Systems & Management 12 (2017), pp 410-421

TECHNICAL EFFICIENCY AND INNOVATIVENESS: A STUDY CARRIED OUT IN BRAZILIAN PRIVATE HOSPITALS

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ABSTRACT

Hospitals have sought to improve their performance and innovativeness has been highlighted as an ally in this mission. The objective of the research was to verify whether the perception of innovation of hospital managers is related to the performance of their organizations. Innovativeness was defined as a measure of the company's ability to innovate and was operationalized through variables related to organizational innovation and the firm's perceived innovation. Performance was defined by the hospital's efficiency in using the resources available to provide services. The results of a survey conducted with managers of 20 private hospitals belonging to the largest health insurance plan operator in Brazil, showed that perceived innovation has an inverse relation with operational efficiency: the greater the capacity or propensity of the company to innovate, both perceived by the internal culture of the organization and by its way of acting in the market, the lower the operational efficiency of the hospital.

Keywords: Innovativeness; Technical efficiency; Private Hospitals; Data Envelopment Analysis; DEA.

PROPPI / LATEC
DOI: 10.20985/1980-5160.2017.v12n4.978

Electronic Journal of Management & System
Volume 12, Number 4, 2017, pp. 410-421
DOI: 10.20985/1980-5160.2017.v12n4.978

1. INTRODUCTION

Hospitals have faced increasing pressure to reduce costs and increase efficiency, and innovation or innovativeness has been highlighted as one of the main drivers of organizational performance, representing an important form of competitive differentiation in the market (Tajeddini *et al*., 2006; Rhee *et al*., 2010). However, the study of innovation in hospital projects is still incipient, and research has focused mainly on the study of health innovation systems (Barzotto, 2008, Albuquerque *et* Cassiolato, 2002) and on the specificities of innovations in hospital services (Vargas, 2006; Isidro-Filho, 2010).

In view of the above, this research aimed to verify whether the perception of innovativeness of managers of private hospitals is related to the operational technical efficiency of health organizations.

This study regards innovation as a measure of the company's ability or propensity to innovate, both perceived by the organization's internal culture and its way of acting in the market. Organizational performance, in turn, is understood as a measure of the efficiency with which the hospital uses the resources it has to provide hospital services compared to other hospitals.

2. THEORETICAL-EMPIRICAL BASIS

2.1 Organizational Performance

The evaluation of organizational performance has received increasing attention from researchers in the last decades (Carneiro da Cunha, 2011), but there is no consensus on how to operate it, since, although the literature on the subject makes numerous performance measures available, none, is considered to be capable of covering all relevant aspects of organizational performance alone (Rogers *et al*., 1998; Combs *et al*., 2005). For Slack *et al*. (1997), the complexity with which companies present themselves in the market makes it impossible to reduce the performance of the business to a single indicator, thus requiring the combination of several indicators to broaden the analysis of business performance.

The first performance studies in the 1950s sought to identify measures that would represent activities within the organizational context (Martindel, 1950; Ridgway, 1956). This idea was reproduced by Drucker (1954) in developing what became known as Management by Objectives. Drucker's studies were complemented by Koontz *et* O'Donnell (1974), but the late 1970s was marked by criticisms of the measurement models of activities strictly internal to the organization.

The focus of research on performance measurement was then directed to financial indicators (Carneiro da Cunha, 2011). However, the researchers' strong acceptance and use of financial measures in performance appraisal did not prevent them from being criticized as well, because such models left out indicators of consumer satisfaction, employee satisfaction, quality and innovation, considered of great importance for the performance of the business (Ittner *et* Larcker, 1998). In health organizations, this discussion has attracted special interest from managers (Neely, 2005), especially in private enterprises, where factors such as pressure from health insurance plans force managers to promote innovations that can reduce costs and increase efficiency, without reducing the quality of the service provided (Souza *et al*., 2009).

2.2 Hospital operating performance

Performance measurement can be done using techniques for quantifying the efficiency and effectiveness of business activities (Neely, 2005), and the operational performance, or non-financial performance, comprises all the measures and indicators established for the evaluation of the operations of the business organization (Perera *et al*., 1997). However, the specificities of hospital organizations make it impossible not only to evaluate them through a single perspective, but also to use traditional performance indicators (Pink *et al*., 2001).

Marinho *et* Façanha (2000) affirm that a model of representation of hospital organizations should consider indicators of two categories of variables: input variables; and output type. The input type is subdivided into seven groups of variables: (a) labor inputs, which refer to the variables of the work performed by the hospital labor force (for example, labor force quantities); (b) capital inputs, indicative of the structural resources that impact on the operational capacity of the hospital, such as physical area and number of beds; (c) financial inputs, referring to general expenses for costing and maintenance, such as medicines, food and consumables (excluding those related to capital and labor); (d) general service inputs or support services such as cleaning, laundry and security; (e) specific service inputs, alluding to diagnosis and therapy, such as laboratory tests, radiographs and physiotherapies; (f) patient-related inputs, which describe general characteristics of entry to care, age, sex, clinical status, number of visits, hospitalizations, surgeries, etc.; and (g) environmental inputs or factors, which characterize the general operating environment of the hospital organization, such as the nature of the hospital property, the geographic region of operation, and the characteristics of the population served.

The variables of the output type are subdivided into three other groups: (a) outputs related to the treatment, which

Electronic Journal of Management & System
Volume 12, Number 4, 2017, pp. 410-421
DOI: 10.20985/1980-5160.2017.v12n4.978

describe the care given to the patients or the hospital intervention performed, such as surgeries, outpatient and emergency care, number and term of hospitalization; (b) quality of service outputs, which comprises the actions, structures and conditions related to the general quality of the services provided, such as attitudes towards complaints, liberality in relation to visits, morbidity, mortality and frequency of work accidents; and (c) social outputs, which relate to the social externalities of the services offered by the hospital, such as care in remote areas and care for the needy.

Comparing public and private hospitals, studies conducted by Hollingsworth (2003; 2008) indicate that public hospitals perform better than private ones, whether or not for profit. Likewise, studies conducted in the United States and Germany suggest that private hospitals are less efficient than public hospitals, which is due to the fact that public institutions face resource constraints and, therefore, seek the maximum efficiency of their use (Tiemann *et* Schreyögg, 2012).

Studies that analyze the efficiency of hospitals in Brazil, using the mathematical model Data Envelopment Analysis (DEA), have frequently used in a combined manner operational and financial indicators and have analyzed mainly hospitals providing services to the Brazilian *Sistema Único de Saúde* (SUS - Unified Health System), both public and private (Proite *et* Sousa, 2004; Varela et Martins, 2011, Guerra *et al*., 2012), and university hospitals (Frainer, 2004; Lins *et al*., 2007; Ozcan *et al*., 2010). When analyzing 1,170 Brazilian hospitals, of which 852 are private and 319 public, Proite *et* Souza (2004) concluded that public institutions tend to be more efficient than private ones, since they would be more focused on improving the quality of services provided, investing more resources than the public. Chart 1 lists the types of non-financial variables most used in hospital surveys, as well as the national and international researchers that used them.

2.3 Innovativeness

Although some researchers question (Cho *et* Pucik, 2005) and others believe that there is still no consensus (Tajeddini *et al*., 2006), innovation has been highlighted as one of the main factors influencing organizational performance (Hurley *et* Hult, 1998; Porter, 1990; Rhee *et al*., 2010). For Simon (2008), since the work of Schumpeter (1934) and Freeman *et* Perez (1988) there is solid evidence of the relationship between the company's innovativeness and its organizational performance.

In the hospital segment, research has shown that innovations influence the performance of adopters and many hospitals have concentrated efforts to develop innovations and invested more resources in improving their innovative performance (Su et al., 2009; Weng *et al*., 2011). Part of the innovation research efforts in hospitals has been based on broad approaches to its analysis, such as in studies on health and hospital innovation systems (Albuquerque *et* Cassiolato, 2002; Barzotto, 2008) and on the specificities of innovations in hospital services (Barbosa, 2009; Isidro-Filho, 2010).

According to the Oslo Manual (OECD, 2005), the fact that a company has produced an innovation is sufficient enough to give it the name of innovative, that is to say, possessing innovation. For Hansen *et al*. (2007), innovation is a feature or characteristic of organizations, and among the most widely held concepts is what defines innovative organizations as those that adopt innovations. According to these authors, recent work has added to the concepts of innovation, besides the creation and use of innovations, strategic, cultural, social and managerial aspects.

In this research, we chose to use a broad concept of company innovation, as suggested by Andressi *et* Sbragia (2004). According to these researchers, innovativeness is not only a form of innovation, but a state of constant introduction of

Chart 1. Operational variables used in national and international surveys

Type of Variable	Application in national and international surveys
Hospital beds	Frainer (2004); Lins et al. (2007); Wolff (2005); Cesconetto et al. (2008); Valdmanis (1992); Magnussen (1996); Maniadakis et Thanassoulis (2000).
Hospital Medical Team	Marinho et Façanha (2000); Proite et Sousa (2004); Frainer (2004); Wolff (2005); Valdmanis (1992); Magnussen (1996).
Nursing team (nurses and technicians)	Wolff (2005); Cesconetto et al. (2008); Banker et al. (1986); Valdmanis (1992); Burgess et Wilson (1998); Maniadakis et Thanassoulis (2000).
Surgical Centers	Marinho et Façanha (2000); Lins et al. (2007).
Hospitalizations	Marinho et Façanha (2000); Lins et al (2007); Grosskopf et Valdmanis (1987); Maniadakis et Thanassoulis (2000).
Emergency care	Silva (2009); Grosskopf et Valdmanis (1987); Valdmanis (1992); Maniadakis et Thanassoulis (2000).
Surgical interventions	Marinho et Façanha (2000); Proite et Sousa (2004); Lins et al. (2007); Ozcan et al. (2010); Grosskopf et Valdmanis (1987); Burgess et Wilson (1998).

Source: The authors.

Electronic Journal of Management & System
Volume 12, Number 4, 2017, pp. 410-421
DOI: 10.20985/1980-5160.2017.v12n4.978

innovations, either internally or externally. Innovativeness will then be defined, for purposes of this research, as a measure of ability or willingness of the company to innovate, both perceived by the internal culture of the organization and for his way of acting in the market.

The innovativeness of the company, measured according to managers' perception, has focused on the evaluation of the internal culture of the organization. Organizational culture, in turn, has been treated as a driver for innovations in the company and, from its analysis, is believed to capture the spirit of innovation of the enterprise (Auh *et* Menguc, 2005). Innovativeness is related to an organization's internal culture, which encourages and enables the emergence of new ideas and new processes, and its evaluation, according to managers' perceptions, has been operationalized through the scale developed by Hurley *et* Hult (1998). This measure, called organizational innovativeness (OI), was later adapted and revalidated by Tajeddini *et al.* (2006) and Tajeddini *et* Mueller (2012) throughout several studies.

Researchers have long emphasized the importance of developing a measure of company innovation from a consumer perspective (Danneel *et* Kleinschmidt, 2001). In this context, there should be an emphasis on the research carried out by Walsh *et* Beatty (2007) and Kunz *et al*. (2010). Walsh *et* Beatty's (2007) surveys are more related to a corporate reputation assessment, which takes into account opinions about the company or people in particular interest groups. The work of Walsh *et* Beatty (2007) approximates that proposed by Danneel *et* Kleinschmidt (2001) for assigning to consumers the centrality in the process of evaluating organizations, but distancing themselves by choosing to evaluate corporate reputation.

Kunz *et al*. (2010) developed a measure of entrepreneurial innovativeness resulting from consumer perception, which had been termed the firm's perceived innovation (PFI-Perceived Firm Innovativeness). This measure evaluates the perception of consumers regarding a series of innovative activities of the company, which broadly attribute a measure of innovation to the organization. The basis for consumers to attribute such measure of innovation is the information, knowledge and experience they have in relation to the organization being analyzed, and the central elements analyzed are novelty, creativity and their impact on the market.

The complementarity of the PFI and OI constructs for a broad assessment of the innovativeness of companies, as proposed in this study, is based on the fact that the PFI is focused on the perception of the consumers and not on the perception of the managers. However, some important considerations need to be made as to how hospitals provide services to consumers. For Slack *et al*. (1997), the transformation performed by hospitals can be better understood as providing a pure service, the health service. This is due to the fact that the product generated has characteristics of intangibility, simultaneity between the production and its consumption and a high contact of the consumer with the productive operations. These characteristics insert the consumer into the production environment of the service and enable him to develop a vision in terms of how innovative the hospital organization is based on the information, knowledge and experiences that the hospital itself makes available during the service. In this way, consumer's perception of the hospital's innovative capacity, developed during the service delivery and the way the health establishment operates in the market, is not completely different from the manager's perception of the hospital enterprise.

According to Sousa *et al*. (2011), many of the requirements for the evaluation of hospital services by consumers are consistent with the efforts expended by hospital administration. This fact makes the PFI construct, originally conceived for the evaluation of the perception of the consumers, a tool apt to evaluate the perception of innovativeness of the hospital enterprise through the perception of its managers, preserving the due adaptations.

In this research, therefore, two constructs of innovativeness will be used to evaluate a broad perception of managers regarding hospital innovativeness: OI, developed by Hurley et Hult (1998) and later adapted by Tajeddini *et al*. (2006); and PFI, developed by Kunz *et al*. (2010).

The necessary adaptations to the application of the constructs, as proposed in the research, are presented below.

3. METHODOLOGICAL ASPECTS

The general objective of this research is to answer the following question: *does the innovativeness of a private hospital project reflect in its operational performance?* To elucidate the issue, it has been broken down into three other more delimited issues: (1) what is the operational technical efficiency of private hospitals? (2) What is the perception of the innovativeness of managers of private hospitals? and (3) Does the managers' perception of innovativeness relate to the comparative technical operational efficiency of the hospitals analyzed?

To reach the proposed objectives, the research was structured in two phases: in the exploratory phase, reports were published by the Ministries of Planning and Health, in order to understand the evolution and the current panorama of the hospital sector in Brazil; in the second phase, sample data were collected with the objective of measuring the operational efficiency of hospitals by converting their inputs into health services, verifying the perception of managers'

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innovativeness, and analyzing whether the perceived innovativeness of managers is related to operational technical efficiency of the hospital.

The data were collected through a questionnaire sent by e-mail to hospital managers, whose position was occupied by management or sector management. *Performance*-related variables, such as number of employees, physicians, beds, etc., were filled directly by the managers; affirmations about the hospital were formulated for the variables of *innovativeness*. These variables were evaluated using a 5-point Likert scale, ranging from totally disagree (1) to fully agree (5). The questionnaires comprise the activities developed by the hospitals in the year 2011. Initially, twenty Brazilian private hospitals, belonging to AMIL, the largest health plan operator in Brazil, were selected to participate in the survey, with a market share of 10.1% in terms of number of beneficiaries, 6.3 million insured lives and a net income of US$ 5.2 billion. However, when checking the data returned by hospital managers, three of them were eliminated from the sample due to inconsistent data. Thus, the final sample consisted of 17 AMIL hospitals: nine located in São Paulo; seven in Rio de Janeiro; and one in Paraná. The names of the hospitals will be kept confidential and, in this research, they are denominated based on their location (SP, RJ, PR).

3.1 Operationalization of variables

Performance: as the main objective of private hospitals is to maximize outputs, using existing resources (inputs), the output-oriented model is appropriate for this type of analysis and is in line with previous studies (Chang *et al.*, 2004; Mogha; *et al.* 2012). Thus, operational performance was calculated through a comparative analysis of the technical efficiency with which hospitals use their resources to provide hospital services.

This research aimed to develop three models of hospital technical efficiency analyzes: *Emergencies*, *Hospitalizations* and *General Model*. The creation of the Emergency and Hospitalization models was motivated by results presented by Weng *et al*. (2011), considering that the focus of hospital technical efficiency has often fallen to the "product" hospital admissions (Wolff, 2005; Cesconetto *et al*., 2008). The General Model was defined with the purpose of constructing a hospital efficiency evaluation in a broader way. In addition to analyzing, in a joint way, the technical efficiencies of the hospitals in providing emergency and hospitalization services, this analysis included variables related to the medical surgery product. The variables proposed for the three models are presented in Chart 2. In addition, the following moderating variables were considered: the size of the hospital (small - up to 50 beds; medium - between 51 and 150 beds; and large - more than 150 beds), the location (capital or countryside) and the nature of the service provided (general or specialized).

The variables were submitted, in each of the models, to the Pearson correlation analysis. As used by Guerra *et al*. (2012), correlation indices between variables above 0.7 were considered high and led to a deeper analysis of the meaning of the relationship between them: whether causality or redundancy. After considering and identifying the variables that would compose the models, the data were processed through Data Envelopment Analysis (DEA). The method used to analyze the variables is the DEA Constant Returns to Scale (DEA CCR), oriented to the outputs. The DEA mathematical model evaluates the efficiency of decision-making units (DMU) by maximizing the weighted input--output ratio. In the DEA CCR analysis, the efficiency of each DMU is calculated in relation to the other members of the group (Marinho *et* Façanha, 2000). The efficiency measure associated with each one is the result of the weighting that allows its maximization, observing the constraints (Carneiro da Cunha, 2011). The main result generated by this mathematical modeling is the technical efficiency indexes of the DMU. Through them it is possible to generate the ranking of efficiency of the hospitals. The DEA analyzes were carried out with the aid of the R statistical software, through the Benchmarking package, and the other analyzes by the software Excel 2007 and PASW Statistics 18.

Innovativeness: The innovativeness of the company was divided into (a) General innovation (GI), measure of the capacity or propensity to innovate, both perceived by the internal culture of the organization and by its way of acting in the market; (b) OI, internal company culture that encourages and enables the emergence of new ideas, new products and new processes; and (c) PFI, perception of how enduring is the capacity of the company that results in new creative and impactful ideas and solutions for the market. Tables 3 and 4 present the operationalization of variables OI and PFI. The variable GI is the combination of the two. The analysis of Pearson correlations was performed and the correlations above 0.7 were considered undesirable.

4. RESULTS

Most of the sample hospitals (71%) are located in the capitals of the three states. They are, mainly, medium-sized units (47%), and only two are small. The majority (88%) are general non-specialist hospitals. Of the 17 managers interviewed, 59% hold a Board position and 35% hold a Hospital Administration position; 53% are male. The majority (53%) are between 40 and 50 years old; 47% have been working in the hospital for less than two years and 16% have been working in the hospital for more than 6 years.

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Chart 2. Model Variables

Model	Variable Type	Variables	Variable
Emergency	Inputs	Number of emergency beds	I2
		Number of doctors in the emergency room	I4
		Number of nursing professionals in the emergency room	I7
	Output	Total number of emergency services provided	O2
Hospitalizations	Inputs	Total number of beds	I2
		Number of in-hospital physicians (routine and on-call)	I3
		Total number of nursing professionals	I6
	Output	Total number of inpatients	O1
General Model	Inputs	Total number of beds	I1
		Number of in-hospital physicians (routine and on-call)	I3
		Total number of nursing professionals	I6
		Number of surgery rooms	I8
	Outputs	Total number of inpatients	O1
		Total number of emergency services provided	O2
		Total number of surgeries performed	O3

Source: The authors.

4.1 Performance

Emergency Model: there was a high correlation between the *number of physicians* and the *number of nursing professionals assigned to the emergency room* (Pearson's coefficient = 0.703). The existence of a correlation between human resources variables in healthcare enterprises has been a frequent observation (Proite *et* Souza, 2004; Frainer, 2004; Cesconetto *et al*., 2008). Such as Cesconetto *et al*. (2008), variables I5 and I8 were incorporated in a new variable as the sum of the two, called *human resources assigned to emergency* (I10). Given the *number of emergency beds* and *human resources assigned to the emergency*, the hospitals that obtained the best results in the *total number of emergency care*, and consequently became reference (efficiency of 100%) for the calculations of the other efficiency indexes, were SP3 and PR1. The average hospital efficiency index in the Emergency sector was 31.7% (SD = 34.2). Compared to the hospitals defined as best practices, the hospital that extracted the lowest results was RJ5 (1.82%): the number of emergency room visits performed by this hospital was 8,188, compared to 447,100 that it should have performed (Graph

Chart 3, Organizational innovation variables

Q1	Our hospital is dynamic
Q9	The directors of our hospital are actively seeking innovative ideas
Q10	Innovations are readily accepted by the directors of our hospital
Q11	Our hospital often adopts organizational / administrative innovations
Q12	Innovation is stimulated and encouraged in our hospital

Source: The authors.

Chart 4. innovativeness variables perceived in the firm

Q1	Our hospital is dynamic.
Q2	Our hospital frequently releases new medical services in the market
Q3	Our hospital is a pioneer in its segment
Q4	Our hospital often adopts new technologies
Q5	Our hospital is advanced and forward-looking
Q6	Our hospital often adopts new medical treatments
Q7	Our hospital has changed the market with its services offerings
Q8	Our hospital often adopts experimental medical treatments

Source: The authors.

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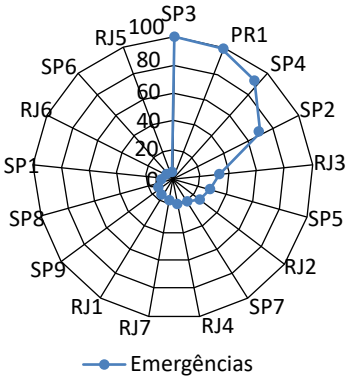
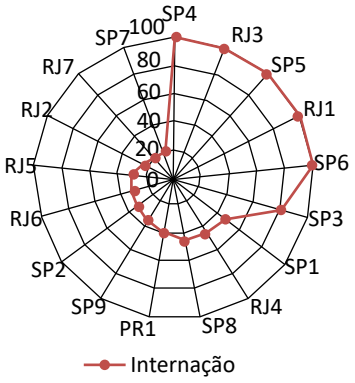
1) . The stratification of the hospital technical efficiency indexes of the *Emergencies* model by size, location and type of service provided indicated that private hospitals of medium size have the best average technical efficiency index (47%), followed by large hospitals. Despite the small number of hospitals in the sample, the low technical efficiency index of small hospitals, 2.52%, is noteworthy. The *general hospital* combination of *medium size* contributed to increase the technical efficiency (72%).



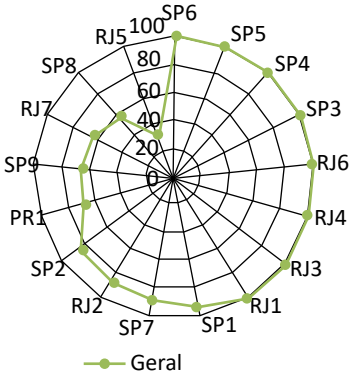
Graph 1. Results of the Operational Efficiency Model called Emergencies
Source: The authors.

Hospitalizations model: the variables *total number of hospital nurses* and *total number of nursing professionals* presented a correlation coefficient of 0.794 and are incorporated by means of their sum to a proxy called *nursing team*, as well as in the previous model. Given the *total number of beds*, *number of internal physicians* of the hospital (routine and on-call) and *nursing staff*, the hospitals that extracted the best results from the *total number of hospitalized patients* were: RJ1, RJ3, SP4, SP5 and SP6. In relation to the hospitals considered as the best practices of hospitalizations, the one that obtained the lowest index in terms of technical efficiency, given the resources at its disposal, was the SP7, with 17.27%. The average rate of hospital efficiency in the *hospitalization* sector was, approximately, 52.4% (Graph 2). The stratification of hospital technical efficiency indices of the *hospitalization* model by size, location and type of service indicated that *large* hospitals have the best average technical efficiency (59%), followed by *medium-sized* hospitals (58%). *Large general hospitals* have the highest average efficiency rate (62%) and *large general hospitals located in the capitals* had an even higher average rate (70%) in the provision of hospitalization services.



Graph 2. Results of the Operational Efficiency Model called Hospitalizations
Source: The authors.

General Model: as well as in the *hospitalizations* model, variables *total number of hospital nurses* and *total number of nursing professionals* were incorporated into the *nursing team* proxy (I11). The variable *total number of beds* had a high correlation index with the variable *number of operating rooms* (0.838); the variable *number of operating rooms* was also highly correlated with the variables *total number of nurses* (0.790) and *total number of surgeries performed*. However, when analyzing the possible relationship between them, it was concluded that there is no redundancy that requires its treatment or elimination. All these variables were maintained in the model. Hospitals that, in view of the available resources (*total number of beds*, *of internal doctors of the hospital*, *of operating rooms* and *nursing staff*), in 2011 obtained the best results (*total inpatients*, *total emergency care* and *total surgeries performed*) were: SP6, SP5, SP4, SP3, RJ6, RJ4, RJ3, RJ1. Compared to these, the hospital that obtained the lowest technical efficiency index, given its resources, was RJ5, with 32.55% (Graph 3).



Graph 3. Results of the Operational Efficiency Model called Emergencies
Source: The authors.

Table 1 presents the generated results, those projected at the technical efficiency frontier and the difference between

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projected and generated for each output used in the research. In analyzing specifically the inefficient hospitals, they had an average technical efficiency of approximately 72%. Given the projections that would allow them to reach the efficiency frontier, it was observed that they provided approximately 70.19% of projected hospitalizations, 73.74% of emergencies and 73.08% of surgeries. The hospital with the lowest technical efficiency index would require an increase of 8,016 hospitalizations, 16,819 emergency care and 3,244 surgeries to project these units to the efficiency frontier. The hospitals that obtained the best general technical efficiency were those of medium size (77%), followed by the large ones (68%). Among the seven hospitals that have achieved maximum efficiency rates, only two are not in a capital. The maximum efficiency hospitals are 86% general hospitals and 57% midsize hospitals.

4.2 Innovativeness

The measures of the three variables of innovation (GI, OI and PFI) were obtained by the sum of the indicators that compose them. Thus, the variables can assume the following values: IG, with 12 indicators, ranges from zero to 60; OI, with five indicators, ranges from zero to 25 and PFI, with eight indicators, ranges from zero to 40.

GI: the hospitals that obtained the highest *GI* perception were RJ5 and PR1, with 57 points each. The smallest measure in terms of innovativeness was SP1 hospital (31 points). The affirmation "our hospital is dynamic" obtained the highest average (agreement) among the managers (4.65); on the other hand, the greatest disagreement was attributed to the statement "our hospital frequently adopts new medical treatments" (mean 2.24).

OI: four hospitals had the highest *OI* perceptions: RJ5, PR1, SP9 and SP2 (25 points). The lowest perception occurred in the hospital SP1 (15 points). Among all variables analyzed in this study, those related to *OI* were the ones that obtained the highest averages, indicating agreement by the managers. This result may have been influenced by the centrality of managers in the management of hospital innovation systems.

PFI: two hospitals share the most perceived post of PFI with 37 points: RJ5 and PR1. The lowest perception is of the hospital SP2, with 17 points. As in the GI model, the affirmation "our hospital is dynamic" obtained the highest average response among managers (4,58), indicating agreement; the lowest mean perception of innovativeness was attributed to the statement: "Our hospital often adopts experimental medical treatments" (2,24), indicating disagreement.

The *GI* measurement results from the combination of the *OI* and *PFI* variables. Thus, it was observed that some hospitals were among the highest OI perceptions, but the same was not observed for *PFI*, culminating in the reduction of *GI*. Graph 4 shows the OI, PFI and GI ranking of the hospitals surveyed.

Table 1. Efficiency ranking with results achieved and designed and differences

DMU	Total number of inpatients			Total number of emergency services provided			Total number of surgeries performed			Efficiency (%)
	R	P	D	R	P	D	R	P	D	
RJ1	23.400	23.400	-	9.000	9.000	-	10.800	10.800	-	100,00
SP3	11.600	11.600	-	254.600	254.600	-	7.341	7.341	-	100,00
RJ3	30.600	30.600	-	87.758	87.758	-	7.421	7.421	-	100,00
SP4	39.142	39.142	-	189.181	189.181	-	9.459	9.459	-	100,00
SP5	12.516	12.516	-	240.799	240.799	-	8.644	8.644	-	100,00
SP6	70.897	70.897	-	32.978	32.978	-	9.310	9.310	-	100,00
RJ4	9.411	9.411	-	110.326	110.326	-	7.425	7.425	-	100,00
RJ6	4.886	4.886	-	8.631	8.631	-	8.648	8.648	-	100,00
SP1	6.607	7.028	420	18.955	20.162	1.206	3.342	3.555	212	94,01
SP7	17.744	19.924	2180	101.489	113.958	12.469	19.108	21.456	2.347	89,06
RJ2	8.100	9.340	1.240	132.000	152.215	20.214	5.160	5.950	790	86,72
SP2	7.175	8.400	1.225	168.314	197.058	28.743	4.516	5.287	771	85,41
PR1	9.045	13.267	4.222	131.531	192.931	61.400	5.014	7.355	2.340	68,17
SP9	12.145	18.060	5.915	105.531	156.928	51.396	8.152	12.122	3.970	67,25
RJ7	11.134	16.976	5.841	121.955	185.944	63.989	7.922	12.079	4.156	65,59
SP8	10.855	18.609	7753	67.859	116.329	48.470	6.777	11.618	4.840	58,33
RJ5	3.869	11.885	8016	8.118	24.938	16.819	1.566	4.811	3.244	32,55

R = Realizado; P = Projetado; D = Diferença

Source: The authors.

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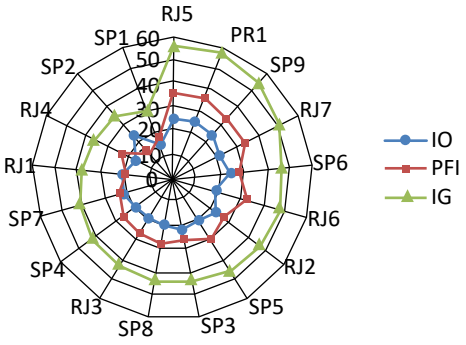

Gráfico 4. Ranking de inovatividade - IO, PFI e IG

Source: The authors.

4.3 Innovativeness vs. performance

The third questioning of the research, "*was the perception of innovation of managers of hospital projects related to the comparative operational efficiency of the enterprises analyzed?*", was investigated through a correlation analysis between the measures of innovativeness (*GI*, *OI*, and *PFI*) and performance models (*Emergencies*, *Hospitalizations* and *General Model*). In all, the relationship between innovation and operational performance was tested in nine different ways. The analysis of correlations between performance models and measures of innovativeness is presented in Table 2.

Table 2. Innovativeness x operational efficiency

Performance model		Innovativeness measures		
		IG	IO	PFI
Emergency (EOE)	Coefficient	0,037	0,239	-0,056
	Sig.	0,889	0,356	0,832
Hospitalizations (EOI)	Coefficient	-0,233	-0,209	-0,186
	Sig.	0,368	0,420	0,474
General Model (EOG)	Coefficient	-0,637**	-0,423	-0,570*
	Sig.	0,006	0,090	0,017

* Significant correlation at 5% ** Significant correlation at 1% (N=17)

Source: The authors.

The perceived innovation (*GI*, *OI*, and *PFI*) did not present a statistically significant correlation with the operational technical efficiency for the restricted operational performance models *Emergencies* (Operational Efficiency of Emergencies - OEE) and *hospitalizations* (Operational Efficiency of Hospitalizations - OEH). However, the *General Model* (General Operational Efficiency - GOE) showed a correlation with statistical significance with *GI* (-0.637) and *PFI* (-0.570), both negative. Thus, it can be concluded that: (a) the greater the capacity or propensity of the company to innovate, both perceived by the internal culture of the organization and by its way of operating in the market (*GI*), the lower the operational technical efficiency (*GOE*) of the hospital undertaking; and (b) the greater the innovative capacity of the hospital enterprise, resulting in new, creative and impacting ideas and solutions in the market (*PFI*), the lower the operational efficiency (*GOE*). The negative correlation between innovativeness and operational efficiency initially contradicts results of research that state that this relationship is positive (Porter, 1990; Hurley *et* Hult, 1998; Tajeddini *et al.,* 2006; Rhee *et al.,* 2010). However, the analysis of these results should highlight some of the specificities of innovation in the service sector, as well as the innovative dynamics of hospitals.

Unlike the technicist view of manufacturing innovation, coproduction and immateriality characteristics in service innovations should be emphasized (Isidro-Filho, 2010). The logic of innovation in Brazilian hospitals consists in the evolution of the hospital product, specifically in health, that is, in the adequacy of the hospital to the predominant convention on the hospital product (Vargas, 2006). The purpose of quality in health services is to improve and refine patient care, that is, to innovate the hospital product (Sousa *et al*., 2011). Although hospitals did not distance themselves from manufacturing in the search for better operational results, the capacity to innovate in health services was shown, in this research, not based on this logic. The perceived innovativeness, especially in the way it operates in the market and in the way the services are provided by the hospital, does not provide gains to the hospitals regarding the number of hospitalizations, emergency care and surgeries, given the resources available to them. However, if managers' perceptions reflect the integrality of hospital innovativeness, it is suggested that the gains of innovativeness are related more specifically to the increase in the quality of hospital services, in consonance with the results of previous research (Hollingsworth, 2003; 2008; Tiemann *et* Schreyögg, 2012), including those carried out in Brazil (Proite *et* Sousa, 2004).

When linking the determinants of quality in services with the provision of hospital services, it can be observed that investing in improving the quality of hospital services would not allow a direct improvement in operational performance. On the contrary, by requiring greater availability of resources to improve determinants, such as reliability and responsiveness, operational performance, as measured by the technical efficiency proposed in this research, would be seriously compromised, as attested by Proite *et* Sousa (2004), Hollingsworth (2003; 2008) and Tiemann *et* Schreyögg (2012). This research supports, therefore, that the greater the innovation in hospital projects, the greater the investments of the hospital in the determinants of the quality of its services, that is, the higher the quality of hospital services due to the greater availability of medical resources, nurses, nursing technicians, beds and operating rooms. Therefore, as a con-

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sequence of these investments, the operational efficiency is lower. In addition, since hospitals normally work with idle capacity due to the possibility of shocks to demand (Marinho *et* Façanha, 2000), it is suggested that more innovative hospitals provide more resources for a possible attendance of these events. Thus, because of improved quality levels in hospital services, by ensuring reliability and responsiveness to consumers, the result is a decrease in their comparative operational efficiency.

5. CONCLUSIONS

Three objectives guided this study: systematizing and comparing the operational efficiency of private hospitals, assessing the managers' perception of the innovations of these hospitals and verifying the relationship between the hospital's innovativeness and its operational performance. In analyzing the comparative operational efficiency of private hospitals, it was noted that inefficiencies in the emergency and/or hospitalization sector do not necessarily imply widespread operational inefficiency. In addition, it was observed that general and large hospitals have higher rates of operational efficiency. The hospital innovation can differ, in the same enterprise and, as mentioned by the same manager, according to the parameters of innovation defined.

In the private hospitals surveyed, there was a negative relationship between innovativeness (GI and PFI) and operational performance. These findings are aligned with the possibility of these enterprises focusing on improving the quality of their hospital services, even if this leads to the loss of operational efficiency, as already observed in previous studies.

Although this study presents limitations (number of hospitals analyzed and measurement of innovativeness under the perception of the manager only), it is believed that it is relevant when establishing correlations between the variables of innovation and operational performance, contributing to the academic discussion about the subject, which began with the studies of Hollingsworth (2003; 2008) and, in Brazil, with the research of Proite et Sousa (2004). As future research, it is necessary to emphasize the need for further study in the technical operational efficiency of private hospitals, the innovative capacity of these enterprises and the performance relationship with the innovation, not restricted to the operational sector.

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Received: April 08, 2015.

Approved: October 11, 2017.

DOI: 10.20985/1980-5160.2017.v12n4.978

How to cite: Saquetto, T.C.; Carneiro, T.C.J.; Araujo, C.A.S et al. (2017), "Technical efficiency and innovativeness: a study carried out in Brazilian private hospitals", Sistemas & Gestão, Vol. 12, No. 4, pp. 410-421, available from: http://www.revistasg.uff.br/index.php/sg/article/view/978 (access day abbreviated month. year).