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EFFECTS OF INNOVATION-ORIENTED VALUES IN THE PERFORMANCE OF INTEGRAL HEALTHCARE IN CHAGAS DISEASE

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Abstract

Evandro Chagas National Institute of Infectious Diseases (INI) has implemented Laboratories for Clinical Research Associated to Healthcare Assistance in Infectious Diseases, structures inspired on Innovative Organization of Mintzberg's theory. In order to improve clinical research according to Integral Healthcare Model, INI's Chagas Disease Clinical Research Laboratory has adopted this organizational innovation as an incentive mechanism based upon values of decentralization and entrepreneurial orientation. This case study uses, as methods to assess said innovation, surveying of micro costs, Activity Based Costing system, Spearman correlation test and DEA. Aggregates knowledge on the contribution of organizational values in multipurpose public health organizations and shows the effects of INI's restructuring on development of research, diversification of healthcare and promotion of cost-effectiveness and overall efficiency.

Introduction

According to literature on competitive advantages, organizations internalize entrepreneurial orientation in order to achieve goals efficiently, deal with competition, and adapt to change; their structure should be less centralized as well as involve more participation; and the structure of the public organization responsible for innovative solutions is decentralized.

At Oswaldo Cruz Foundation (Fiocruz), for instance, the Innovative Organization structure (Mintzberg, 1995) in 2006 and the Clinical Research Laboratory Associated with Healthcare substructure in 2007 were chosen for the restructuring of Evandro Chagas National Institute of Infectious Diseases (INI). It has aimed at improving its performance in innovative research, by means of the incorporation of the organizational values of autonomy and entrepreneurial orientation. INI has integrated healthcare, research and teaching activities to the Integrated Action (PAI) organizational structure in 1999, and has promoted the innovative orientation of the Chagas Disease Clinical Research Laboratory (Lapclin-Chagas) in 2007.

The aim of this Short Competitive Manuscript is to assess the effect of the organizational restructuring oriented to organizational values of decision-making decentralization in the promotion of clinical research, and the development of comprehensive care in Chagas disease, according to the principles of the Integral Healthcare Model.

Conceptual Framework

Literature on public health discusses the basics of Integral Healthcare Model, whose characteristics fit the mission of multipurpose public health organizations as INI. For analytical purposes, in turn, this kind of organization is herein understood as a productive organization subjected to internal conflicts of interest that: provides comprehensive healthcare services associated with teaching and research; uses specialized resources, many of which sold in incomplete markets; produces "public goods" whose assessment depends on user experience; and stands as a benchmark for health services development.

This model of attention is associated with the actions of health promotion, prevention of and recovery from disease, as well as with healthcare practices oriented by the precedence of human rights over market relationships. It is characterized as a model of transition from ambulatory medical care focused on the specialized doctor to procedures focused on multidisciplinary work, that promotes: interaction of health professionals with patients and peers (Ross, 2009); multidisciplinary healthcare (Oliveira, Nascimento, & Marcolino, 2012); and inclusion of patients and community (Knaul et al, 2012; Ivers et al., 2011).

On its turn, since the origin of INI's labs, the organization of the Fiocruz Institutes as Professional Organization (Mintzberg, 1995) was taken on by professionals with highly standardized skills, emphasizing professional authority, but was characterized by poor governance of organizational objectives.

As for the Divisional Organization model (Mintzberg, 1995) that succeeded the Professional Organization model in order to promote mission-oriented health research through results-oriented management since 1995, it in fact ensured restricted autonomy to the Institutes, whose strategic plans were *a priori* defined with Fiocruz's "central office" on the basis of performance assessment. In order to attract resources for clinical research, INI integrated the activities of lab diagnostics, healthcare, teaching and infectious disease research, focused in infectious diseases targeted by its strategic plan (Jorge et al., 2006). In line with the "new public management" paradigm, INI's search for strategic positioning resulted in an attempt to combine efficiency with effectiveness in treatment regimens. Incentive mechanisms and organizational values such as orientation to results, management decentralization, accountability and flexibilization of procedures (Cunill Grau, & Ospina Bozzi, 2003) arrived on the scene, but standardization of activities restricted the promotion and autonomy of clinical research.

Research activity, typically dynamic and complex, is subjected to uncertainty, thanks to which integration of clinical research associated with assistance depends on the effective interaction, through mutual adjustment, of professionals with different patterns of skills (Harris, 1977) in *ad hoc* project teams. In 2007, restructuring in accordance with the Innovative Organization model has: focused on encouraging innovation-oriented organizational values with the empowerment of the operating nucleus, decentralization as well as freedom of "mutual adjustment" between professionals for establishing research teams; and conditioned the creation of labs and their survival thanks to their results (Mintzberg, 1995). It focused on evolving labor division and research coordination mechanisms, in accordance with the existing projects, such as the creation of INI's clinical research labs, substructures of comprehensive care like Lapclin-Chagas, designed to take on fast-response linkages with the users of the researches, in order to promote innovative research (Fundação Oswaldo Cruz [FIOCRUZ], 2006).

In this sense, the need to internalize the initiative and develop the individual's potential (Morton, & Hu, 2008) has highlighted the choice of the organizational structure which holds conditions to

promote organizational values of entrepreneurial orientation at Fiocruz. Jointly combined, values of autonomy and competitive, innovative and proactive attitude, as well as predisposition to risk would result in the improvement of the organization's performance in achieving goals more efficiently and in the acquisition of the capacity to adapt to turbulent environments (Jogaratnam, & Ching-Yick Tse, 2006).

Finally, from the perspective of Economic Analysis, search for efficiency explains the organization and expresses its rationality (Varian, 2006). The doctrine of the so-called Managerial Public Administration, for instance, is consistent with the principles and policies of Economic Analysis (La Forgia, & Couttolenc, 2008). Particularly in presence of complete information on production processes, the objective function of profit maximization in the neoclassical theory of the firm's equilibrium in the short run explains the search for absolute efficiency in using resources. Efficiency sustains the organization's survival in the market; costs savings and cost-saving oriented innovation express organizational performance success.

However, the Organization's Internal Economics incorporates the asymmetric information hypothesis to describe interaction between manager and production agents, from which results the interest in assessment models adopting the informational hypothesis of the existence of inefficiencies out of the manager's control, the so-called type X inefficiencies (Leibenstein, 1966). Acknowledgement of inefficiencies, of information costs and of imperfect information requires appropriate treatment of the distinction between inefficiencies in dealing with phenomena controlled by managers and the effects of factors beyond control. To assess managers, the alternative behavioral hypothesis is that they look for relative efficiency (Mantri, 2008), that is, to emulate best practices observed among peers, giving rise to the interest in models like Data Envelopment Analysis (DEA).

Moreover, in complex organizations, integrating a significant family of economic units with different types of property and activity, including multipurpose public health organizations like INI, oriented by Integral Healthcare Model, the coexistence of internal groups of interest creates difficulties for the precise definition of their common goals (Bisang, & Katz, 1996), and for the organization's overall assessment, when not all activities have similar performance levels. With views to a summary measure for performance assessment of these multipurpose organizations, selection of a standard of comparison is also dealt with in literature on evaluation by the identification of the so-called efficiency border through DEA method for calculating the frontier of empirically observed production possibilities for the pairs of these organizations.

Research Methodology

In this Short Competitive Manuscript, assessment problem is stated as a problem of construction and analysis of indicators of the effects of new substructures resulting from pro-decentralization organizational change of INI on: the distribution of healthcare resources among its' labs; and the volume and diversification of the assistance, cost-performance of clinical care, and efficiency in the use of Lapclin-Chagas' resources.

The employed method is a case study of the new organization of Lapclin-Chagas, with empirical support provided, first, by indicators on the evolution of volume, diversification, expenditures and production costs of its activities, with views to assess its overall growth and costs performance in the period 2006-2011. Internal cooperative attitude was achieved by eliminating duplicity of effort through compilation of secondary data from INI public files to quantify production and diversification variables (Jorge et al, 2006). Costs and expenditures investigation considered appropriation: of incentives for genuine production choices (Birkinshaw, Hamel, &

Mol, 2008) through the census of production expenses (Djellal, & Gallouj, 2005) on micro-costs level (Brewer, Norren, & Garrison, 2005) - required for efficient management (Medici, & Marques, 1996) – and of "indirect" costs (Nakagawa, 1994) - or "common" costs (Milgrom, & Roberts, 1992). Survey of micro costs method (Horngren, Sundem, & Stratton, 2004) and Activity Based Costing system (ABC) were used.

Here called Direct Expenses, several expenditure items at micro costs level registered in the labs' budget compose actual unit costs, namely expenditures with: kits & reagents; outsourcing - individuals; stockroom items; non-stockroom consumption items; telephony; amortization of permanent material; maintenance of permanent material; and internal administrative support. Expenditures registered in the budget of Fiocruz central office, here called Indirect Expenses, include: personnel not paid by INI; transfer medicines; internal administrative support; and administration of the campus (Jorge et al., 2006). Production, costs and permanent material data refer to annual periods, with views to crossing off seasonal fluctuations (Medici & Marques, 1996). Expenditure of permanent material covers reserve funds for the organization's sustainability (Bresser Pereira, 1996). "Personnel expenses" for each product amounts to the sum of wages and charges relating to specific share of time of each professional in charge of its production (Grönroos, 2003). Diagnosis expenses is estimated as expenditures related to each individual use of the exam's result, that is, part of expenditure for carrying out the exam the results of which can be read for the progress of several research projects.

Next, this performance assessment considers that, regarding the effect of INI's restructuring on cost effectiveness in labs' healthcare activities: annual expenditure for each activity per lab represents preference on the distribution of resources of each INI activity among them; and that average unit cost of each lab's specific activity represents its effectiveness in costs in the use of resources. Assessment of the organization's overall performance in costs aims to answer whether expenditures per activity are primarily directed to substructures with better performance in costs, in order to contribute to efficiency. This manuscript investigates the relationship between different annual expenditures and unit costs per INI's lab activities in 2011, when organizational innovation matured. Spearman coefficient identifies the type of actual association between average and annual expenditures per lab activity in 2011 (Triola, 2005). The hypothesis on the effect of the new structure on the lab's cost performance is that in the activity in which expenditure per unit of output is higher, allocation of 2011 budget funds is lower when compared with the endowments destined to it in the other labs.

Given the diversity of services encompassed by INI's PAI, the overall performance of Integral Healthcare Model in Lapclin-Chagas was assessed for efficiency in the use of resources, starting from the analysis of labs' relative efficiency synthesis-scores with respect to a DEA-efficient frontier. The DEA product-oriented model with variable scale returns (DEA-BCC-O) was used to: investigate its maximum output with aggregate consumption of inputs kept constant, because INI's PAI budgets are established *a priori*, so that manager's target is to increase results obtained; and compare production processes of decision making units (DMU) with different sizes, such as the PAI.

Out of the total of INI's fourteen PAI, the performances of eight PAI already structured according to the Integral Healthcare Model in the period 2002-2012 were considered, amounting to eighty eight observation units: annual PAI in Chagas disease, acute febrile diseases and dengue, human T-lymphotropic virus, leishmaniasis, mycosis, toxoplasmosis, tuberculosis and HIV / AIDS (Jorge et al., 2006). Inputs per PAI variables of the model are: (a) physician-hours – time allocated by each physician; and (b) operating expenditures excluding staff - annual

expenditure on medicines, reagents and hospital supplies. Products per PAI are: (a) exams – annual amount of exams; (b) consultations – annual amount of consultations; (c) admissions - annual number of admission days; (d) scientific production – annual number of published articles; (e) cohort – annual number of new research patients; and (f) teaching – annual number of approved dissertations and theses.

Results

Measures of association among variables representing the participation of the various labs in the annual expenditure of each healthcare activity and its performance in costs in that activity are presented in Table 1. Indicate an inverse association among the variables of annual and average expense and cost effectiveness in the activities – the resources employed in the labs with better cost performance are higher (Zar, 1972).

Table 1 - INI – Cost Effectiveness of the Distribution of Expenses in the Healthcare Activity per Lab: 2011

R, RE		ANNUAL DE: 2011			
		Ambulatory	**Day-Hospital**	**Admission**	**Intensive care**
DE/ Assistance: 2011	Ambulatory	-0,72 (R)**	-	-	
	Day-Hospital	-	-0,56 (RE)	-	
	Admission	-	-	-0,69 (R)***	
	Intensive care				-0,73 (RE)**

Source: Elaborated by the authors.

R, RE – Spearman correlation coefficient, respectively without and with posts tie.

DE - Direct Expense (registered in INI' budget; under INI's manager control).

**: p < 5%, ***: p < 10%

Indications of positive effects on production in the five years post Lapclin-Chagas' restructuring (2006-2011): annual number of clinical research projects in progress quadrupled; physicians' consultations increased by 9%; nursing procedures by 140%; and admission days by 105% - see Table 2. Clinical research projects listed in Figure 1 exemplify those in progress in the main Lapclin-Chagas' lines of investigation (Hasslocher-Moreno et al., 2013). Until 2012, Lapclin-Chagas' teaching activity in post-graduate courses *stricto sensu* of cardiology (UFRJ) and infectious diseases (INI) areas resulted in seven doctoral theses and twenty eight Masters' dissertations (Hasslocher-Moreno et al., 2013). Table 3 concerns evolution of volume and diversification in assistance to Lapclin-Chagas' 2200 patients' cohort per types of clinical procedures and exams performed, as well as of the annual expenditures and effective unit costs, direct and indirect expenses: in the period, annual number of exams and procedures grew 36% and variety of types grew 12%. From the perspective of minimizing costs, calculation of Direct Expenses provides an overall diagnosis on performance in costs of healthcare services per Lapclin-Chagas assistance activity in the period. According to Table 4, actual unit cost of medical consultations, nursing procedures, admission day and day-hospital care came down.

Table 2 - Lapclin-Chagas - Annual Production Evolution per Activity: 2006-2011

Activity	Amount/Year	
	2006	2011
Ambulatory		
Infectologist Consultation	3.019	3.100
Non-Infectologist Medical Consultation	1.770	2.122
Non-Medical Specialty Consultation	4.140	767
Nursing Procedures	2.701	6.476
Admission	268	548
Day-Hospital	1	10
Teaching (1)	18	29
Research (2)	4	18

Source: INI.

Footnotes:

(1) Graduates

(2) Research Projects in Progress.

Figure 1- Lapclin-Chagas - Clinical Research Projects: 2012

• Progression to chronic Chagas' heart disease in a cohort of Chagas disease
• Longitudinal Study of Cardiac Morbidity and Mortality in Chronic Phase of Chagas disease
• Experience with treatment pro-elimination of Trypanosoma cruzi in chronic Chagas disease patients
• Cardiopulmonary rehabilitation program in patients with heart disease of infectious etiology
• Clinical study in patients with chronic chagasic cardiopathy. BENEFIT study
• Pharmaceutical care in the quality of life of patients with heart failure due to chronic Chagas disease: randomized clinical trial
• Clinical and epidemiological aspects of Chagas disease in patients of Rio de Janeiro state
• PCR implementation for the diagnosis of Chagas disease as a clinical routine
• Chronic Chagas' disease diagnosis through signs, symptoms and exhibitions in individuals with diagnostic investigation indication
• Predictive value of transforming growth factor-β1 in Chagas disease: towards a biomarker surrogate of clinical outcome
• Cardiac performance analysis of Chagas patients in light of new echocardiographic methods
• Study of the mechanisms involved in the genesis and maintenance of fibrosis during infection by Trypanosoma cruzi
• Prevalence of the genotypes NOS and IFN-gamma in Chagas patients and correlation with prognostic markers

Source: Elaborated by Lapclin-Chagas

Table 3 - Lapclin-Chagas – Clinical Care, Diagnostics and Support: 2006-2011

DESCRIPTOR	2006				2011			
	AMOUNT	TYPES	ANNUAL DIE (*) (**)	DEI/ASSISTANCE (*)	AMOUNT	TYPES	ANNUAL DIE (*) (**)	DIE/ASSISTANCE (*)
Infectologist Consultation	3.019	2	581.860,43	192,73	3.100	2	254.575,38	82,12
Non-Infectologist Medical Consultation	1.770	2	164.695,03	93,03	2.122	2	241.250,36	113,69
Non-Medical Specialty Consultation	4.140	2	473.012,85	114,25	767	2	298.327,94	389,00
Outpatient Procedures	117	14	27.241,32	232,10	145	16	61.007,55	420,06
Nursing Procedures	2.701	45	95.593,25	35,39	6.476	81	112.499,59	17,37
Day-Hospital Procedures	1	-	6.708,32	6.708,32	10	-	15.284,79	1.528,48
Admission Day (nourishment and medication included)	268	-	426.008,15	1.589,58	548	-	957.522,03	1.747,30
Admission Day	268	-	341.766,20	1.275,25	548	-	856.768,56	1.563,45
Patient Hospitalization	25	-	341.766,20	13.670,65	46	-	856.768,56	18.625,40
Admission Day - Intensive Care (nourishment and medication included)	-	-	-	-	221	-	332.211,65	1.503,22
Admission Day - Intensive Care	-	-	-	-	221	-	283.338,66	1.282,08
Patient Hospitalization - Intensive Care	-	-	-	-	19	-	283.338,66	14.912,56
Pathological Anatomy Lab	462	4	118.009,95	255,45	910	4	154.617,94	169,93
Bacteriology and Bioassays Lab	1.315	19	122.734,40	93,32	2.087	18	172.446,68	82,64
Imaging Lab	1.131	60	291.959,03	258,03	611	57	314.900,01	515,54
Immunodiagnostic Lab	2.806	21	150.569,13	53,66	2.786	21	137.439,54	49,34
Mycology Lab	13	2	1.525,80	116,91	4	3	832,77	188,92
Parasitology Lab	749	8	77.558,28	103,51	485	7	60.106,66	124,04
Clinical Analysis Lab	16.148	57	487.038,26	30,16	26.373	52	461.430,32	17,50
Ampule Dispensing	5.300	-	2.516,35	-	100	-	60,54	-
Capsule Dispensing	10.000	-	316,88	-	2.000	-	89,69	-
Pill Dispensing	411.000	-	318.230,10	-	265.020	-	130.188,25	-
Meals at Day-Hospital	1	-	6,93	-	10	-	296,51	-
Meals at Ambulatory	N. D.	-	28.908,21	-	N. D.	-	30.679,35	-
Meals at Hospitalization	268	-	57.553,30	-	548	-	93.517,75	-
Meals at Hospitalization – Intensive Care	0	-	0,00	-	221	-	37.714,27	-
Internal Mngmt Srvces	-	-	376.419,80	-	-	-	503.297,12	-
Campus Mngmt Srvces	-	-	368.390,41	-	-	-	537.922,70	-

Source: INI.(*) 2013 prices in R$. (**) DIE - Direct and Indirect Expenses (partly registered in the budget of Fiocruz central office; out of INI's manager control).

Table 4 - Lapclin-Chagas - Annual Expense and Unit Cost per Healthcare Service: 2006-2011

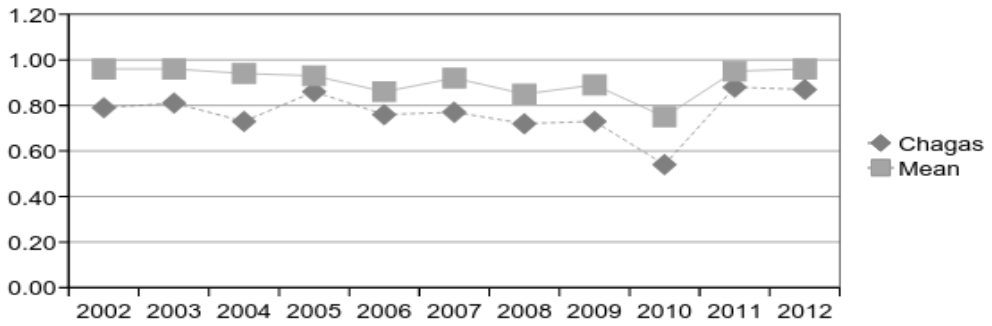
ACTIVITY	ANNUAL DE (*) (**)		DE per Care Service (*)		
	2006	2011	2006	2011	2006/2011
AMBULATORY	300.331,33	241.307,34	-	-	-
Infectologist Consultation	64.480,23	64.375,83	21,36	20,77	DECAY
Non-Infectologist MedicalConsultation	48.599,52	39.779,50	27,45	18,75	DECAY
Non-Medical Specialty Consultation	112.470,59	32.963,55	27,17	42,98	RISE
Outpatient Procedures	15,75	16.329,03	0,13	112,36	RISE
Nursing Procedures	74.765,24	87.859,42	27,68	13,57	DECAY
ADMISSION	238.899,35	425.283,50	891,42	776,06	DECAY
INTENSIVE CARE	-	203.562,48	-	921,10	-
DAY-HOSPITAL	5.506,19	8.659,02	5.506,19	865,90	DECAY
TEACHING	155.908,45	231.057,52	8.493,80	7.865,04	DECAY
RESEARCH	236.050,31 (***)	565.530,63	18.042,06 (***)	31.124,42	RISE
Σ	**936.695,62**	**1.675.400,50**	**35.400,48**	**27.936,58**	DECAY

Source: INI.

(*) 2013 prices in R$. (**) DE - Direct Expense (registered in INI' budget; under INI's manager control). (***) For the year 2009.

Quantifying eight input and output variables of INI's PAI and calculating DEA-BCC-O model through the solution of the underlying Linear Programming Problem as well as employing the Frontier Analyst® software, relative technical efficiency scores for annual PAI in the 2002-2012 period are obtained and Chagas PAI's efficiency evolution is compared with the evolution of the annual average efficiency in Figure 2. Results of nonparametric tests designed to measure statistical accuracy of results of experiment similar to the analysis herein developed have confirmed that variations of scores obtained are statistically significant - see Jorge et al (2006).

Figure 2 - Relative Technical Efficiency Annual Evolution per PAI - 2002-2012



Source: Elaborated by the authors.

Conclusions

As knowledge production activity, clinical research is typical of public health organizations and clinical research in infectious diseases fits in multipurpose public health organizations; its

development requires more effective knowledge exchange between research and healthcare assistance activities. Based upon the conceptual framework of Mintzberg (1995), reconstruction of clinical research trajectory in Fiocruz sheds light on the success in choosing the single case study approach to assess Lapclin-Chagas. Expectations on the promotion of organizational values of entrepreneurial orientation and decentralization through Lapclin-Chagas's restructuring in 2007 were of growth of research, teaching and healthcare, as well as of diversification and effectiveness in costs of comprehensive healthcare procedures rendered.

It was evidenced, during the period of analysis: the high diversification of Lapclin-Chagas' healthcare procedures; that Lapclin-Chagas' patients receive healthcare assistance of interdisciplinary and multiprofessional character; and that the commitment of Lapclin-Chagas's treatment model of Chagas disease is directed to: health promotion; evidence-based decisions; humanized healthcare; social and family involvement in care; social protection assistance; and control of risk behavior. Performance in costs assessment confirms association between restructuring oriented to promote these values, and effectiveness in costs of the distribution among labs of the INI's budgetary resources per activity. In other words, resources allocation strengthened the most efficient labs. It could not be confirmed, however, the costs minimizing behavior in the strict sense of microeconomic rationality: in the period 2006-2011, Lapclin-Chagas' growth wasn't followed by unit costs reduction of outpatient consultations in non-medical specialties and medical procedures, at 2013 prices. Efficiency Analysis shows that, since promotion of pro-innovation orientated values, PAIs' relative technical efficiency grew along time, and that INI's annual expenses in the PAIs, as well as Lapclin-Chagas' management, associated positively with the search for best practices in the distribution of resources per activities of each PAI.

As contribution to knowledge, this Short Competitive Manuscript has established association between the dynamics of change promoted by values of innovative orientation in INI as of 2007, and the search for efficiency driven by peer's performance adopted as hypothesis in Efficiency Analysis (Ozcan, 2008). As managerial contribution, it confirmed the association of INI's new organizational structure of clinical research integrated to healthcare assistance with relative efficiency-oriented incentive, highlighting evidences of the potential benefit of its replication for growth and improvement of Chagas disease treatment. In this sense, it has demonstrated the DEA model explanatory power for understanding multipurpose organizations, although analysis of a single case imposes limitations on the generalization of these research findings.

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