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ORIGINAL PAPER

Financing reform and productivity change in Brazilian teaching hospitals: Malmquist approach

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Abstract This study evaluates the performance and productivity changes for the Brazilian Federal University Hospitals, considering the years of 2003 and 2006, that is, before and after a 2004 financing reform. The analysis is based on the Malmquist index approach. Results indicate that the financing reform provided improvement in the technical efficiency, although the technological frontier has not presented a positive shift. This suggests that increased budgets were a good stimulus for efficiency but the intended enhancement of the technology through the financing reform has not yet taken place.

Keywords Efficiency · Malmquist index · Brazilian hospital performance · Healthcare reform

1 Introduction

Productivity of teaching hospitals in Brazil generated a policy debate with respect to the new reimbursement system implemented in 2004. With the new reimbursement system, one of the main questions is whether teaching hospitals would be able to

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enhance their mission of education and research without sacrificing the quality of patient care (Lins et al. 2007).

According to the Institute for Health Policy Issues (IEPS/WHO): “a teaching hospital is a center of complex health care characterized by the important role it plays in providing tertiary care, its involvement in teaching and research related to the type of care it dispenses, and by the high concentration of resources it attracts”. Teaching hospitals compared to community counterparts are costly and have important political influence (Linna et al. 1998). In Brazil, teaching hospitals comprise 10% of the national health system’s acute beds, 26% of the ICU beds, 12% of the admissions and outpatient visits, and almost 40% of the high complexity procedures delivered by the Unified Brazilian Health System (SUS). Despite the high rate of productivity of teaching hospitals in the health system of Brazil, only a few studies have been conducted to determine their efficiency.

In Brazil, a financial crisis for teaching hospitals began in the 1990s. The amount of money transferred from the government to the hospitals has been chronically below the amount needed. This fact generated an increasing debt for the hospitals (reaching about one hundred million dollars by late 2003). This resulted in shutting down 10% of the hospitals’ beds. Accordingly, as was announced by local university authorities, the research and teaching functions of these hospitals was substantially harmed (Lins et al. 2007).

The debate concerning the causes of the crisis still continues. Teaching hospital managers claim that without higher reimbursements for patients, their hospitals cannot operate efficiently and effectively. The government understands that the funds should be increased. Nevertheless, by introducing contracts with specified goals, the government wants a guarantee that managerial changes will be implemented inside the hospitals towards gains in efficiency. The government authorities purport that hospital managers should make prudent decisions in technological choices and behaviors in order to reduce waste. Hence, assessment of the hospitals’ administrative technological choices and their implementation needs further study.

In 2004, the Ministry of Health (MH) initiated financial reform to deal with this problem. The main premise of the reform was to increase the funding to teaching hospitals, while having the quality of their medical and teaching missions guaranteed by a management effort. From then on, it was agreed that the payment system should be transformed in a fixed budget based on productivity goals (not only medical, but teaching and research as well) set in a contract signed by the hospital manager and the local public health authority. Previously, the MH had paid additional reimbursements for indirect teaching expenses based on a percentage of the hospitals’ total medical procedures delivered, in a Prospective Payment System. (Lins et al. 2007)

To join the financial reform, each hospital can voluntarily ask for certification as a teaching hospital, which is granted by the Ministry of Health and Ministry of Education if both Ministries. This requires that both ministries be in agreement regarding the applicant hospital’s capability of providing teaching and research, its professional management, and its integration with the health system. By 2007, 139 hospitals were certified and 108 joined the financial reform, including federal, state, church-owned and for-profit units (Lins et al. 2007). What is not known is the impact on efficiency caused by these changes.

The purpose of this study is to analyze productivity and efficiency changes for all (thirty) general Brazilian teaching hospitals, academic medical centers, that are University based and managed by the Ministry of Education, for the years, 2003 and 2006, that is, immediately before and after the financing reform was initiated. Another objective is to define the role of the different components of the crisis. Considering the two points of view, low financing and/or inefficient hospital management of resources, the assessment of the financing reform's results should have a double perspective: the possible gain in efficiency after the increase of the budgeted volume, and the possible gain in efficiency after the change in the regulatory strategy, by means of setting goals on a contract. Finally, it is important to assess the association between medical care efficiency and teaching load inside of these hospitals.

2 Methods

Given the ongoing conflicts between the federal payer and hospital providers, there is little empirical information as to whether and how efforts from the payer and from the provider sides may affect provider efficiency over time. Data Envelopment Analysis (DEA) is a choice of technique for multi-output/ multi-input hospital efficiency. This study aimed to examine technical efficiency longitudinally among the multiple-output producers of teaching hospitals, as the most clinically advanced group of providers, by performing DEA Malmquist index analysis to shed light on such effects.

The Malmquist productivity index provides a measure of productivity change and is based on measurement of productivity suggested by Caves et al. (1982). Färe et al. (1992, 1994) proposed the nonparametric Malmquist index to measure productivity with linear programming based DEA. The input-oriented Malmquist productivity index is composed of four input-oriented distance functions. The change in productivity between period t (the base period-2003) and period $t+1$ (2006) for the hospitals is defined as follows:

$$M_i^{t+1}\left(y^{t+1}, x^{t+1}, y^t, x^t\right) = \left[\frac{H_i^t\left(y^{t+1}, x^{t+1}\right)}{H_i^t(y^t, x^t)} \frac{H_i^{t+1}\left(y^{t+1}, x^{t+1}\right)}{H_i^{t+1}(y^t, x^t)}\right]^{\frac{1}{2}}$$

where M_i is the input-orientated Malmquist index, y represents the output vector that can be produced using the input vector x. Two of the four distance functions, $H_i^{t+1}(y^{t+1}, x^{t+1})$ and $H_i^t(y^t, x^t)$, are technical efficiency measures, and the remaining functions, $H_i^t(y^{t+1}, x^{t+1})$ and $H_i^{t+1}(y^t, x^t)$, indicate cross-period distance functions. $H_i^t(y^{t+1}, x^{t+1})$ shows the efficiency measure using the observation in 2006 relative to the frontier technology in 2003. $H_i^{t+1}(y^t, x^t)$ shows the efficiency measure using observation in 2003 relative to the frontier technology in 2006.

An important feature of the DEA based Malmquist index is that it can decompose the overall productivity measure into two mutually exclusive components, one measuring change in technical efficiency (catching-up effect) and the other measuring change in technology (frontier shift or innovation). Since the Malmquist productivity

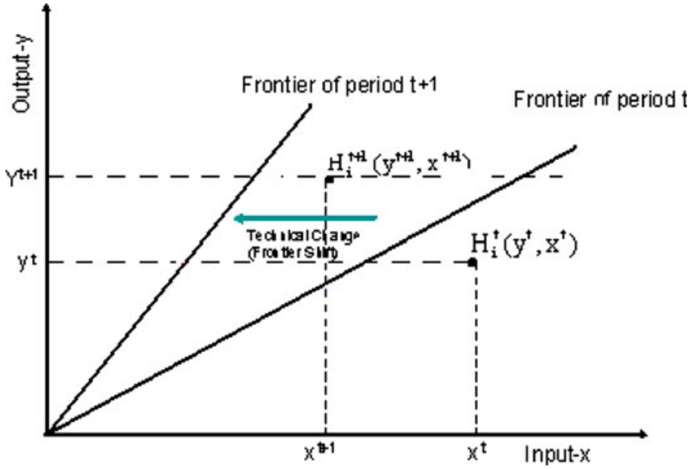

Fig. 1 Illustration of technical change (Frontier shift)

index is the product of these two components, the decomposition can be shown as:

$$M_i^{t+1}\left(y^{t+1}, x^{t+1}, y^t, x^t\right) = \underset{\text{(EFFICIENCY CHANGE)}}{\frac{H_i^{t+1}(y^{t+1}, x^{t+1})}{H_i^t(y^t, x^t)}} \cdot \underset{\text{(TECHNICAL CHANGE)}}{\left[\frac{H_i^t(y^{t+1}, x^{t+1})}{H_i^{t+1}(y^{t+1}, x^{t+1})} \frac{H_i^t(y^t, x^t)}{H_i^{t+1}(y^t, x^t)}\right]^{\frac{1}{2}}}$$

Figure 1 illustrates the concept of technical change (frontier shift) for a hospital (H_i) in a single input and output situation from time period t (e.g., 2003) to time period $t+1$ (e.g., 2006). H_i at time period t uses x^t amount input and y^t amount output, and away from the frontier of period t. This means H_i is not efficient (let its efficiency be approximately 0.76). The same hospital at time $t+1$ uses less inputs (x^{t+1}) and produces more outputs (y^{t+1}), thus improves its efficiency (let's assume to 0.82), however, during the elapsed time due to technological changes (innovation) efficiency frontier for all hospitals shifts towards the left, meaning to become perfectly efficient H_i must also catch-up with this frontier shift. Thus, despite the improvement on efficiency, the efficiency improvement for H_i is not sufficient with respect to the frontier for period $t+1$.

The efficiency component of the index measures changes in technical efficiency from 2003 to 2006. That is, it measures how the units being examined have managed to catch up to the frontier (Färe et al. 1994). On the other hand, the technical component of the index measures changes in the production frontier (i.e., a shift in best-practice technology) from 2003 to 2006. In an input-oriented evaluation, if the values of the Malmquist index and its components are less than 1, equal to 1, or greater than 1, they indicate progress, no change, or regress, respectively (Caves et al. 1982; Färe et al. 1992).

2.1 Data source

Data for the 30 general teaching hospitals related to the Federal Brazilian Universities from the 2nd half of the budget period of 2003 and 2006 were obtained from the Information System of Ministry of Education for the Federal University Hospitals (SIHUF/MEC).

2.2 Models and variables

The DEA technique is usually applied to cross-sectional data. In this case, the teaching hospitals are conceptualized as multi-input/multi-output decision making units (DMU) in the context of a health system. The study uses the Malmquist productivity index, as a commonly applied approach to assessing dynamic efficiency in a DEA environment, assuming an input-oriented constant-return-to-scale (CRS) method, as these hospitals are similar in size. Since managers of teaching hospitals can be assumed to have more opportunities to reduce the inputs used to produce outputs than to control increases in outputs, an input-oriented model is more appropriate (Ozgen and Ozcan 2004; Langabeer and Ozcan 2008).

The literature shows that there is a generally accepted choice of the variables for the DEA applications of hospitals (Chilingerian and Sherman 2004; O'Neill et al. 2008; Ozcan 2008). Hence, based on previous research, this study used similar input and outputs for the DEA based Malmquist model. Inputs of the study consist of: labor force (physicians and full time equivalent non-physicians), operational expenses (not including payroll), beds, and service-mix. According to Ozcan (1993), these last two variables are excellent as proxy measures for the assets of the hospitals (accounting for 63% of the variance). The service-mix variable also denotes the total number of diagnostic and special services, that is, the service complexity. The same study reported that DEA-generated hospital scores were stable across a wide variety of input and output combinations. The outputs of the study includes: admissions, inpatient surgeries and outpatient visits; all of them adjusted according to the complexity index of the hospital.

As a proxy measure of case-mix, SIHUF includes a continuous variable called High Complexity Procedures Information System—Sistema de Informações para Procedimentos de Alta Complexidade (SIPAC)—which reveals the resources available for accomplishing high complexity procedures regulated by the Ministry of Health, such as neurological, cardiac, orthopaedic and transplantation surgeries. For adjustment, we divided each individual SIPAC hospital value by the mean SIPAC among all hospitals, creating a complexity index that was multiplied to all output variables.

To summarize the hospital teaching functions, two proxy variables were used: (a) teaching dedication (the number of residents per physician), and (b) teaching intensity (the number of residents per bed), as adopted from Grosskopf et al. (2004) and Campbell et al. (1991). Because the DEA efficiency score only considered assistance variables, the teaching variables' mean and median were compared between efficient and inefficient hospitals to test if the administrative changes could have done any harm to the teaching activities.

Table 1 Summary of the efficiency scores, malmquist index and its components

Statistics	Efficiency 2003	Efficiency 2006	Malmquist index	Efficiency change	Frontier shift
Mean	0.58574	0.67263	1.20859	0.89716	1.36542
St. Dev	0.29543	0.32813	0.42768	0.27614	0.29444

3 Results

The 2004 financial reform provided an average budget increase of 51%. This was associated with adjustments in the proportional composition of the different types of assistance (surgeries, admissions, outpatient visits) as a consequence of administrative changes and settlements with the local health authorities (signed in contract). As a mean, there was a decrease of the admissions and the surgeries in 6 and 4%, respectively, for the teaching hospitals in this study. On the other hand, as observed in many other countries after such reforms (Linna 2000), the outpatient care increased by 44%. Table 3 in Appendix depicts these overall changes as well as facility specific information in income and outputs for all teaching hospitals in Brazil. Only four hospitals had no increase in their budgets after the reform (FUAM, UFAL, UFCG, UNIFESP), and more importantly, none of these hospitals had any decrease in their efficiency score. For example, UNIFESP stayed efficient; FUAM and UFAL had a significant efficiency increases as a result of additional outpatient care, while UFCG's score stayed almost the same. For all hospitals, outpatient visits augmentation was the most common factor for efficiency increase after the reform (90% or 27 hospitals increased their outpatient visits); on the other hand, the teaching hospitals augmented their admissions and surgeries, 53 and 60%, respectively.

As shown in Table 1, the average efficiency of all hospitals increased from 58.6 to 67.3%. Table 4 in Appendix shows the efficiency score for each hospital in 2003 and 2006, along with the values of the Malmquist Index, catch up and frontier shift (values less than 1 means increase in the respective index).

As of 2003, only five hospitals were on the efficiency frontier (HCPA, UFRJ, UFU, UNB, UNIFESP); however in 2006, this number increased to ten (FMTM, FUAM, HCPA, UFGO, UFMG, UFPE, UFPR, UFRJ, UFU, UNIFESP). Only six hospitals had lost ground on their relative efficiency scores. Among these, only one hospital (UNB) that reduced all measured output activities, despite that it had a 50% increase in its budget, lost its place at the frontier. On the other hand, the six hospitals that reached the frontier just after the reform increased their outpatient visit activities from 4 to 89%, and none had decreased admissions and surgeries.

Despite the gain observed in the efficiency change component, with the catching-up of the hospitals to the frontier, the Malmquist Index had shown a regress for most of the hospitals (28 in 30). This is due to a frontier contraction, as can be observed by the mean frontier shift component above one. That is, albeit the financial reform gave a chance for these hospitals to make managerial adjustments to reach economic balance after the budget augmentation (gaining efficiency), however the intended technological change for the frontier as a whole has not taken place yet. This is to be undertaken by a management effort attached to a new form of payment, where there must be a commitment and accountability of the hospital manager to the goals of the healthcare

Table 2 Teaching intensity (residents/beds) and Dedication (residents/physicians) according to efficiency (2003–2006)

	Teaching intensity		Teaching dedication	
	Mean	Median	Mean	Median
Efficient Hospital 2003	0.53	0.47	0.66	0.58
Inefficient Hospital 2003	0.45	0.42	0.52	0.44
Efficient Hospital 2006	0.56	0.46	0.66	0.43
Inefficient Hospital 2006	0.42	0.44	0.48	0.40

systems. Only with these objectives accomplished, a positive frontier shift would be observed (along with a progress in the frontier shift component).

Table 5 in Appendix shows the benchmarks for the inefficient units in 2003 and 2006. In general, efficient hospitals similar in complexity tend to be the benchmarks for the inefficient units. Also, we observe some tendencies for these hospitals in the near future as they lose or gain status as being a benchmark for others. We can illustrate this with the UFRJ and HCPA hospitals which were found to be efficient in both years. UFRJ decreased its position as a benchmark for 20 hospitals in 2003 and to only one hospital in 2006; otherwise, HCPA increased its position as benchmark from two to fourteen hospitals. In Table 3 in Appendix, one could observe that the UFRJ hospital maintained its efficiency via increasing inpatient visits by 4% and reducing admissions and surgeries by 28 and 10%, respectively. On the other hand, HCPA increased all its output activities. As UFRJ lost position as a benchmark for many peer hospitals, it is important to verify, with additional data, if the hospital will lose its capacity for maintaining efficiency if there is a shift to the left and upwards in best-practice technology.

One must also assure that the catching-up effect (efficiency) for hospitals does not happen at the expense of the quality of the teaching activities. In order to illustrate this, teaching intensity and teaching dedication for both years were calculated. Table 2 shows the mean and median for teaching intensity and teaching dedication for efficient and inefficient hospitals, in 2003 and 2006. Although not statistically significant, efficient hospitals tend to have a higher teaching intensity and dedication than their non-efficient counterparts.

4 Discussion

The DEA based Malmquist Index proved to be very useful in assessing financial reforms of the national health systems, and thereby aiding decision makers for health policy. This has already been demonstrated earlier by a study of the Finnish hospitals' reform in 1993 (Linna 2000) and the Austrian hospitals' reform in 1997 (Sommersguter-Reichmann 2000). Both studies demonstrated a clear technological improvement (frontier shift), not accompanied by a technical efficiency change.

The demonstrated usefulness of the Malmquist Index for hospital reform can be observed also in our study from three distinct perspectives.

(1) From one point of view, the hospital manager can use these data to establish strategic maneuvers, compare the hospital situation with the other similar hospitals

and look for benchmarks to find a reference or ways of amelioration. In the case of Brazilian University Hospitals, in order to augment efficiency, there was a clear tendency to enhance the relationship with primary care centers (by means of a contract signed with the local public health authority) and to intensify new modalities of care, such as homecare and outpatient surgeries. These measures were reflected by the increase in the outpatient visits, not necessarily accompanied by admissions or inpatient surgeries. Moreover, as the sub-financing component of the crisis was mitigated with the budget increase, most hospitals have shown internal administrative skills to maintain, catch-up or approximate their position in relation to the efficient frontier. On the other hand, the hospital that lost their relative efficiency scores or those that fell from frontier should be investigated carefully concerning their managerial ability to deal with the crisis.

(2) From the perspective of the government authorities, the index could be seen as a synthetic measure for the policy results. As the ultimate goal of the reform was to gain efficiency through the innovation of the financing structure, they are interested in the effect of technological change by measuring the shift in the production possibilities frontier. There is evidence in the literature that activity-based financing, set in a contract, is associated with increased efficiency (Biørn et al. 2003), and also that sub-financing generates a low efficiency score (Ferrier et al. 2006). In the present study, after the reform, there was an increase in the technical efficiency of the majority of the hospitals but no evidence of technological gain. This means that the increased budget was absolutely necessary to improve the caching up for most of the teaching hospitals. Nevertheless, because the technological frontier shift is based on administrative and behavioral changes, it takes more time to show any evidence of improvement. So, it is necessary to allow for a wider length of time to conclude for or against the technological change that came with the financial reform. This finding is consistent with the UK National Health System (NHS) study, when, first, there was a regress and, later, a clear technological improvement (Maniadakis et al. 1999). In the NHS study, it was suggested also that the technological shift became more important than the technical change because the hospitals were already efficient at the beginning of the observation, which is not our case.

(3) The last perspective, but not the least, should consider other environmental factors, neither associated to the funding rate, nor to the internal administrative capabilities, that could influence positively or negatively the efficiency scores of the teaching hospitals, and their response to the financing reform. These could be socioeconomic and demographic variables. The hospitals are spread inside a country with continental proportions and with organizational variables, such as ownership status of the hospitals, and even management variables (e.g., the competitive structure of the surrounding market, the historical relationship constructed between the manager and local authority). These issues were not considered in the present study but should be addressed in the near future to enrich any conclusion about financing reform. Some of these data could be regressed as independent variables to the efficiency score and, more urgently, the same data analyzed to the University Federal Hospitals should be evaluated for the remaining

teaching hospitals, not only to validate the present results, but also to compare the impact of financing reform to different ownership types of teaching hospitals.

Finally, concerning the association between the medical care efficiency and the teaching intensity, the study suggests that there was no impairment of the teaching activities after the reform. On the contrary, as demonstrated by Schreyögg and Von Reitzenstein (2008), it seems to be important to explore and induce the development of teaching and research inside the hospitals to gain efficiency, as a possible complementary strategy to deal with the financial crisis faced by these units.

Appendix

See Tables 3, 4 and 5.

Table 3 Financial volume and output variation after the reform of the federal teaching hospitals

Hospital	Income SUS 2003 ($\times 10^6$)	Income SUS 2006 ($\times 10^6$)	Difference income (%)	Difference surgeries (%)	Difference admissions (%)	Difference outpatient visits (%)
FMTM	1.54	2.31	0.49	−0.07	0.51	0.36
FUAM	0.71	0.53	−0.26	0	−0.14	0.04
FUFMS	1.03	1.37	0.33	0.33	0.01	0.15
FUFS	0.19	0.35	0.87	1.33	1.43	1.62
FURG	0.54	0.76	0.4	−0.28	−0.02	2.11
HCPA	5.35	6.65	0.24	0.1	0.02	0.4
UFAL	1.01	0.96	−0.06	0.04	−0.15	0.09
UFBA	0.95	1.89	1	0.24	0.24	0.05
UFCE	1.43	3.36	1.36	−0.21	0	0.1
UFCG	0.33	0.33	−0.02	0	−0.41	0.07
UFES	1.31	1.52	0.16	−0.11	−0.03	−0.15
UFF	1.47	1.92	0.3	−0.05	0.06	0.75
UFGO	2.02	2.6	0.29	0.23	0.1	0.89
UFJF	0.45	0.65	0.45	1.2	0.84	1.34
UFMA	3.03	4.42	0.46	0.15	0.11	0.72
UFMG	3.74	4.81	0.29	0.08	−0.02	0.44
UFMT	0.51	0.92	0.8	0.76	0.52	1.67
UFPA	0.52	1.72	2.29	1.1	0.71	1.92
UFPB	0.43	0.78	0.8	0.18	0.39	0.7
UFPE	1.48	2.19	0.48	−0.02	0.09	0.81
UFPEL	0.81	1.24	0.54	−0.11	−0.23	0.17
UFPR	3.62	5.65	0.56	0.1	0.14	0.69
UFRJ	2.42	3.98	0.65	−0.28	−0.1	0.04
UFRN	0.53	0.98	0.86	−0.2	−0.15	−0.12
UFSC	1.09	1.98	0.81	0	0.17	1.21
UFSM	1.9	2.62	0.38	0.06	0.19	1.04
UFU	3.95	4.85	0.23	−0.2	−0.11	0.72

Table 3 continued

Hospital	Income SUS 2003 ($\times 10^6$)	Income SUS 2006 ($\times 10^6$)	Difference income (%)	Difference surgeries (%)	Difference admissions (%)	Difference outpatient visits (%)
UNB	1.25	1.92	0.54	−0.27	−0.61	−0.01
UNI-RIO	0.67	0.74	0.1	0.2	−0.11	0.03
UNIFESP	10.24	9.8	−0.04	−0.33	−0.1	0.39
Mean	1.82	2.46	0.51	−0.06	−0.04	0.44

Source: SIHUF/MEC

Table 4 List of efficiency scores for brazilian teaching hospitals

Hospital	Efficiency 2003	Efficiency 2006	Malmquist index	Efficiency change	Frontier shift
FMTM	0.72002	1.00000	0.99292	0.72002	1.37902
FUAM	0.55742	1.00000	0.79904	0.55742	1.43346
FUFMS	0.37897	0.56428	1.24082	0.67161	1.84754
FUFS	0.05382	0.07059	0.72922	0.76242	0.95645
FURG	0.36667	0.44217	1.01122	0.82924	1.21946
HCPA	1.00000	1.00000	1.03962	1.00000	1.03962
UFAL	0.47110	0.73143	1.03823	0.64408	1.61196
UFBA	0.65473	0.48255	1.61924	1.35680	1.19342
UFCE	0.62426	0.43966	1.64300	1.41987	1.15715
UFCG	0.28706	0.28082	1.28197	1.02223	1.25410
UFES	0.76440	0.88830	1.22714	0.86052	1.42604
UFF	0.66520	0.78212	0.99898	0.85051	1.17457
UFGO	0.71867	1.00000	0.94475	0.71867	1.31458
UFJF	0.36385	0.84665	0.59662	0.42975	1.38831
UFMA	0.67288	0.80122	1.05170	0.83982	1.25229
UFMG	0.96358	1.00000	1.07048	0.96358	1.11094
UFMT	0.07071	0.12276	0.89783	0.57604	1.55862
UFPA	0.05887	0.07286	1.20871	0.80794	1.49604
UFPB	0.15804	0.19020	1.23143	0.83093	1.48200
UFPE	0.69689	1.00000	1.19181	0.69689	1.71020
UFPEL	0.30285	0.26920	1.32399	1.12501	1.17687
UFPR	0.83975	1.00000	1.09974	0.83975	1.30961
UFRJ	1.00000	1.00000	1.61668	1.00000	1.61668
UFRN	0.52418	0.29117	2.14672	1.80024	1.19246
UFSC	0.44789	0.57594	1.22327	0.77767	1.57300
UFSM	0.67666	0.82408	1.13993	0.82111	1.38828
UFU	1.00000	1.00000	1.13690	1.00000	1.13690
UNB	1.00000	0.85844	2.81344	1.16491	2.41516
UNI-RIO	0.53361	0.64453	0.98889	0.82791	1.19444
UNIFESP	1.00000	1.00000	0.95335	1.00000	0.95335

Table 5 Hospitals' Benchmarks in 2003 and 2006

Hospital	Benchmarks 2003	Benchmarks 2006
FMTM	UFRJ, UFU, UNB, UNIFESP	Efficient
FUAM	UFRJ	Efficient
FUFMS	UFRJ, UFU, UNB	HCPA, UFPE
FUFS	UNIFESP	FUAM, HCPA, UNIFESP
FURG	UFRJ, UFU, UNB	FUAM, HCPA, UNIFESP
HCPA	Efficient	Efficient
UFAL	UFRJ, UFU, UNB, UNIFESP	FUAM, HCPA
UFBA	UFRJ, UNIFESP	FUAM, HCPA, UFGO, UNIFESP
UFCE	UFRJ, UNIFESP	HCPA, UFMG, UFU, UNIFESP
UFCG	UNB, UNIFESP	UFPE, UNIFESP
UFES	UFRJ, UFU, UNIFESP	FUAM, HCPA, UFGO
UFF	UFRJ, UNIFESP	FUAM, UFGO, UNIFESP
UFGO	UFRJ, UFU, UNIFESP	Efficient
UFJF	UFRJ, UFU, UNIFESP	UFGO, UFU
UFMA	UFRJ, UFU, UNB, UNIFESP	HCPA, UFMG, UFGO, UFU
UFMG	UFU, UNB, UNIFESP	Efficient
UFMT	HCPA, UNB, UNIFESP	HCPA, UFPE
UFPA	UFRJ, UNB, UNIFESP	UFMG, UFPR, UFRJ
UFPB	UFRJ, UNB, UNIFESP	HCPA, UFPE, UNIFESP
UFPE	UFRJ, UFU, UNB, UNIFESP	Efficient
UFPEL	HCPA, UFU, UNB, UNIFESP	HCPA, UFMG, UNIFESP
UFPR	UFRJ, UFU, UNB, UNIFESP	Efficient
UFRJ	Efficient	Efficient
UFRN	UFRJ, UNIFESP	FUAM, HCPA, UFGO, UNIFESP
UFSC	UFRJ, UNB, UNIFESP	FMTM, UFPE, UNIFESP
UFSM	UFRJ, UFU	HCPA, UFGO, UFU
UFU	Efficient	Efficient
UNB	Efficient	HCPA, UFPE
UNI-RIO	UFRJ, UNIFESP	FUAM, UFGO, UNIFESP
UNIFESP	Efficient	Efficient

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