysis of hospital quality under the NHI (from 1989 to 2002).

$MR_{i,t}\,(IR)_{i,t} = \alpha_0 + \alpha_1\, AP_{i,t} + \alpha_2\, MS_{i,t} + \alpha_3\, NT_{i,t} + \alpha_4\, LOS_{i,t} + \alpha_5\, BED_{i,t} + \alpha_6\, DOC_{i,t} + \alpha_7\, NUR_{i,t} + \alpha_8\, DB_{i,} +_t \alpha_9\, TC_{i,t} + \alpha_{i,10}\, BA_{i,t} + \varepsilon_{i,t}$

Panel data analysis: (Fixed Effects Model)								
Dependence Var.:								
Quality	**Mortality rate**				**Infection rate**			
Mortality / infection rate	**(from 1989 to 2002)**				**(from 1989 to 2002**			
Independence Var.:	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**
Constant	0.3086***(-8.1055)	0.2447***(-8.8741)	0.3784***(-9.1882)	0.3371***(-8.309)	0.1622***(-6.1683)	0.1351***(-7.464)	0.2042***(-6.913)	0.1739***(-6.127)
MSF (Market factors):								
AP (Aging people at 65 and over)	0.0380***(-6.7571)	0.0192***(-3.9218)	0.0404***(-7.4766)	0.0415***(-7.1037)	0.0190***(-4.8981)	0.0136***(-4.2312)	0.0220***(-5.6768)	0.0205***(-5.0325)
MS (Competition index)	0.2157*** (-3.4037)	0.2186***(-3.7945)	0.2456***(-4.3841)	0.2391***(-3.7268)	0.3463***(-7.9114)	0.3436***(-9.087)	0.3771***(-9.3834)	0.3573***(-7.958)
OPF (Operational factors):								
NT (New technology)	-0.2031***(-4.0304)	-0.3106***(-5.4523)	-0.4020***(-7.2638)	-0.3760***(-6.0517)	-0.1195***(-3.4343)	-0.1330***(-3.5576)	-0.1764***(-4.4432)	-0.2012***(-4.6275)
LOS (Average lengthof stay)	0.0139***(-4.5014)	0.0311***(-9.4893)	0.0152***(-5.1715)	0.0168***(-5.4939)	0.0041*(-1.9473)	0.0130***(-6.0645)	0.0048**(-2.3008)	0.0056**(-2.6023)
BED (Scale)	-0.1097***(-6.1755)	-0.0890***(-5.6196)	-0.1116***(-6.9422)	-0.1000***(-5.7067)	-0.0889***(-7.2463)	-0.0760***(-7.3144)	-0.0946***(-8.2035)	-0.0840***(-6.8486)
DOC (Doctors to patients)	-0.0207***(-5.7318)	-0.0158***(-4.0991)	-0.0203***(-5.6998)	-0.0225***(-6.4394)	-0.0054**(-2.1793)	-0.0066**(-2.6113)	-0.0054**(-2.1153)	-0.0064**(-2.6120)
NUR (Nurses to patients)		-0.0063***(-8.3571)				-0.0027***(-5.0603)		
Control Var.:								
DB (debt ratio)	-0.0074***(-3.6302)	-0.0065***(-3.2813)	-0.0054***(-2.8290)		-0.0036***(-2.5957)	-0.0037***(-2.6686)	-0.0032**(-2.3344)	
TC (hospital costs)	-0.0957***(-3.3670)		-0.0996***(-3.6206)	-0.0842***(-3.0279)	-0.0450**(-2.2910)		-0.0552***(-2.7969)	-0.0388**(-1.9962)
BA (Dummy-afterand before)	-0.0021(-0.9154)			-0.0019(-0.8030)	-0.0002(-0.1414)			-0.0004(-0.2452)
F	12.3595***	19.3613***	14.3874***	12.6130***	4.5643***	8.1810***	5.7232***	4.6392***
Adjusted R-squared	0.5756	0.6253	0.5899	0.5806	0.3337	0.4499	0.364	0.3373
N	153	153	153	153	153	153	153	153

1.MR/IR = quality index; TC = cost control index in hospitals (ratio of total operational costs to sales); AP= population aged 65 and over; NT = new technology; LOS = averaged length of stay; DOC = doctor density; NUR = nurse density; Bed = total number of beds in hospital; DB = debt ratios; BA = dummy variable (years after adopting the NHI = 1; years before = 0); MS = an inverse of competition index.. 2. T-statistics are reported in parentheses. 3. * Significant at the 0.10 level; ** Significant at the 0.05 level; *** Significant at the 0.01 level.

quality has not improved after the advent of the NHI; and secondly, the factors that influence quality in Taipei public hospitals include both market factors (population aged 65 and over, and competition), and operational factors (new technology, LOS, scale, doctors density and nurses density), which are all directly influenced by the advent of the NHI. Finally, lower professional density, longer LOS and increased the

Table 5: Panel data regression analysis of hospital quality (levels) before (from 1989 to 1994) and after the NHI (from 1996 to 2002)
$MR_{i,t}\,(IR)_{i,t} = r_{i,0}+r_{i,1}\,AP_{i,t-1} + r_{i,2}\,MS_{i,t-1} + r_{i,3}NT_{i,t-1} + r_{i,4}\,LOS_{i,t-1} + r_{i,5}\,BED_{i,t-1} + r_{i,6}\,DOC_{i,t-1} + r_{i,7}NUR_{i,t-1} + r_{i,10}\,DB_{i,t-1} + v_{i,t}$

Panel data analysis: (Fixed Effects Model)								
Dependence Var.: (quality)	**Mortality rate**				**Infection rate**			
Mortality / Infection rate	**(1996-2002)**	**(1989-1994)**	**(1996-2002)**	**(1989-1994)**	**(1996-2002)**	**(1989-1994)**	**(1996-2002)**	**(1989-1994)**
Independence Var.:	**(1-1)**	**(1-2)**	**(2-1)**	**(2-2)**	**(1-1)**	**(1-2)**	**(2-1)**	**(2)**
Constant	0.5244***(-6.0875)	-0.0584(-1.3240)	0.1551***(-5.3184)	0.0568*(-1.7622)	0.3838***(-6.6335)	-0.0124(-0.7300)	0.0255**(-2.2455)	-0.1032***(-8.5236)
MSF (Market factors):								
AP (Aging people at 65 and over)	0.0169**(-2.1319)	0.0156(-1.6164)	0.0179**(-2.2573)	0.0121(-1.2766)	0.0191***(-3.0033)	0.001(-0.277)	0.0151***(-2.8231)	0.0015(-0.2921)
MS (Competition index)	1.1569***(-4.2248)	0.0537(-0.5594)			1.1338***(-6.2488)	0.1137(-1.5852)		
OPF (Operational factors):								
NT (New technology)	-0.3081***(-3.3465)	0.0156(-0.1817)	-0.3023***(-2.9752)	0.0098(-0.1107)	-0.2264***(-3.3555)	0.0415(-1.256)	-0.1700***(-3.2787)	0.0737**(-2.2098)
LOS (Average length of stay)	0.0081**(-2.1143)	0.0420***(-3.8648)	0.0115**(-2.3876)	0.0458***(-5.2535)	0.0110***(-2.774)	0.0249***(-5.9686)	0.0107***(-2.7339)	0.0401***(-9.2403)
BED (Scale)	-0.3509***(-4.9021)	-0.0278(-0.9847)	-0.0481***(-5.2473)	-0.0245(-0.8710)	-0.2961***(-6.2149)	-0.0101(-0.8932)	-0.031(-1.4726)	-0.011(-1.5832)
DOC (Doctors to patients)	-0.007(-1.1662)	-0.0573***(-4.8376)	-0.0031(-0.7489)	-0.0573***(-4.7577)	0.0012(-0.3735)	-0.0436***(-9.5638)	0.0007(-0.2277)	-0.0495***(-9.9494)
NUR (Nurses to patients)	-0.0035**(-2.1932)	-0.0053***(-3.0295)	-0.0032**(-2.1022)	-0.0058***(-3.2906)	-0.0144***(-2.8428)	-0.0014**(-2.1219)	-0.0107**(-2.5439)	-0.0024***(-3.6903)
Control variable:								
DB (Debt ratio)			-0.0130*** (-3.2182)	0.0317(-0.823)			-0.0107**(-2.5439)	0.0052(-0.361)
F	7.8836***	19.2252***	7.6095***	19.4281***	4.2855***	15.3658***	4.7321***	13.5346***
Adjusted R-squared	0.5858	0.7658	0.58751	0.7678	0.3879	0.7851	0.4032	0.6922
N	83	60	83	60	83	60	83	60

1 MR/IR = quality index; AP= population aged 65 and over; MS = an inverse of competition index; NT = new technology (medical equipment/total fixed assets); LOS = averaged length of stay; DOC = doctor density; NUR = nurses density; Bed = total number of beds in hospital; DB = debt ratios. 2. T-statistics are reported in parentheses. 3. * Significant at the 0.10 level; ** Significant at the 0.05 level; *** Significant at the 0.01 level.

elderly lead to poor quality of care.

DISCUSSION

Original questions

This paper attempts to determine whether the quality has improved since the NHI, what factors affect the changes in hospital quality before and after the NHI, and how to improve the key drivers of quality to enhance healthcare quality in the future. We hope to simultaneously solve the problem of cost and quality in the future. As asserted by Porter and Teisberg (2006), high quality care should be less costly.

Findings and explanation: Evaluation of quality and its factors

The first major finding is that the quality of care has not significantly improved. To clarify the reasons for the insignificant improvement in quality, this study examines what factors influence quality under the NHI (from 1989 to 2002).

The second major finding is that seven factors (Table 4) - the population aged 65 and over, market competition, new technology, LOS, scale, doctor density and nurse density –affect health quality. Moreover, we evaluate the change in drivers affecting quality before (from 1989 to 1994) and after the NHI (from 1996 to 2002), respectively.

The third finding which is in Table 5 is that, after the NHI, lower professional density, longer LOS and increased the elderly lead to deteriorate quality.

How to improve quality for hospital managers and policymakers

This study has implications for hospital managers and policymakers for trying to find the solutions for improving quality in the future. From the hospitals' point of view, the decline in physician density and the increased LOS in Table 3 are the major factors leading to lower quality of care. Actually, after the NHI, the number of physicians increased by 62%, but mainly in non-profit and private hospitals - 91% (The Taipei Health Information Indices Report, 2005). Hospital managers should suggest more flexibility in adjusting incentive programs for their professional staffs to government (Chu et al., 2003). In addition, longer LOS represents inefficient, ineffective and inappropriate treatment. However, low doctor density, increased number of idle beds and inappropriate FFS payment system tend to extend LOS and increase mortality rates. Therefore, hospital managers should enhance efficiency and cost-effective care by improving healthcare allocation and decreasing LOS, which should in turn, improve the quality of care.

Policymakers understand that the expanded number of insured elderly people significantly leads to the poorer quality of care. The government should increase health promotion and illness prevention activities for the elderly to reduce the disabilities and chronic diseases. Therefore, the preventive efforts can be expected to improve quality of healthcare for the elderly. The government should also establish a sound elderly extended-care system, for example, by encouraging the re-building of the three-generation family value to improve quality (Chi and Hsin, 1999). Finally, the trade-off effect between cost and quality indicates that Taiwan may have to refocus on quality, not cost containment. Therefore, Taiwan policymakers have to realize what quality is and what drives it to change, and then set the benchmarks for improving mortality and infection rate levels. Links between these benchmarks and payment is an effective way to motivate quality improvement among all hospitals in Taiwan (Rosenthal et al., 2005). Eventually, the improved quality may lead to better cost containment.

LIMITATIONS AND FUTURE RESEARCH

This paper is limited in terms of interpretation and generalization by the small sample size, and the characteristics of Taipei public hospitals. Also, the measurement of patient value is difficult. We use health outcome to replace patient value. Moreover, we use the mortality rate and infection rate to represent value quality - health outcome (Cheng et al., 2002; Shen, 2003; Porter and Teisberg, 2006), because this study difficultly obtains other quality indices (Chang et al., 2004). Future research can extend the quality indices and expand the database to include private hospitals.

Contribution

We made an important distinction on what factors affect quality. Moreover, we identify what drivers lead to a direct deterioration in healthcare quality. This distinction can help policymakers and hospital managers to set the priorities for improving the quality. Finally, the findings may also be referred by policymakers and hospital managers in other low income and developing countries, which meet similar issues.

REFERENCES

Aiken L, Clarke S, Sloane D (2002). Hospital staffing, organization, and quality of care: Cross-national findings. Nurs. Outlook, 50 (5): 187-194.

Anderson GF, Hurst J, Hussey PS, Jee-Hughes M (2000). Health spending and outcomes: trends in OECD countries, 1960-1998. Health Aff., 19(3): 150-157.

Brownell MD, Roos NP (1995). Variation in length of stay as a measure of efficiency in Manitoba hospitals. Can. Med. Assess. J., 152(5): 675-682.

Casalino L, Gillies RR, Shortell SM, Schmittdiel JA, Bodenheimer T, Robinson J, Rundall T, Oswald N, Schauffler H, Wang MC (2003). External Incentives, Information Technology, and Organized Processes to Improve Health Care Quality for Patients With Chronic Diseases. JAMA, 289(4): 434-441.

Chang HH (1998). Determinants of hospital efficiency: the case of central government-owned hospitals in Taiwan. Omega, 26(2): 307-317.

Chang HH, Cheng MA, Das S (2004). Hospital ownership and operating efficiency: Evidence from Taiwan. Eur. J. Oper. Res., 159: 512-527.

Chang HH, Chang WJ, Das S, Li SH (2004). Health care regulation and the operating efficiency of hospitals: evidence from Taiwan. J. Account. Pub. Policy, 23(4): 483-510.

Chang L, Lan YW (2010). Has the National health insurance scheme improved hospital efficiency in Taiwan? Identifying of the factors that affect efficiency. Afr. J. Bus. Manage., 4 (17): 3752-3760.

Chang T, Liang J, Ransom S (2005). How Taiwan does it: seeing more patients for less. Phys. Exec., 31(4): 38-41.

Cheng SH, Ho YC, Chung KP (2002). Hospitals quality information for patients in Taiwan: can they understand it? International J. Qual. Health Care 14(2): 155-160.

Cheng TM (2003). Taiwan's new National Health Insurance Program: genesis and experience so far. Health Aff. 22(3): 61-76.

Chi SK, Hsin PL (1999). Medical utilization and health expenditure of the elderly in Taiwan. J. Fam. Econ. Iss., 20(3): 251-270.

Chiang TL (1997). Taiwan's 1995 health reform. Health Policy, 39(3): 225-239.

Chou SYJ, Liu T, Hammitt JK (2004). National Health Insurance and technology adoption: evidence from Taiwan. Contemp. Econ. Policy, 22(1): 26-38.

Chu HL, Liu SZ, Romeis JC, Yaung CL (2004). The Initial Effects of Physician Compensation Programs in Taiwan Hospitals: Implications

for Staff Model HMOs. Health Care Manage. Sci., 6(1): 17-26.
Clarke A (2002). Length of in-hospital stay and its relationship to quality of care. Qual. Saf. Healthc., 11: 209-211.
Clarke A, Rosen R (2002). Length of stay: How short should hospital care be? The European J. Pub. Health, 11(2):166-170.
Coll de Tuero G, Sanmartin MA, Vargas SV, Trèmols IS, .Saez MZ, Barceló AR (2004). Does blood pressure change in treated hypertensive patients depending on whether it is measured by a physician or a nurse? Blood Pressure, 13(3): 164-168
Department of Health (2005). The National Health Insurance Annual Statistical Report. Executive Yuan, Republic of China: Department of Health Press.
Department of Health (2005). The Statistical Annual Report of Medical Care Institution's Status and Hospital's Utilization. Executive Yuan, Republic of China: Department of Health Press.
Ferlie EB, Shortell SM (2001). Improving the Quality of Health Care in the United Kingdom and the United States: A Framework for Change. Milbank Q., 79 (2): 281–315.
Haddad S, Fournier P (2002). Quality, cost and utilization of health services in developing countries. A longitudinal study in Zaïre. Soc. Sci. Med., 40(6):743-753.
Hung JH, Chang L (2008). Has cost containment after the national Health Insurance system been successful? Determinants of Taiwan hospitals costs? Health Policy, 85(3): 321-335.
Hunt SD, Morgan RM (2004). The resource – advantage theory of competition: a review. Rev. Mark. Res., 1: 153-205.
McCue MJ (1997). Small hospitals with positive cash Flow: why are they winners? Med. Care Res. Rev., 54(1): 32-60.
McCue MJ, Thomson JM, Dodd-McCue D (2001). Association of market, mission, operational, and financial factors with hospitals' level of cash and security investments. Inquiry 37: 411-422.
Muth ML, Donaldson L (1998). Donaldson. Stewardship Theory and Board Structure: a contingency approach. Corp. Govern., 6(1): 5-28.
Peterson LR, Noskin GA (2001). New technology for detecting multidrug-resistant pathogens in the clinical microbiology laboratory. Emerg. Infect. Dis., 7(2): 305-311.
Picone GA, Sloan FA, Chou SY, Taylor DH (2003). Does Higher Hospital Cost Imply Higher Quality of Care? Rev. Econ. Stat., 85 (1): 51-62
Porter ME, Teisberg EO (2006). Redefining Health Care: Creating Value-based Competition on Results. Boston: Harvard Business School Press.
Propper C, Burgess S, Green K (2004). Does competition between hospitals improve the quality of care? Hospital death rates and the NHS internal market. J. Pub. Econ., 88(8): 1247-1272
Reerink IH, Sauerborn R (1996). Quality of Primary Health Care in Developing Countries: Recent Experiences and Future Directions. Int. J. Qual. Health Care, 8: 131-139
Rosenthal MB, Frank RG, Li Z, Epstein AM (2005). Early experience with Pay-for-performance From concept to practice. JAMA. 294: 1788-1793.
Seshamani M, Gray A (2004). Time to death and health expenditure: an improved model for the impact of demographic change on health care costs. Age Ageing, 33(6): 556-561.
Seshamani M, Gray A (2004). A longitudinal study of the effects of age and time to death on hospital costs. J. Health Econ., 23(2): 217-235.
Shen YC (2003). The effect of financial pressure on the quality of care in hospitals. J. Health Econ., 22: 243-269.
Sochalski J (2004). Is more better? The relationship between nurse staffing and quality of nursing care in hospitals. Med. Care, 42(2S): 67-73.
Thomas-Hawkins C, Flynn L, Clarke SP. (2008). Relationships between registered nurse staffing, processes of nursing care, and nurse-reported patient outcomes in chronic hemodialysis units. Nephrol Nurs J., 35(2): 113.
Waldman DA, Gopalakrishman M (1996). Operational, organizational, and human resource factors predictive of customer perceptions of service quality. J. Qual. Manage., 1(1): 91-107
Younis M, Rivers PA, Fottler MD (2005). The impact of HMO and hospital competition on hospital costs. J. Healthc. Financ., 31(4): 60-74.
Zimmer Z, Martin LG, Lin HS (2005). Determinants of old-age mortality in Taiwan. Soc. Sci. Med., 60(3): 457-470.