Effects of Global Budgeting on the Distribution of Dentists and Use of Dental Care in Taiwan

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Objective. To examine the effects of global budgeting on the distribution of dentists and the use and cost of dental care in Taiwan.

Data Sources. (1) Monthly dental claim data from January 1996 to December 2001 for the entire insured population in Taiwan. (2) The 1996–2001 population information for the cities, counties and townships in Taiwan, abstracted from the *Taiwan-Fukien Demographic Fact Book*.

Study Design. Longitudinal, using the autocorrelation model.

Principal Findings. Results indicated decline in dental care utilization, particularly after the implementation of dental global budgeting. With few exceptions, dental global budgeting did not improve the distribution of dental care and dentist supply.

Conclusions. The experience of the dental global budget program in Taiwan suggested that dental global budgeting might contain dental care utilization and that several conditions might have to be met in order for the reimbursement system to have effective redistributive impact on dental care and dentist supply.

Key Words. Dental global budgeting, dental care, distribution of dentists, utilization, costs

Cost-containment and equitable access to health services have been longstanding concerns among health policymakers (Carr-Hill 1994; Davis 1991; Smith and Sheldon 2000). As the demand for health care continues to grow and the financial incentives that influence health professionals' choice of practice location remain differentiated geographically (Johnston and Wilkinson 2001; Kobayashi and Takaki 1992), the significance of these issues is likely to extend into the foreseeable future. However, because of the rapid rise of health care cost in many countries since the 1970s, cost containment has dominated the agenda of health policy, often at the expense of commitment to ensuring equal access to health services.

Among the variety of cost containment mechanisms that have been experimented, global budgeting has assumed increased popularity and appeared to be effective in arresting the untamed growth of health care expenditures in many Organization for Economic Cooperation and Development

(OECD) and Asian countries (Carr-Hill 1994; Chu 1992; Detsky et al. 1990; Detsky, Stacey, and Bombardier 1983; Henke, Murray, and Ade 1994; Lave, Jacobs, and Markel 1992; Redmon and Yakoboski 1995; Wiley 1992). A study by the U.S. General Accounting Office in 1991 estimated that global budgets in certain countries had lowered inflation-adjusted spending on health care services by 9 to 17 percent. Examining the trend of pharmaceutical expenditures in Germany, Ulrich and Wille (1996) found that compared with the reference price system for expenditure control, the introduction of global budgeting in 1993 had a more effective and lasting cost-containment impact. More recently, Leonard et al. (2003) compared the case-based approach in Austria with the global budgeting approach in Canada in terms of the impact on hospital care and found that Austrian inpatients stayed longer in hospitals than Canadian inpatients.

Despite this preliminary evidence, the literature on global budgeting is mostly descriptive and prescriptive. Rigorous empirical assessment of the effects of global budgeting remains scarce (Wolfe and Moran 1993). Furthermore, existing studies are limited to global budgets for medical care (including hospital and physician services) and pharmaceutical coverage. How effective global budgeting is in relation to the control of dental care cost is largely unknown. This study is intended to fill the gap by examining the impact of global budgeting on dental care cost using data collected in the Taiwanese National Health Insurance System, which recently underwent the process of introducing global budgets into the dental care sector. Also in a departure from previous studies that focused solely on the cost-containment outcomes of global budgeting, this study assesses the impact of global budgeting on the distribution of dental health manpower and dental care utilization.

The experience in Taiwan may further our understanding of the impact of global budgeting for three reasons. First, dental care is seldom included as part of the benefit package in countries that provide public or national health insurance (NHI). Even less common is the administration of dental care

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expenditure through a global budgeting mechanism (with Germany being another exception), thus limiting our understanding of the cost and utilization of dental care in a government-controlled health insurance system. Second, supply-side cost control mechanisms, such as global budgeting, may have unintended consequences for health service availability. The Taiwanese system adopts an explicit redistributive design that sets a different budget cap for each health insurance region on a per capita basis. Understanding whether the design results in more or less equitable distribution of health manpower and health care utilization would be of interest to health policymakers. Third, the enactment of Taiwanese NHI preceded the implementation of global budgets by more than three years. The lag enables us to separate the confounding effect of national health insurance from the redistributive effects of global budgeting on dentist supply and dental care utilization.

Taiwanese Global Budgeting System

The Act of National Health Insurance in Taiwan specifically required the adoption of a global budgeting system in health care reimbursement. Implementation of the reimbursement system began in July 1998, more than three years after the enactment of Taiwanese NHI in March 1995. Similar to those of OECD countries such as Canada, Germany, and France, the global budgets in Taiwan are specific to different sectors of the health care delivery system. The implementation was incremental: first for dental care in July 1998, second for Chinese traditional medicine in July 2000, third for office-based medical care in July 2001, and lastly for hospital care in July 2002 (Cheng 2003).

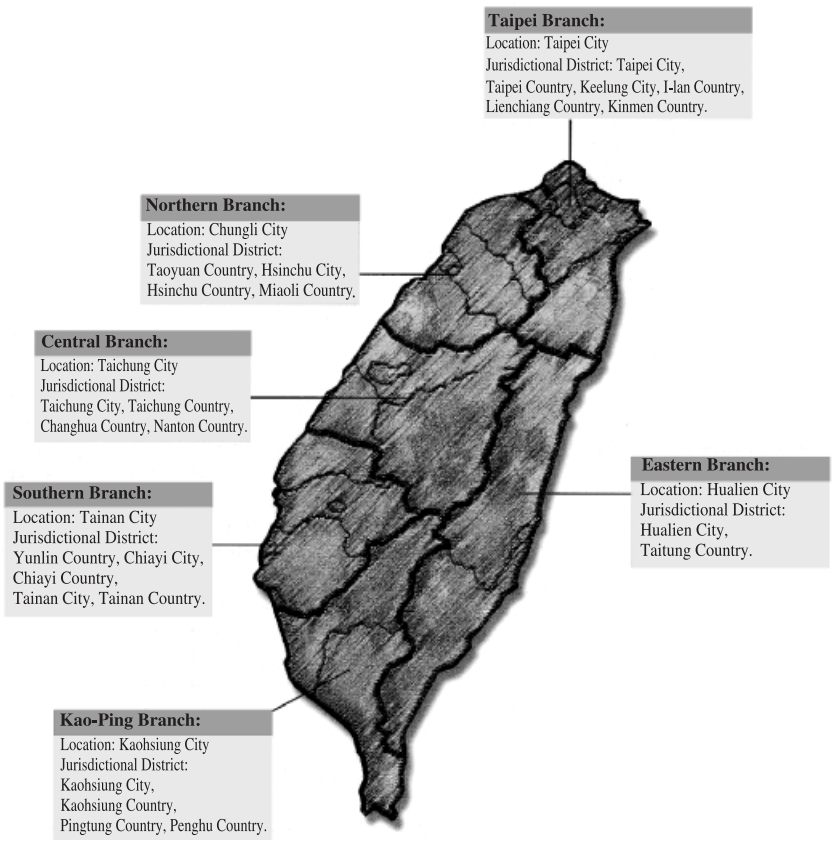
The global budgeting system is designed to replace a national fee-for-service payment system that was in place since the installation of NHI. The budget process takes the form of negotiation between the funding source and the health care sector to which the budget is applied. The negotiation is conducted in a committee, with representatives from the Bureau of National Health Insurance (the sole insurer), health provider associations, labor unions, employer groups, as well as health insurance experts and academic researchers. Every year, a fee negotiation committee under the supervision of the Department of Health negotiates and sets the total health care budget to be spent in the following year for the specific sector. The budget is then divided and allocated to six health insurance regions according to the relative size of the region's population. The insurance regions are groupings of adjacent administrative areas, formed by the Bureau of National Health Insurance to

divide the nation into six regions with similar population and geographical sizes (Figure 1). Within each region, NHI-reimbursed dental care expenditures are capped by the allocated budget and the cap is binding.

Implementation of Dental Global Budgeting

An important goal of Taiwanese dental global budgeting was to achieve equity in dental care resources through population-based allocation of annual global budgets. In view of the significant regional differences in dental expenditures and for fear of the resistance of providers and patients to a swift change in the

Figure 1: Geographic Coverage of Six Health Insurance Regions in Taiwan's National Health Insurance System



reimbursement method, several phased-in steps were taken to allocate dental global budgets according to the capitation design. Starting in the fiscal year that began in July 1998, a yearly expenditure cap for dental care was determined annually by a fee negotiation committee. However, in the initial phase between July 1998 and June 1999, only 10 percent of the budget allocation across health insurance regions used the population-based approach. The other 90 percent of the budget was still allocated based on experienced expenditure. In the second phase from July 1999 to December 2000, the population-based allocation of the global budget was raised to 20 percent. In the remaining phases, the percentage of population-based allocation continued to increase to 40 percent in fiscal year 2001, 50 percent in fiscal year 2002, 70 percent in fiscal year 2003, 90 percent in fiscal year 2004, and eventually to 100 percent in fiscal year 2005 and afterwards.

The Bureau of National Health Insurance authorizes each health insurance region to form a peer review organization under the supervision of the National Dentist Association to process and audit claims and undertake other peer review functions. Reimbursement to dentists is based on an existing fee-for-service schedule, which lists each reimbursable service and its points of worth. Except for the copayment and registration fee per visit, there is no out-of-pocket cost for the insured that receive care.[1] A dentist's monthly revenue, therefore, is the product of total service points in a month and the dollar value for each point in a particular region. The dollar value for each service point is recalculated every three months based on the region's expenditure and total service points during that period. Restricted by the predetermined expenditure cap, a region that has a higher service volume would have a lower dollar value per service point, and vice versa. The insured can receive dental care across regions and the costs are paid off between regions at the end of the year based on the dollar value of each service point in the region where the services were provided. Thus, the reimbursement rates for dental services are floating and are different across health insurance regions depending on the amount of the allocated budget, amount of services demanded, and the practice pattern of dentists in a region.

Because over 90 percent of dentists in Taiwan are private practitioners, it is uncertain how the peer review influences the behavior of dentists. Results of claim reviews seem to depend on the aggressiveness of the peer review group, despite that every group follows the same principles and procedures set up by the National Dentist Association. This is evidenced in the variation of dollar value per service point across health insurance regions. Based on quarterly figures from the third quarter of 1998 (the first quarter of dental global budget)

to the fourth quarter of 2001, the highest mean dollar value per service point is 1.09 for the Eastern region with standard deviation of 0.09 and the lowest mean value is 0.95 for the Central region with standard deviation of 0.04.

HYPOTHESES

As with the logic underlying the global budgeting systems in other countries, the annual expenditure cap provides health care providers an incentive to use inputs efficiently in service delivery and to eliminate unnecessary health care (Cowan 1997). Thus, we expect dental utilization to decline after the implementation of dental global budgeting in Taiwan.

A distinct design feature of Taiwanese dental global budgeting is that distribution of expenditures is determined based on a capitation system, that is, according to the population size of a defined geographic area. Thus, dental global budgeting may equalize the allocation of dental care resources and induce dentists to practice in traditionally underserved areas. According to the efficient markets theory (La Porta et al. 1997), market efficiency could be achieved when the price in the market is transparent and reflects all relevant information. As information about the global budget, the dollar value of each service point (adjusted every three months), and the average levels of dentist income in different geographic areas would become readily accessible to dentists under the global budgeting system, market efficiency may be materialized to reduce the geographic differences in dentist supply and dental care accessibility. To illustrate, two geographic areas, A and B, have an equal size of population but A has a higher dentists to population ratio than B. Under the Taiwanese dental global budget system, dentists in A will have less revenue, on average, than dentists in B. All things being equal, the assumption of income maximization among dentists would have us predict a gradual migration of dentists from A to B, thus reducing the discrepancy in access to dental services between the two areas.

METHODS

Research Design and Data

The study took advantage of a natural experiment in the Taiwanese NHI. The policy intervention was the introduction of dental global budgeting in July 1998. The analysis used monthly dental claim data from January 1996 to December

2001, a total of 72 monthly observations, for the entire insured population in Taiwan. The data contained utilization and cost information for outpatient dental visits, patient identifiers, and the identification numbers of dentists that provided the services. The National Health Research Institute, authorized by the Bureau of National Health Insurance, generated and provided the dataset. Annual information about the population sizes of cities, counties and townships in Taiwan was abstracted from the *Taiwan-Fukien Demographic Fact Book*, published by the Ministry of the Interior, Republic of China (ROC).

To define geographic units that reflect the patterns of health service provision and utilization, the Department of Health, ROC, developed a Medical Service Area (MSA) System in the Medical Regionalization Network Plan of Taiwan. The system grouped adjacent administrative boundaries (mainly townships) into a medical district based on population size, health care manpower and facilities, road and transportation systems, and concentration of residents using the same sets of health care facilities and resources. As a result, 17 medical service areas were formed, which were further divided into 64 submedical districts.[2] Each of the 64 submedical districts belongs to a health insurance region. The number of submedical districts in the health insurance region ranges from 7 to 15.

These 64 submedical districts constituted the units of analysis in this study. The determination of these analytical units was based on two considerations. First, as Wilson and Tedeschi (1984) suggested, the area population should be homogeneous in that residents in the area sought care at the same cluster of health care facilities. Second, of the three levels of geographic division in the MSA system (i.e., health insurance regions, medical districts, and submedical districts), the submedical districts displayed the greatest amount of variation in the dependent variables of the analysis and therefore were most likely to reflect changes in dental care resources and utilization.

Assessment of Dentist and Utilization Distribution

Following Peacock, Devlin, and McGee (1999), the change in equity was first assessed by comparing and tracking the difference in resource distribution between the upper and lower quartile of the submedical districts to see if the discrepancy reduced annually (indicative of improved equity) over the study period. Furthermore, the Lorenz curve's Gini coefficient was calculated using monthly data to evaluate the impact of global budgeting on the distribution of dentists and dental care use. The Gini coefficient provides an overall estimate of inequity in dentists and utilization distribution (Chen 2002; Morrow 1997;

Lynch et al. 1998). It ranges between 0 and 1, with a higher value indicating greater inequity.

Gini coefficients were computed for four dental care indicators across submedical districts—number of dentists, number of dental visits, number of dental patients, and dental care expenditures—as dependent variables in the multivariate analysis. The number of dentists represented the supply of the key dental care manpower in each geographic area. The number of dental visits and the number of dental patients reflected the level of demand for dental services. Because patients had different needs and the nature of dental visits varied, dental care expenditures were also included to assess the amount of dental care resources utilized in each area.

Gini coefficients were calculated monthly throughout the study period. Although the allocation of dental global budgets was not yet 100 percent based on the capitation system when the study was concluded, the study spanned across the pre-global budget period and the first three phases of the dental global budgeting program. Thus, the study data could be used to determine if change in the distribution of dentists and dental care utilization was due to the installation of global budgeting and the subsequent increases in capitated budget allocation.

Statistical Analysis

The interrupted autocorrelation analysis was used to determine whether dental global budgeting resulted in any significant change in the distribution of dentists and dental care utilization, holding constant the initial time trend. The analysis was employed to examine the impact of hospital global budgeting in France (Redmon and Yakoboski 1995). A recent study by Van De Voorde, Van Doorslaer, and Schokkaert (2001) showed that the time-series model was comparable to the "difference model" based on the difference between an intervention group and a comparison group (i.e., a group not experiencing the study policy change). Specifically, the research demonstrated that the time-series model produced reliable findings in the absence of a comparison group in the study design.

A simplified representation of the model used in this study is as follows:

$$Gini_t = C + TimeTrend + TimeLag + GB\%Capitation + TimeTrend^{*}GB\%Capitation + \varepsilon$$

where $Gini_t$ is the Gini coefficient for month t, C a constant, *TimeTrend* a time function (coded 1 for the first month of the study period, 2 the second month,

etc.), *TimeLag* a serial correlation function, and *GB%Capitation* representing the percentage of capitated budget allocation (with 0 indicating the pre-global budget period). An interaction term of *TimeTrend* and *GB%Capitation* was also included to capture the joint effect of the two variables. The model did not control for the aggregate socioeconomic status of each submedical district, because the variation across districts remained stable during the study period.

TimeTrend was included to take into account the natural growth, as resulting from the national health insurance and other social and economic factors, and to separate it from the effect of dental global budgeting. With time-series data, the model's error terms are correlated between time periods, known as autocorrelation or serial correlation. This violates an important assumption of ordinary least squares that errors are identical and independently distributed (*iid*), resulting in incorrect *t*-statistics for hypothesis testing because of inefficient estimation of the coefficients. We evaluated the order of autocorrelation and found a one-month lag in the data. Thus, an AR(1) process—that is, using previous month's observation as a covariate to capture the time lag effect—was employed in the model. A sudden rise in dental visits, dental expenditure, and dental patients was observed in December of each year. A dummy variable, *December*, was therefore included to capture this temporal pattern. The model was estimated using the *SHAZAM* econometric software version 9, Professional Edition (Northwest Econometrics Ltd., 2001).

RESULTS

The annual changes in dental care statistics between 1996 and 2001 are presented in Table 1. Over the period, the insured population grew steadily, approaching complete health insurance coverage for the nation's population in 2001. Access to dental care—indicated by the number of dental patients—also improved significantly; by 2001, 39.48 percent of the nation's population had received dental care. Increased financial accessibility through insurance coverage also affected the total number of dental visits and the total dental expenditure, both rising annually throughout the study period. Despite this increase, it is interesting to note that the number of dental visits per patient, the expenditure per dental visit, and the expenditure per dental patient remained rather stable over the same period. In fact, the number of dental visits per patient declined after 1998. The average expenditure per patient also dropped between 1998 and 1999 and increased only mildly afterward. Both of these results may be attributable to the implementation of dental global budgeting in 1998.

Table 1: Trend of the Insured Population, Dental Care Utilization, and Dentist Supply in Taiwan, 1996–2001

	1996	*1997*	*1998*	*1999*	*2000*	*2001*
No. insured population	20,041,448	20,492,317	20,757,185	21,089,859	21,400,826	21,653,555
No. dental patients	6,623,272	7,172,871	7,553,040	7,856,629	8,113,287	8,547,870
Total dental visits	19,038,770	21,469,235	22,876,678	23,447,747	23,748,287	24,757,644
Total expenditure (in NT$1,000)	17,150,742	19,629,071	21,770,286	23,252,292	25,087,115	26,668,808
No. dentists	9,267	9,110	9,200	9,419	9,679	9,850
Percent dental patients/insured	33.05%	35.00%	36.39%	37.25%	37.91%	39.48%
Dental visits/patients	2.87	2.99	3.03	2.98	2.93	2.90
Expenditure (in NT$)/visits	900.8	914.3	952.6	991.7	1056.4	1077.2
Expenditure (in NT$)/patients	2589.5	2736.6	3028.8	2959.6	3092.1	3119.9
No. dentists per 100,000 insured	46.24	44.46	44.32	44.66	45.23	45.49

Also presented in Table 1 was the trend of dentist supply, that is, the total number of dentists as well as the number relative to population size—which declined in 1997 and rose gradually for the remaining period.

We expected increased equity as a result of dental global budgeting. This prediction was first assessed by comparing the relative levels of dental care utilization and dentist supply in the upper- and lower-quartile submedical districts. As indicated in Table 2, the expectation was supported. All the four variables assessed displayed changes that were consistent with our expectation; that is, the discrepancy between submedical districts in the upper quartile and those in the lower quartile (based on the upper quartile to lower quartile ratio) decreased over the period from 1996–2001.

Interrupted time-series analysis using monthly data of the 64 submedical districts was performed to further examine the prediction of improved equity. Results are presented in Table 3. Of note is that the adjusted R squares of the models were above 0.9, suggesting a good fit of the models. The Durbin-Watson tests for the models were all larger than 1.837, which is the upper limit of the Durbin-Watson d statistic with $n = 70$ ($n = 72$ in our case), $k = 7$, and significance level at $p < 0.05$, suggesting the absence of the first-order serial correlation problem in the models.

As shown in Table 3, the beta coefficients of the variable *TimeTrend* were negative and statistically significant across the models, indicating a general

Table 2: Comparisons between the Upper and Lower Quartiles of All 64 Submedical Districts in Taiwan Based on Dental Care Utilization and Dentist Supply, 1996–2001

	1996	*1997*	*1998*	*1999*	*2000*	*2001*
Percent dental patients/insured						
Upper quartile	42.47	45.03	46.10	47.13	47.72	50.00
Lower quartile	18.68	21.38	22.93	24.07	24.86	26.45
Upper quartile/lower quartile	2.27	2.11	2.01	1.96	1.92	1.89
Dental visits/patients						
Upper quartile	3.09	3.26	3.30	3.23	3.14	3.09
Lower quartile	2.71	2.80	2.83	2.81	2.80	2.79
Upper quartile/lower quartile	1.14	1.17	1.16	1.15	1.12	1.11
Expenditure (NT$)/patients						
Upper quartile	2,760.71	2,911.65	3,049.83	3,136.43	3,254.70	3,286.06
Lower quartile	2,220.47	2,386.80	2,523.46	2,668.72	2,857.85	2,905.81
Upper quartile/lower quartile	1.24	1.22	1.21	1.18	1.14	1.13
No. dentists per 100,000 insured						
Upper quartile	76.55	72.85	72.80	71.31	71.75	71.53
Lower quartile	18.42	18.60	19.38	21.22	22.62	22.51
Upper quartile/lower quartile	4.16	3.92	3.76	3.36	3.17	3.18

trend of improvement in the equity of dental care utilization and dentist supply in Taiwan. The beta coefficients for *GB%Capitation* were also negative and, supporting our expectation, two of them—the ones for the Gini coefficients of dental visits and dentists—were statistically significant at $p<0.10$. This suggests that, ceteris paribus, there was an improvement toward more equitable access to dental care and more even distribution of dentists across submedical districts subsequent to the introduction of dental global budgeting. Such improvement, however, did not last and appeared to reduce over time as indicated by the significant and positive coefficients associated with the interaction term between *TimeTrend* and *GB%Capitation*. Similarly, the interaction term was significant and positive in the model for dental patients, suggesting that the distribution of dental patients became less even over time in the postglobal budget period, despite a general time trend of increased equity. The only significant and negative interaction term between *TimeTrend* and *GB%Capitation* was associated with dental expenditures. One interpretation is that dental expenditures became gradually more equitable after the implementation of dental global budgeting.

With one exception, the variable *December* was statistically significant and positive in the models shown in Table 3, suggesting that dental care utilization became less even in December of each observed year. The

Table 3: Effect of Dental Global Budgeting on the Distribution of Dental Care Utilization and Dentist Supply: Interrupted Time-Series Analysis of Gini Coefficients

	Dental Patients		*Dental Visits*		*Dental Expenditures*		*Dentists*	
	β	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*
Constant	0.1875***	0.0013	0.1954***	0.0011	0.2183***	0.0013	0.2911***	0.0011
TimeTrend	−0.0006***	0.0001	−0.0004***	0.0000	−0.0005***	0.0001	−0.0006***	0.0000
GB%Capitation	−0.0281	0.0227	−0.3744*	0.1895	−0.0387	0.0211	−0.0439*	0.1660
TimeTrend∗GB%Capitation	0.0010**	0.0003	0.0010**	0.0003	−0.0004***	0.0003	0.0010***	0.0002
December	0.0036***	0.0010	0.0042***	0.0008	0.0037***	0.0009	–	–
AR(1)	0.4557***	0.1094	0.4867***	0.1112	0.3315***	0.1112	0.5681***	0.1011
Adjusted R^2	0.9005		0.9120		0.9398		0.9755	
DW	1.8787		2.0031		1.9291		2.1529	

*$p < 0.1$;
**$p < 0.05$;
***$p < 0.01$.

coefficients for variable *AR(1)* indicated significant and positive autocorrelations in the longitudinal panel observations.

As a final test, we repeated the interrupted time-series analysis for each health insurance region (i.e., stratified time-series analysis) to assess whether the same patterns of results could be obtained across the six regions. The dependent variables were the Gini coefficients among submedical districts within each health insurance region. Findings are presented in Table 4, focusing on the impact of dental global budgeting on the equity of dental care and dentist distribution. The pattern of results varied across health insurance regions, with some regions (the Southern and Eastern regions) displaying greater improvement in the equity of dental care than others.

DISCUSSION

This study was based on a natural experiment in Taiwan's national health insurance system to investigate the impact of global budgeting on dental care utilization and the equity of dental care and dentist distribution—an issue that was heretofore unexamined in the literature. We expected that, based on the design features of the Taiwanese global budgeting program, the utilization of dental care would decline and the distribution of dental care and dentists would become more equitable as a result of dental global budgeting. Results provided partial support for our expectations.

First of all, it is worth noting the success of the Taiwanese National Health Insurance System in approaching full coverage and thus ensuring equitable financial access to health care across different socioeconomic sectors of the population. An example of the progress can be found in the increased access to dental care, indicated by the percentage of dental patients in the insured population, between 1996 and 2001.

Access to dental care, however, is no assurance that the care obtained was appropriate and that services were delivered efficiently. Free of cost concerns, the insured would be more likely to seek care, whether it is needed or not (Manning et al. 1987). Similarly, without cost constraints, health care providers might inflate service demands and incur unnecessary services, in part because of their asymmetric dominance of medical information (Fuchs 1986). As such, a significant increase in utilization might be expected in a national health insurance system. The results of our analysis showed otherwise. Despite the growth of dental care coverage, the dental expenditure per dental visit remained stable and was in line with the inflation rate during the

Table 4: Effect of Dental Global Budgeting on the Distribution of Dental Care Utilization and Dentist Supply across Health Insurance Regions: Stratified Interrupted Time-Series Analysis of Gini Coefficients[†]

	Dental Patients		*Dental Visits*		*Dental Expenditures*		*Dentists*	
Health Insurance Region	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*
Taipei region								
GB%Capitation	−0.1781	0.0281	−0.0123	0.0262	−0.5871	0.0296	−0.0213	0.0180
TimeTrend * GB%Capitation	0.0005	0.0004	0.0004	0.0003	0.0011*	0.0004	0.0002	0.0002
Northern region								
GB%Capitation	0.1771**	0.0628	0.1105*	0.0537	0.1895**	0.0681	0.0287	0.0709
TimeTrend * GB%Capitation	−0.0018	0.0010	−0.0005	0.0007	−0.0019	0.0011	0.0003	0.0011
Central region								
GB%Capitation	−0.0519	0.0354	−0.0343	0.0380	−0.0403	0.0402	−0.0278	0.0248
TimeTrend * GB%Capitation	0.0012*	0.0005	0.0011*	0.0005	0.0008	0.0005	0.0004	0.0003
Southern region								
GB%Capitation	−0.1401**	0.0436	−0.0511	0.0458	−0.1553***	0.0429	−0.0647	0.0437
TimeTrend * GB%Capitation	0.0025***	0.0006	0.0013*	0.0006	0.0022***	0.0006	0.0011	0.0006
Kao-Ping region								
GB%Capitation	−0.0663	0.0374	−0.0635	0.0348	−0.0760	0.0426	−0.1428**	0.0504
TimeTrend * GB%Capitation	0.0009	0.0005	0.0011*	0.0005	0.0010	0.0006	0.0026**	0.0008
Eastern region								
GB%Capitation	−0.1839*	0.0874	−0.1059	0.0823	−0.2475**	0.0932	0.1119	0.1504
TimeTrend * GB%Capitation	0.0030*	0.0013	0.0021	0.0012	0.0039**	0.0014	−0.0024	0.0023

[†]Only the results of two variables, GB%Capitation and TimeTrend * GB%Capitation, are shown.

study period. Changes in the number of dental visits and the expenditure per patient were also small and displayed some decline after 1998, suggesting a positive impact of dental global budgeting in utilization control.

Improved access to dental care does not necessarily reduce the unequal distribution of dental care and dentist supply across geographic areas. As the global budget for dental care were allocated on a per capita basis to local areas, we expected the reimbursement system might improve the equity of dental care and dentist distributions over time. This expectation was not strongly supported in the analysis. Overall, results indicated improved equity over the study period based on the comparison of submedical districts in the upper and lower quartiles of dental care and dentist supply. The improvement in the majority of cases could not be attributed to the implementation of dental global budgeting, but was mainly accounted for by a general time trend that was unrelated to the new reimbursement system.

Several reasons may explain the finding. First, the allocation of dental global budgets was not 100 percent based on the relative population size of health insurance regions. Therefore, the financial incentive might not be strong enough to rectify the unequal distribution of dental care and dentist supply. Second, an unofficial survey found that 20 percent to 70 percent dental expenditures came from patients' out-of-pocket payments for nonreimbursable services, suggesting that government reimbursement in the national health insurance system did not constitute the sole source of dentists' revenue. Thus, global budgeting had little impact on the distribution of dental care and dentist supply, because patients and dentists were able to incur services beyond the mandated coverage of national health insurance depending on patients' ability to pay out-of-pocket and because of the lack of incentive for dentists to relocate their practice so long as they could maintain the same "target income" by providing additional services.

Third, over 90 percent of dentists in Taiwan were independent, free-standing practitioners. In such "diffused" markets, individual dentists' delivery of services might have a trivial impact on the payment rates under the global budgeting system. A rational decision of dentists, therefore, was to ignore this trivial impact when making resource allocation decisions. Alternatively, dentists might rush to provide services early in the budget year and reduce the service amount later in the year on the assumption that reimbursement rates would be adjusted downward over the budget year to conform to the global cap. Or, they might choose to provide fewer services if reimbursement rates decreased significantly. In other words, the changes in labor supply induced by global budgets are not necessarily efficiency enhancing as the efficient markets theory dictates.[3]

Fourth, financial incentives alone might be insufficient to affect improvement in dental care and dentist distributions. An organizational component was built in the global budgeting system that relied on peer review groups at the region level to monitor and audit the utilization of dental services. Along with the population-based allocation of global budgets, the design of peer review, in theory, should help reduce the geographic variation in dental care and dentist supply within and across health insurance regions. In practice, the influence of peer review groups might vary depending on the organizational autonomy of the review group, the level of consensus among local providers, and the collective interests of dentists in the region. A review group might be weak if it became a captive of local interest groups and therefore lacked the autonomy to follow the auditing guidelines in policing the practice of dentists. A strong review group, on the other hand, could work to serve the common good of patients, thus equalizing the dental resources in the region, or to protect the interest of existing members by barring the entry of dentists into the local markets. All this might produce variant effects, hampering or facilitating the redistributive impact of dental global budgeting, as indicated in the results of the stratified time-series analysis by health insurance region. Understanding of the specific role of the peer review groups in utilization control and dental resource distribution, however, is limited and will await future research.

In addition, it is interesting to note that changes in the distribution of dental care utilization were not necessarily consistent with changes in dentist distribution. While health manpower policies usually operate under the assumption that even distribution of health care providers is required to ensure equitable accessibility to health care (Capilouto and Ohsfeldt 1996), our analysis suggested that financial incentives might have redistributive effects on health care access and utilization in the absence of an effective intervention on health manpower distribution.

Research Limitations

The use of time-series data enhanced our ability to assess the independent impact of dental global budgeting on the level and distribution of dental care and dentist supply. The design, however, could not adequately rule out the potential effects of other concurrent events on the examined outcomes. One way to test this possibility is to compare our analysis with that of a different health care (e.g., inpatient care, Chinese medicine) that has a different

timetable for global budgeting. Data restrictions, unfortunately, prevented us from making the comparison.

Furthermore, in areas with a given global budget, rent-seeking may lead to inequitable outcomes. Individuals with higher socioeconomic status (SES), for example, may be better able to capture the globally budgeted funds, so if there are service shortages induced by global budgets, those with lower SES may lose out. Thus global budgets could worsen equity. This may explain the many positive effects of global budgeting on Gini coefficients in the region-specific time-series analysis. Lack of sociodemographic information at the submedical district level restricted our ability to explore such variations by SES.

Despite these limitations, the experience of Taiwan's dental global budgeting suggests that the reimbursement system may contain dental care utilization and that several conditions—including complete allocation of global budgets on a per capita basis, control of out-of-pocket payment from patients, appropriate organization and implementation of peer review groups—may have to be met if the reimbursement system were to have effective redistributive impact on dental care and dentist supply. These could be of important lessons to policymakers in countries that are confronted with both cost containment and equitable access issues.

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NOTES

1. Low-income individuals and certain categories of disadvantaged populations are exempted from all the copayments.
2. The official design of the Medical Service Area (MSA) System constitutes 63 submedical districts. For the purpose of the analysis, we included the remote islands of Taiwan as the 64th submedical district.
3. We thank one of the reviewers for suggesting this explanation.

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