

Assessment of health technical efficiency in the cities of the Rota dos Bandeirantes health region of the state of São Paulo, Brazil

João Alves dos Santos-Neto (<https://orcid.org/0000-0003-0904-5566>)¹

Áquilas Nogueira Mendes (<https://orcid.org/0000-0002-5632-4333>)²

Antonio Carlos Pereira (<http://orcid.org/0000-0003-1703-8171>)¹

Luiz Renato Paranhos (<http://orcid.org/0000-0002-7599-0120>)³

Abstract *Although administrators unanimously agree that the Brazilian Unified Health System (SUS) is underfunded, it is also unanimous that there are problems in the efficiency of expenditures management. From this perspective, this study assessed the health technical efficiency in the seven cities of the Rota dos Bandeirantes health region of the state of São Paulo, Brazil, from 2009 to 2012, through the Health Technical Efficiency Index. This index includes structure and results indicators, mainly from the goals and indicators agreement system, and it is collected from the database of the SUS Informatics Department. It was identified that only one city reached high health technical efficiency, while the other cities presented low efficiency. It was concluded that cities with higher income available and higher per capita expenditures achieved the best health indicator results and, therefore, better health technical efficiency indexes. However, some cities, even though small in structure, obtained better results than neighboring cities, which shows structure management efficiency. Thus, the resource represented an essential condition for efficiency, however not sufficient.*

Key words *Efficiency, Service indicators, Unified health system*

¹ Faculdade de Odontologia de Piracicaba, Universidade Estadual de Campinas. R. Cerejeira 61, Cidade das Flores. 06184-040 Osasco SP Brasil. drjoaoalves@yahoo.com.br

² Faculdade de Saúde Pública, Universidade de São Paulo. São Paulo SP Brasil.

³ Faculdade de Odontologia, Universidade Federal de Uberlândia. Uberlândia MG Brasil.

Introduction

The underfunding of the Brazilian Unified Health System (SUS) is unanimous in the speech of administrators, and although acknowledging the problems in the efficiency of expenditure management, they advocate that the system operates with funding below the required. A funding model compatible to a health policy that proposes to be universal and integral has yet to be created¹⁻⁶

Management efficiency is important in all fields and situations, but for public systems with scarce funding, efficiency is vital to reduce the deleterious effects in the quality of services provided⁷. Performance measurement is one way to obtain efficiency in public services and this approach is becoming increasingly relevant in the public management models⁸

Efficiency assessment in public health management is a difficult and challenging task, because it is both inserted in a high-complexity environment and influenced by different variables⁷. On the other hand, efficiency assessment is essential to verify the application of resources and the return provided to citizens⁹.

In 2010, the World Health Organization (WHO) revealed in the World Health Report¹⁰ that making sufficient financial resources available is useless if they are applied inefficiently. Moreover, it was estimated that 20 to 40% of resources spent in health are wasted, suggesting that the causes of the inefficient process should be assessed so that public policies are created to reduce such management inefficiency¹⁰.

Even in the national scenario of the lack of resources in the system, there are major differences in the funding models of the Brazilian Unified Health System (SUS) of cities and, consequently, in the efficiency of the health care provided by the cities included in this system. Thus, identifying and measuring these differences of models and efficiency may contribute to promote models that are more successful and even use them as parameters for the less efficient cities¹¹

Given the above, this study assessed the technical efficiency in the management of available resources, through the Health Technical Efficiency Index (HTEI)¹² of the seven cities in the *Rota dos Bandeirantes* health region of the state of São Paulo, Brazil, from 2009 to 2012. The HTEI was used in this research because it is a fairly simple method that may be replicated equally in other periods and health regions.

Methods

Type and characterization of the study location

It was an ecological study that used secondary data from the public domain offered by the Department of Health through the SUS Informatics Department (DATASUS), in the cities of the *Rota dos Bandeirantes* health region of the state of São Paulo, Brazil, from 2009 to 2012. The *Rota dos Bandeirantes* health region includes seven cities: Osasco, Carapicuíba, Barueri, Jandira, Itapevi, Santana de Parnaíba, and Pirapora do Bom Jesus. Its characterization was obtained through the 2014 Health Map of the *Rota dos Bandeirantes* Region^{12,13}.

The *Rota dos Bandeirantes* health region was selected for this study because of the great heterogeneity of its cities, as well as for the different collection standards and the existence of different models of public health expenditure management¹⁴. The years from 2009 to 2012 were set for the study for being the last completed period of municipal government management with data available for analysis.

Selection of indicators

All indicators that were used to assess the efficiency of cities were obtained in a free-access database, through the Health Portal of the Brazilian Department of Health. The financial indicator (total per capital expenditure) was obtained through the Brazilian Information System on Public Health Budgets (SIOPS)¹⁵, available at http://siops-asp.datasus.gov.br/cgi/siops/siops_indic/municipio/anoal/prv_index.htm. The socioeconomic indicator (GDP per capita) was obtained through demographic and socioeconomic information from the TABNET/DATASUS¹⁶, available at <http://www2.datasus.gov.br/DATASUS/index.php?area=0201>. The other indicators were obtained from a historical series in the list of indicators determined in the agreement of 2013/2015 and made available through the TABNET/DATASUS¹⁶.

In order to select the structure and results indicators used in the efficiency assessment of the cities, the following inclusion criteria were considered: systematic availability by the data sources, potential for positive or negative interference with the result of this indicator through actions and activities performed in the city, potential for

use in all cities in the region regardless of population size and other distinguishing variables, and presentation in proportion, percentage, or ratio formats, to which size of the population studied does not interfere with the presentation format of the result.

The following exclusion criteria were used for selecting indicators: indicators with discontinued availability by the databases or calculated in longer periods than annually, indicators which results do not depend on actions and activities that may be performed by the cities, indicators that assess situations or events that are not common to all the cities studied, and indicators which results are presented by absolute numbers or in rate formats (1/1000, 1/10,000, 1/100,000) and that may not be compared between the cities analyzed regardless of population size. In this sense, the mortality indicators were excluded for being presented in rates (1/1000) and because in the case of small cities (less than 100,000 inhabitants) such as Pirapora do Bom Jesus, these rates may vary extensively due to the small number of deaths and births. For these cases, it is recommended to analyze the rates by combining several years or according to the absolute number of deaths¹⁷, making it impossible to compare with the other cities in the region.

Structure indicators

The following structure indicators were selected: total per capita expenditure, population coverage estimated by the primary care teams, and Gross Domestic Product (GDP) per capita. Although the GDP per capita is not a health resource indicator, it was used in this study as a structure indicator, because it quantifies the economic activity of the city, which reflects on municipal collection and directly impacts the service offer to the population, assuming there is a relationship between city wealth and a greater ability of the city management to develop its health system¹⁸. The “total per capita expenditure of the SUS” indicator was selected over other financial indicators, such as “available income” or “percentage of the city’s own income applied to health” for representing the total resource contribution to the health system, through the city’s own resources and federal or state transfers.

Results indicators

The following results indicators were selected: ratio of Hospitalization for Ambulatory Care

Sensitive Conditions (HACSC), reason for medium-complexity ambulatory procedures in the resident population, reason for medium-complexity clinical and surgical hospitalizations of the resident population, reason for cervical cytopathological examinations in women aged 25 to 64 years, reason for screening mammograms performed in women aged 50 to 69 years, ratio of live births from mothers with 7 (seven) or more prenatal visits, and ratio of vaccines in the basic vaccination calendar of the child, with vaccination coverage achieved and ratio of cure of new bacilliferous pulmonary tuberculosis cases.

The HACSC was selected to measure primary care results, and although some studies¹⁹⁻²¹ show that the rate of HACSC is conditioned by factors that are both not controlled by the primary care and strongly associated with the socioeconomic conditions of the population, a systematic review by Nedel et al.²² showed an association of fundamental principles of primary care with lower risk of HACSC.

Although they are not performed completely and directly by all the cities, the medium-complexity clinical and surgical hospitalizations, the medium-complexity ambulatory procedures, the cervical cytopathological examinations, and the screening mammograms suffer an interference from the primary care structure and the organization for accessing regional referral services. The other results indicators are inherent to the primary care activity and according to the Brazilian National Policy of Primary Care, the cities are responsible for organizing, executing, and managing primary care services and actions.

Data analysis

The Health Technical Efficiency Index (HTEI) was used to calculate the efficiency of cities¹². This method measures efficiency by comparison among the other cities assessed, so it allows comparing cities within one region¹². On the one hand, the variables assessed combine the structure indicators for each of the seven cities at each year studied and, on the other hand, the variables analyzed separately combine the results indicators for the cities at each year studied. Therefore, the Structure Efficiency Index (SEI) is calculated initially for each indicator selected, for each city, and at each year assessed, and then the Result Efficiency Index (REI) is calculated for each indicator selected, for each city, and at each year assessed. The following formula was used to calculate these indexes:

$$\text{Efficiency Index} = 1 - \frac{\{(R_{\text{best}} - R_{\text{calc}})\}}{(R_{\text{best}} - R_{\text{worst}})}$$

In this formula, R_{best} represents the best result at the period assessed for each variable, R_{calc} corresponds to the indicator of the city to be calculated in the variable, and R_{worst} refers to the worst result at the period assessed for each variable.

After calculating the SEI of each variable, the simple arithmetic mean is extracted from the results of the SEI of each city, therefore finding the municipal SEI. The same process is performed to find the REI.

After calculating the SEI and the REI of each city, the simple arithmetic mean is extracted from the results of both indexes for the final calculation of the HTEI, which is expressed in the interval between 0 and 1. Values below 0.500 are considered “low” efficiency, values from 0.500 to 0.799 are “medium” efficiency, values from 0.800 to 0.899 are “high” efficiency, and values over 0.900 are “very high” efficiency¹².

Results

The cities included in the *Rota dos Bandeirantes* health region are located in the west metropolitan region of the state of São Paulo, Brazil, in a neighboring area of cities that are geographically close but profoundly different, including in relation to demographics. Their populations vary from 16,238 inhabitants in Pirapora do Bom Jesus, 110,842 inhabitants in Jandira, 113,945 in Santana de Parnaíba, and 206,558 inhabitants in Itapevi to 373,358 inhabitants in Carapicuíba, and 668,877 inhabitants in Osasco. The Human Development Index (HDI) of 2010 also shows heterogeneity in the cities of the *Rota dos Bandeirantes*. The city of Pirapora do Bom Jesus has the lowest HDI of the region (0.727), ranking in the 418th place of the cities in the state of São Paulo, followed by the city of Itapevi (0.735) - 345th place, Carapicuíba (0.749) - 236th place, and Jandira (0.760) - 164th place. These cities are rather far from Barueri and Santana de Parnaíba, which present HDI of 0.786 and 0.814, respectively and rank in the 47th and 9th places of the cities of the state of São Paulo.

Table 1 shows the results of structure indicators used to calculate the SEI. The structure difference of the city of Barueri stands out relative to the regional mean and to the other cities.

Table 2 shows the SEI of each city and the regional mean, as well as the regional ranking that classifies from first to seventh place. In the structure efficiency assessment, the only city that reached the “very high” efficiency standard was Barueri. The other cities presented “low” efficiency.

Table 3 shows the results of each indicator used to calculate the REI. It may be noticed that the city of Barueri obtained superior results to the regional mean for all indicators and at all years assessed.

Table 4 presents the REI of each city and the regional mean, as well as the efficiency standard and the ranking of each city of the region. In this result efficiency assessment, Barueri and Santana de Parnaíba reached “medium” efficiency and the other cities reached “low” efficiency in the results.

Table 5 shows the HTEI results of the cities and the regional mean, as well as the efficiency standard and the regional ranking of each city. The only city that reached “high” efficiency was Barueri, which obtained “very high” efficiency in some of the years. The other cities presented “low” health technical efficiency.

Discussion

This study shows that the cities of the *Rota dos Bandeirantes* health region are presented as a continuous geographical space with cultural, economic, and social identities, a communication network, as well as shared transportation and commercial networks, according to the definition of health region by the 2006 Health Agreement²³. However, they present obvious differences in population characteristics, economic and social conditions, structure available, and structure management efficiency to produce positive health indicator results.

In order to assess the technical efficiency in the health structure management of the cities, the Health Technical Efficiency Index (HTEI) was used, likewise other studies^{12,24,25}. Some studies have used the Data Envelopment Analysis (DEA)^{9,11,24,26-29}, which according to the authors, is limited by the benevolent analysis of the classic models, resulting in a great number of 100% efficient units (cities) and reducing the comparison between them^{9,24,25}. One study used both methods for efficiency assessment²⁵, showing that the results obtained by the HTEI were mostly compatible to the results obtained by the DEA method.

The HTEI was used in this research for being a fairly simple method that does not require a

Table 1. Results of structure indicators of the seven cities and regional mean of the Rota dos Bandeirantes health region, from 2009 to 2012.

Indicator	City	2009	2010	2011	2012
Total per capita health expenditure, in Brazilian Reais.	Barueri	1,179.97	1,171.85	1,507.73	1,557.47
	Carapicuíba	247.65	267.12	286.45	364.74
	Itapevi	383.17	396.48	503.91	573.79
	Jandira	395.67	313.88	350.59	385.64
	Osasco	501.4	554.38	674.88	668.66
	Pirapora do Bom Jesus	625.99	502.58	569.89	555.98
	Santana de Parnaíba	592.91	681.55	931.72	1.033.10
	Regional Mean	534.14	558.9	683.49	722.59
Percentage of primary care team coverage	Barueri	99.57	100	87.56	83.31
	Carapicuíba	25.27	21.77	22.46	22.07
	Itapevi	44.53	38.13	31.63	27.49
	Jandira	32.63	32.99	30.46	36.13
	Osasco	38.35	36.51	36.41	33.9
	Pirapora do Bom Jesus	55.09	89.2	73.03	31.33
	Santana de Parnaíba	51.67	50.38	56.46	64
	Regional Mean	45.81	44.01	41.27	39.63
GDP per capita, in Brazilian Reais.	Barueri	99.602	115.275	131.291	134.644
	Carapicuíba	7.813	9.279	10.603	11.079
	Itapevi	17.674	25.631	31.467	32.497
	Jandira	12.572	15.232	16.587	16.736
	Osasco	43.996	54.578	58.822	58.604
	Pirapora do Bom Jesus	7.882	8.086	9.066	9.349
	Santana de Parnaíba	28.282	33.463	41.712	43.649
	Regional Mean	38.261	45.674	51.168	51.919

Source: Brazilian Department of Health^{13,14}.

Table 2. Structure Efficiency Index (SEI), mean for the period, efficiency standard, and regional ranking, according to cities and regional mean from 2009 to 2012.

Cities	SEI 2009	SEI 2010	SEI 2011	SEI 2012	SEI 2009 a 2012	Efficiency standard	Regional ranking
Barueri	1.000	1.000	1.000	1.000	1.000	Very High	1 st
Carapicuíba	0.000	0.004	0.004	0.005	0.003	Low	7 th
Itapevi	0.171	0.172	0.167	0.150	0.165	Low	5 th
Jandira	0.103	0.087	0.079	0.102	0.093	Low	6 th
Osasco	0.281	0.313	0.313	0.280	0.297	Low	3 rd
Pirapora do Bom Jesus	0.269	0.374	0.336	0.104	0.271	Low	4 th
Santana de Parnaíba	0.316	0.354	0.439	0.506	0.404	Low	2 nd
Média Regional	0.305	0.319	0.320	0.309	0.313	Low	-

specific software or operation training. It is completely developed in Excel spreadsheets and may be replicated equally in other periods and health regions, using the indicators selected.

Moreover, it is worth mentioning a few recent international studies on the use of the efficien-

cy concept, mostly directed to the perspective of health systems in general. Cetin and Bahce³⁰ have published a study that assessed the efficiency of health systems of the Organization for Economic Cooperation and Development (OECD) countries and, likewise the present study, the

Table 3. Outcome of results indicators of the seven cities and regional mean of the Rota dos Bandeirantes health region, from 2009 to 2012.

Indicator	City	2009	2010	2011	2012
Percentage of hospitalization for ambulatory care sensitive conditions	Barueri	31.83	29.75	26.61	25.82
	Carapicuíba	27.79	27.03	25.43	24.01
	Itapevi	19.11	21.65	19.79	20.16
	Jandira	29.18	26.66	21.6	25.34
	Osasco	26.38	26.39	24.91	21.88
	Pirapora do Bom Jesus	22.73	18.86	27.14	23.95
	Santana de Parnaíba	20.79	23.59	27.59	26.4
	Regional Mean	27.03	26.59	24.82	23.42
Reason for medium-complexity ambulatory procedures	Barueri	2.5	4.1	4.23	4.35
	Carapicuíba	1.23	2.22	2.4	2.34
	Itapevi	1.77	1.61	2.25	2.88
	Jandira	1.16	1.27	1.55	1.75
	Osasco	0.88	2.07	2.39	2.26
	Pirapora do Bom Jesus	1.08	1.49	2.33	1.96
	Santana de Parnaíba	1.7	1.93	2.64	2.35
	Regional Mean	1.36	2.27	2.6	2.62
Reason for medium-complexity hospitalizations	Barueri	3.92	5.21	5.38	5.62
	Carapicuíba	3.03	3.45	3.47	3.46
	Itapevi	2.8	3.07	3.31	3.46
	Jandira	2.98	2.61	2.55	2.83
	Osasco	2.44	2.81	2.98	3.03
	Pirapora do Bom Jesus	2.83	3.06	2.91	2.75
	Santana de Parnaíba	1.52	2.25	2.59	2.69
	Regional Mean	2.8	3.27	3.41	3.5
Reason for cervical cytopathological examination in women aged 25 to 64 years	Barueri	0.89	0.99	0.99	0.91
	Carapicuíba	0.36	0.38	0.37	0.3
	Itapevi	0.7	0.62	0.6	0.56
	Jandira	0.57	0.54	0.47	0.42
	Osasco	0.24	0.56	0.38	0.52
	Pirapora do Bom Jesus	0.68	0.6	0.52	0.47
	Santana de Parnaíba	0.8	0.83	0.8	0.82
	Regional Mean	0.46	0.6	0.52	0.55
Reason for mammograms in women aged 50 to 69 years	Barueri	0.47	0.59	0.68	0.7
	Carapicuíba	0.07	0.03	0.24	0.22
	Itapevi	0.2	0.15	0.39	0.36
	Jandira	0.19	0.05	0.26	0.22
	Osasco	0.13	0.08	0.12	0.22
	Pirapora do Bom Jesus	0.16	0.1	0.18	0.27
	Santana de Parnaíba	0.37	0.38	0.49	0.5
	Regional Mean	0.18	0.16	0.27	0.31

it continues

results show that efficiency varies widely among the OECD countries, which indicates heterogeneity of the health services offered. A study³¹ on the efficiency determinants of the Canadian

health system concluded that the local system presents great inefficiencies (ranging from 18 to 35%), which result from three sets of factors: factors related to management (e.g., hospital re-

Table 3. Outcome of results indicators of the seven cities and regional mean of the Rota dos Bandeirantes health region, from 2009 to 2012.

Indicator	City	2009	2010	2011	2012
Percentage of live births with 7 or more prenatal visits	Barueri	87.54	79.05	78.78	77.46
	Carapicuíba	63.9	61.56	64.91	63.65
	Itapevi	68.54	68.5	67.94	64.01
	Jandira	75.43	73.59	71.83	68.32
	Osasco	72.61	68.71	69.89	66.98
	Pirapora do Bom Jesus	73.81	67.32	74.77	69.96
	Santana de Parnaíba	80.13	82.87	83.65	83.53
	Regional Mean	73.38	70.03	71.1	68.92
Percentage of vaccines with adequate coverage	Barueri	66.67	50	77.78	88.89
	Carapicuíba	50	0	55.56	88.89
	Itapevi	16.67	50	77.78	66.67
	Jandira	83.33	83.33	77.78	33.33
	Osasco	16.67	16.67	100	33.33
	Pirapora do Bom Jesus	83.33	100	88.89	88.89
	Santana de Parnaíba	33.33	16.67	66.67	77.78
	Regional Mean	50	45.24	77.78	68.25
Percentage of cure of new pulmonary tuberculosis cases	Barueri	86.27	87.93	92	82.05
	Carapicuíba	90.63	87.38	91.34	73.47
	Itapevi	84	84.38	88.52	67.27
	Jandira	78.26	87.5	89.66	60
	Osasco	74.7	85.26	80	68.75
	Pirapora do Bom Jesus	50	100	88.89	63.64
	Santana de Parnaíba	85.71	100	80	77.78
	Regional Mean	81.66	86.84	86.33	70.68

Source: Brazilian Department of Health^{15,16}.

Table 4. Results Efficiency Index (REI), mean for the period, efficiency standard, and regional ranking, according to cities and regional mean from 2009 to 2012.

Cities	REI 2009	REI 2010	REI 2011	REI 2012	REI 2009 2012	Efficiency standard	Regional ranking
Barueri	0.830	0.694	0.796	0.848	0.792	Medium	1 st
Carapicuíba	0.356	0.148	0.260	0.310	0.269	Low	6 th
Itapevi	0.519	0.322	0.469	0.420	0.433	Low	3 rd
Jandira	0.498	0.288	0.357	0.081	0.306	Low	5 th
Osasco	0.242	0.215	0.261	0.245	0.241	Low	7 th
Pirapora do Bom Jesus	0.463	0.513	0.355	0.295	0.407	Low	4 th
Santana de Parnaíba	0.600	0.541	0.378	0.534	0.513	Medium	2 nd
Regional Mean	0.438	0.324	0.365	0.383	0.377	Low	-

admissions), factors related to public health (e.g., smoking and obesity rates), and environmental factors (e.g., average regional income).

This specific efficiency analysis study in local health systems in the *Rota dos Bandeirantes* region used structure and results indicators that

Table 5. Health Technical Efficiency Index (HTEI), mean for the period, efficiency standard, and regional ranking, according to cities and regional mean from 2009 to 2012.

City	HTEI 2009	HTEI 2010	HTEI 2011	HTEI 2012	HTEI 2009 - 2012	Efficiency standard	Regional ranking
Barueri	0,915	0,847	0,898	0,924	0,896	Alta	1°
Carapicuíba	0,178	0,076	0,132	0,158	0,136	Baixa	7°
Itapevi	0,345	0,247	0,318	0,285	0,299	Baixa	4°
Jandira	0,300	0,187	0,218	0,092	0,199	Baixa	6°
Osasco	0,262	0,264	0,287	0,263	0,269	Baixa	5°
Pirapora do Bom Jesus	0,366	0,444	0,346	0,199	0,339	Baixa	3°
Santana de Parnaíba	0,458	0,447	0,409	0,520	0,459	Baixa	2°
Regional Mean	0,371	0,321	0,342	0,346	0,345	Baixa	-

were different from other researches^{32,33}. The content of these indicators is based on the idea of efficiency suggested by the Economic Commission for Latin America and the Caribbean (ECLAC)³⁴. It is important to report that this organization has been highlighting the issue of efficiency for dealing with the integrated social policy and its decentralization process in the scope of Latin America, including the principles of universality, solidarity, and equity, which relate to the perspective of the SUS principles in Brazil. In this line of ECLAC thinking, authors^{35,36} developed their analyses on health efficiency and decentralization process. For some studies³⁴⁻³⁶, a health decentralization policy is expected to result in efficiency gains without impairing equity, which should be measured by the impact of decentralization on regional inequalities (differences of income and service locations of sub-national units, socioeconomic differences of the population, etc.). Although these studies³⁴⁻³⁶ acknowledge the potential efficiency gain from the decentralization process, it is worth noting the concern with the ratio of efficiency increase and equity reduction.

The selection of specific indicators for the present study followed a few inclusion and exclusion criteria. These criteria made the assessment results more likely to have been influenced positively or negatively by the management actions of the city assessed and more likely to be applied to any other health region, regardless of the characteristics of the cities included in it, always respecting the equitable aspects.

The use of the GDP per capita in this study came from the assumption of the relationship between city wealth and a greater management ability for the city to develop its health system.

Considering the difficulties in obtaining reliable and regular economic information derived from the containment of public expenditures, it may be affirmed there is a series of advantages that an economic indicator such as the GDP of cities may offer. Duarte¹⁸ states that the GDP per capita is constructed with administrative records, which makes it an easier indicator for analyzing the sectoral economic dynamics. It is a city profile comparable in the entire national territory, with annual periodicity. Such sectoral dimension becomes relevant, as it is difficult to find, in the state of São Paulo, municipal indicators that deliberately combine the three economic aspects of agriculture, industry, and services within the same method.

Barueri was the only city of the region to present “high” technical efficiency (between 0.800 and 0.899). This city reached the best results in all the years researched, for structure and results efficiency and health technical efficiency. The city of Santana de Parnaíba ranked in second place also in the three assessments, but did not reach the level of “high” technical efficiency. The city of Barueri, followed by Santana de Parnaíba, presents the highest per capita income of the region and, similar to another study²⁷, it shows that cities with higher income available and higher per capita expenditures reach the best results for health indicators, therefore, better HTEI.

The small number of efficient cities was also observed in other studies^{9,11,12,25-28}, which found few or no efficient cities. In the assessment of structure efficiency, Barueri obtained the maximum assessment of “very high” efficiency in all years assessed. In this assessment, Santana de Parnaíba ranked in second place in the re-

gion, but obtained only “medium” efficiency in the year 2012; in the remaining years and in the mean of all four years, it reached “low” efficiency.

In the assessment of results efficiency, Barueri presented “medium” efficiency, which shows that although it has an optimal health structure, the results do not correspond to it, indicating the need for improving management in order to improve results. In the regional mean, Santana de Parnaíba presented a “low” structure assessment - mean results, indicating good structure management.

The results of the research for the city of Itapevi stand out, because even though it is a small city, it presented better results than some of its neighbors. On the other hand, the city of Osasco, which presents a good structure relative to the other cities of the region, could not obtain good indicator results in the period assessed. It is also worth noting the results of the smallest city by population and collection ability of the region - Pirapora do Bom Jesus -, which presented good indicator results and, although it did not reach “high” technical efficiency, it was ahead of other rather larger cities. This situation is different from the results identified in another study²⁷, in which small cities with fewer resources available were overall more inefficient.

It was evident in our study that small cities can reach good results and show structure management efficiency. On the other hand, larg-

er cities may fail in the health indicator results (indicators that measure exactly what the cities should do) and show structure management inefficiency. This situation was also observed in other studies^{12,25,26}, which concluded that cities with greater resource allocation did not present a better performance regarding some health indicators and that the increase in health expenditures does not necessarily mean better indicator results and, consequently, better efficiency.

Conclusion

It could be concluded that the resource represented an essential condition for efficiency, however it was not sufficient. The results obtained in the technical efficiency assessment of the cities selected are expected to help SUS managers in the three government branches to reflect on the need to adopt mechanisms that change the standard of technical efficiency of these local health systems, promoting support to achieve the category of “high” technical efficiency.

Thus, it is suggested the need for public policies toward reducing inequities among Brazilian cities, as well as the support for the other federal entities as to offer technologies to improve the municipal management in order to make a better use of the resources available.

Collaborations

JA Santos-Neto: contributed to the survey and data analysis, AN Mendes: contributed to the study design and final writing, AC Pereira: contributed to the final writing and LR Paranhos: contributed to the organization of the collected data and the final writing.

References

1. Mendes A. A longa batalha pelo financiamento do SUS. *Saude Soc* 2013; 22(4):987-993.
2. Mendes A, Marques RM. O financiamento do SUS sob os "ventos" da financeirização. *Cien Saude Colet* 2009; 14(3):841-850.
3. Mendes A, Leite MG, Marques RM. Discutindo uma Metodologia para a Alocação Equitativa de Recursos Federais para o Sistema Único de Saúde. *Saude Soc* 2011; 20(3):673-690.
4. Espirito Santo ACG, Fernando VCN, Bezerra AFB. Despesa pública municipal com saúde em Pernambuco, Brasil, de 2000 a 2007. *Cien Saude Colet* 2012; 17(4):861-871.
5. Marques RM, Mendes A. A problemática do financiamento da saúde pública brasileira: de 1985 a 2008. *Econ Soc* 2012; 21(45):345-362.
6. Mendes EV. 25 anos do Sistema Único de Saúde: resultados e desafios. *Estud Av* 2013; 27(78):27-34.
7. Smith PC, Street A. Measuring the efficiency of public services: the limits of analysis. *J R Statist Soc A* 2005; 168(2):401-417.
8. Greiling D. Performance measurement: a remedy for increasing the efficiency of public services. *Int J Product Performance Manag* 2006; 55(6):448-465.
9. Marinho A. Avaliação da eficiência técnica nos serviços de saúde nos municípios do estado do Rio de Janeiro. *Rev Bras Econ* 2003; 57(3):515-534.
10. Organização Mundial da Saúde (OMS). *Relatório mundial da saúde: Financiamento dos sistemas de saúde. O caminho para a cobertura universal* [Internet]. Genebra: OMS; 2010 [acessado 2015 Nov 25]. Disponível em: <http://www.who.int/eportuguese/publications/pt/>
11. Politelo L, Scarpin JE, Hein N. Eficiência do atendimento do SUS nas microrregiões do estado de Santa Catarina. *Rev Admin Hosp* 2013; 10(1):19-35.
12. Mendes A. *Financiamento, gasto e gestão do Sistema Único de Saúde: a gestão descentralizada semiplena e plena do sistema municipal no Estado de São Paulo (1995- 2001)* [tese]. Campinas: Universidade Estadual de Campinas; 2005.
13. Rede Regional de Atenção à Saúde 05 (RRAS 05). *Mapa da Saúde da Região da Rota dos Bandeirantes*. São Paulo: Secretaria de Estado da Saúde; 2014.
14. Santos-Neto JA, Mendes AN, Pereira AC, Paranhos LR. Análise do financiamento e gasto do Sistema Único de Saúde dos municípios da região de saúde Rota dos Bandeirantes do estado de São Paulo, Brasil. *Cien Saude Colet* 2017; 22(4):1269-1280.
15. Sistema de Informações sobre Orçamentos Públicos em Saúde (SIOPS). Ministério da Saúde (MS). Departamento de Economia da Saúde, Investimentos e Desenvolvimento. *Dotação atualizada*. [acessado 2015 Nov 20]. Disponível em: http://siops-asp.datasus.gov.br/cgi/siops/siops_indic/municipio/anual/prv_index.htm

16. Departamento de Informática do SUS (DATASUS). Ministério da Saúde. Coordenação-Geral de Disseminação de Informações em Saúde. Brasília 2015. [acessado 2015 Nov 20]. Disponível em: <http://www2.datasus.gov.br/DATASUS/index.php?area=0201>
17. Brasil. Ministério da Saúde (MS). Secretaria de Gestão Estratégica e Participativa. Departamento de Articulação Interfederativa. *Caderno de diretrizes, objetivos, metas e indicadores 2013-2015*. 3ª ed. Brasília: MS; 2015. (Série Articulação Interfederativa, v. 1).
18. Duarte LS. Região Metropolitana de Campinas: uma análise metodológica do PIB dos Municípios. In: *Anais do II Encontro Nacional de Produtores e Usuários de Informações Sociais, Econômicas e Territoriais*; IBGE 2006; Rio de Janeiro. p.1-15.
19. Parchman ML, Culler S. Primary care physicians and avoidable hospitalizations. *J Fam Pract* 1994; 39(2):123-128.
20. Ricketts TC, Randolph R, Howard HA, Pathman D, Carey T. Hospitalization rates as indicators of access to primary care. *Health & Place* 2001; 7(1):27-38.
21. Steiner JF. Hospitalizations for ambulatory care sensitive conditions: where do we go from here? *Ambul Pediatr* 2007; 7(3):263-264.
22. Nedel FB, Facchini LA, Martín M, Navarro A. Características da atenção básica associadas ao risco de internar por condições sensíveis à atenção primária: revisão sistemática da literatura. *Epidemiol Serv Saúde* 2010; 19(1):61-75.
23. Brasil. Ministério da Saúde (MS). Portaria nº 399, de 22 de fevereiro de 2006. Divulga o Pacto pela Saúde 2006 – Consolidação do SUS e aprova as Diretrizes Operacionais do Referido Pacto. *Diário Oficial da União* 2006; 22 fev.
24. Mazon LM. *Reflexos da aplicação dos recursos financeiros públicos em saúde no desenvolvimento regional* [dissertação]. Canoinhas: Universidade do Contestado; 2012 [acessado 2015 Nov 20]. Disponível em: http://www.unc.br/mestrado/editais/DISSERTA-CAO_LUCIANA_MARIA_MAZON.pdf
25. Mazon LM, Mascarenhas LPG, Dallabrida VR. Eficiência dos gastos públicos em saúde: desafio para municípios de Santa Catarina, Brasil. *Saude Soc* 2015; 24(1):23-33.
26. Portulhak H, Raffaelli, SCD, Scarpin JE. *A Eficiência das Aplicações de Recursos Voltadas à Saúde Pública nos Municípios Brasileiros: Uma Análise Baseada no Índice de Desenvolvimento do Sistema Único de Saúde (ID-SUS)* [Internet]. XXXVII Encontro da Associação Nacional de Pesquisa em Administração (ANPAD), Rio de Janeiro, 2013 [acessado 2015 Dez 27]. Disponível em: http://www.anpad.org.br/admin/pdf/2013_En-ANPAD_APB2223.pdf
27. Queiroz MFM, Silva JLM, Figueiredo JS, Vale FFR. Eficiência no Gasto Público com Saúde: uma análise nos municípios do Rio Grande do Norte. *Rev Econ NE* 2013; 44(3):761-776.
28. Ferreira MP, Pitta MT. Avaliação da eficiência técnica na utilização dos recursos do sistema único de saúde na produção ambulatorial. *Sao Paulo Persp* 2008; 22(2):55-71.
29. Ferreira FML, Mendes CM, Oliveira VM. Análise da Eficiência técnica do Sistema Único de Saúde (SUS) nos Municípios de Mato Grosso, nos anos de 2008 a 2010. Eixo: Financiamento dos Sistemas de Saúde. *Anais Congresso da Associação Brasileira de Economia da Saúde (ABRES): VI Jornada* [Internet]. Brasília; 2012. [acessado 2015 Dez 27]. Disponível em: http://abresbrasil.org.br/sites/default/files/trabalho_05.pdf.
30. Cetin VR, Bahce S. Measuring the efficiency of health systems of OECD countries by data envelopment analysis. *J Applied Economics* 2016; 48(37):3497-3507.
31. Allin S, Grignon M, Wang L. The determinants of efficiency in the Canadian health care system. *Health Econ Policy Law* 2016; 11(1):39-65.
32. Marinho A. Avaliação da eficiência técnica nos serviços de saúde nos municípios do Estado do Rio de Janeiro. *Rev Bras Econ* 2003; 57(3):515-534.
33. Faria PF, Jannuzzi PM, Silva SJ. Eficiência dos gastos municipais em saúde e educação: uma investigação através da análise envoltória no estado do Rio de Janeiro. *Rev Adm Pública* 2008; 42(1):155-177.
34. Comissão Econômica para América Latina e Caribe (Cepal). *Equidad, desarrollo y ciudadanía*. Santiago de Chile: Publicación de las Naciones Unidas; 2000.
35. Cominetti R. *Descentralización de la atención de la salud en América Latina: un análisis comparativo*. Santiago de Chile: Cepal; 1997.
36. Draibe S. *Avaliação da descentralização das políticas sociais no Brasil: saúde e educação fundamental*. Santiago do Chile: Cepal; 1997. [Informe Final do Projeto Estudios de Descentralización de Servicios Sociales, División de Desarrollo Económico].

Article submitted 09/05/2017

Approved 05/03/2018

Final version submitted 07/03/2018

