

## **Process Innovation In Information Technology Resources Adopted In Hospitals In City Of São Paulo – Brazil**

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### **ABSTRACT**

This study describes the adoption of innovations supported by ICT and their determinants, in three hospitals at the central region of the city of Sao Paulo - Brazil. The qualitative research was based on 11 interviews and analyzed barriers, facilitators, benefits and future challenges of three innovations aspects: Management System of Intensive Therapy Unit, Patient's Electronic Medical-Card and Surgery Intelligent Room. The verified benefits were: diminishment of diagnostic errors, prescriptions and interventions, and faster patients' recovery.

**Keywords:** Process Innovation; Information Technology; Patient's Electronic Medical-Card; Management System; Innovations Aspects

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## INTRODUCTION

During the last 30 years, the increasingly competitive globalized world has remained as evidence of broad technological transformations caused via a substantial escalation of information access by society and organizations; mainly through innovative resources available with the use of Information Technologies.

The volume of researches on innovation processes in hospitals has increased meaningfully throughout the last 20 years, thus showing us, that this process has been mostly researched as a macro, in terms of changes for organizational structures through innovations on action constraint, (LÄNSISALMI et. al., 2006). According to Fleuren et. al. (2004), surveyors are consensual as to the complexity and dynamic character of these innovations for health care providers. We shall then enhance that innovation is a product implementation (services or goods) whether being new or with a meaningful improvement; or a process, or a new marketing method, or a new organizational method for business practices, for organizing work environment or even for external relationships (OECD, 2005, p 55).

Technology innovation activities are a combination of scientific, technological, organizational, financial and commercial stages, including investments on the latest knowledge which leads or even tries to lead to product implementation and to new or improved processes (OECD - MANUAL DE FRASCATI, 2007, p. 27). Thus being, innovation awareness along with all its amplitude, contributes for identifying features that affect innovation processes and results within hospital organizations.

Hospitals have been constantly introducing innovations, mainly concerning as a support to Information Technology resources, whether as for diagnosis and disease treatment, as well as for improving quality for health care assistance and professional training, as pointed out by Djellal and Gallouj (2005). This behavior implies with professional qualification development relevant to technological innovation in intensive environment.

Another important factor on service sectors, refers to the qualification of employees, who with their professional performance can transform goods belonging to organizations, in other words, they provide services (GADREY, 2001), modifying the reality of people by means of security, health, comfort, among other final characteristic perceived by consumers, clients or beneficiaries (GALLOUJ, 2002). According to Zarifian (2001), the logic of production of a service requires professional qualification

with a bigger scope focused on the work station where the set of tasks are predetermined.

Service production connotes modification of the status of a person or goods, thus clearly demonstrating a set of professional capacities present in the relationship between service providers and clients-users (ZARIFIAN, 2001). Starting from the adoption of Information Technologies in hospitals, we can notice direct impacts on the organizational structures as well as on the qualifications of employees dealing directly or indirectly with patients' health care and with the qualifications required for users (complete Blood Count access or Brain Mapping via internet, for instance). Through this line of action, the hereby survey maintains as a goal, the description of those innovations adopted as Information Technology supports and their decisive results, exploring thus the necessary qualifications involved for the execution of this process.

Besides the above introduction, the article has been structured along other four sections. The first section presents a theoretical conceptual basis and its relation between Innovation and Information Technologies amid the hospital context. The second section describes: the employed research method, collection technique and data analysis. The third reported section deals with the outcome of discussions facing the utilized theoretical reference. The fourth section deals with final considerations and research recommendations.

## **LITERATURE REVIEW**

The term 'innovate' is originated from Latin; *innovo, innovare*, which signifies to become new, to invent or begin using new ideas, methods, equipment, etc., to modernize. As well as the word 'innovation' derives for the word *innovatione*; which means a new or refreshed idea (BARBIERI, 2004; MACHADO, 2004; VICENTI, 2006). Therefore, a new and surprising product or service is appointed as an innovation, when it meets up consumers' expectations, needs and desires (DAMANPOUR, 1996).

According to Rogers (1995), innovation consists on an idea, practice or material good that contains a significant application. Luecke (2003) and regards it as an incorporation of knowledge into something original and relevant. Hussey (1997) describes it as a creative idea applied to working environments, in other words, converted into an action.

On the other hand, Kotler and Keller (2006) define it as a service product perceived as innovative.

According to Schumpeter (1988), innovations for means of production have propelled and kept capitalism. However, the author further adds that the invention of new processes, goods and methods may still not be converted to innovation.

According to Afuah (2003, p. 14), “innovation requires invention and commercialization”. Van De Ven, et. al. (2000) supports this idea by explaining that not every invention may become an innovation; meanwhile the first one remains limited inside creation, the second involves creation itself and the development and implementation of new ideas as a whole. Barbieri (2004) and Gundling (1999) additionally say that innovation consists on the implementation of something that generates profits. Deducing therefore, that the applicability, destination and potential to generate economical profits are in reality what converts an invention into an innovation.

## **INNOVATION IN BRAZIL**

Innovation policies were definitely included into the developed countries' governmental agendas in the 90's (STAREC, 2012). Information Technology progresses and diffusion among the different production segments have facilitated a fast growth in productivity, strengthening regional flexibility – with a strong impact on international investment flows – accelerating service expansion of the sector and intensive educational activities (CARVALHO, 2009). New technology expansion fronts, increasing internal and external restrictions for governmental aids for industries and a rapid productive and financial internationalization process, have defined content changes and comprehensiveness of the public policies dedicated to industrial and technological developments. Economies with broader service predominance, strongly supported on qualified professionals and on Research & Development undertake are facing a decrease. Current governmental policies differ from those prevailing until the 70's, which have gradually been outgrowing from the support of specific industrial and important technological project sectors, to emphasizing innovation; on academic and corporate research interaction for more horizontal programs and instruments, amidst a

context where technological fronts amplify into diversified directions and national innovation systems face a huge international pressure (WHEELWRIGHT et. al., 2012). Therefore, the regularly documented emergent picture; as for instance, through organization analysis for economic cooperation and development, is nowadays a multifaceted prevalence from the last two decades. There are no shortcuts for this matter, as for instance for the great concentration areas. This does not mean that there are no priority fields, since great emphasis has been demonstrated in all countries; nanotechnology and life sciences with a highlight over biotechnology. But new technologies imply redefinitions over traditional sector cuts. Thus a huge tendency to converge occurs for; telecommunications, informatics, and the electronic industry. On the other hand, nanotechnology and biotechnology are overarching various industry sectors, resulting at large, that national technological policies become a bit unclear as on the point of view of traditional sector classifications on behalf of policies that affect numerous segments and a wide set of instruments: for human resources training encouragement, for entrepreneurs, for developing efforts towards enterprise technology, for regional clusters with great competing potential, for financial policies to support innovative companies, for providing institutional surroundings favorable to innovation; as for instance, the inclusion of new protectoral legislations on intellectual property (STAREC, 2012).

Specific industrial cuts remain in many countries, mainly because medium to medium-high technology are still predominant among most industrial structures. Even so, they coexist with increasing technological challenges in a comprehensive and transversal manner, which includes a broad range of productive sectors with a great potential for expansion, as we may clearly observe in the nanotechnology case (STAREC, 2012). Substantive differences may be observed even among developed countries, by means of financing Research & Development and its active performances, its intensity, composition and impacts over economic variables like jobs, foreign trade and productivity. Actually a good number of developed countries have evidently been formulating and implementing comprehensive technology policy strategies, and this fact is a model of the greatness of challenges placed in this field, besides the importance assigned to Science and Technology for progress in these economies for the next years (FREY e DUARTE, 2009).

## **INNOVATION PROCESSES**

According to Tidd et. al. (1997), innovation processes are a business key for companies; associated to renovation and business evolution. Thus rebuilding what companies provide and how they create and deliver this offer. Therefore, innovation is an essential activity linked to growth and survival.

Innovation processes implicates the following stages (TIDD et. al. 1997):

- Environment prospectus - internal and external – identifying and processing relevant signs of menaces are opportunities related to changes;
- Making decisions based on a strategic vision of how companies may improve their development;
- Obtaining resources which enable an answer – whether through creating something new with research and development, or acquiring something external through technology transference;
- Project implementation for an effective response: developing technology and internal/external factors in market.

Each company may adapt the innovation process according to its own peculiarities meanwhile it comprises with its own manner of constructing knowledge: large companies may have their own Research & Development laboratories and even employ outsourced research. Small companies give priority to agile solution developments mainly sourced from practical samples gathered from day-to-day answers to problems. Despite these variations, the underlying pattern of innovation stages remains constant.

Such changes among companies may also demand radical changes in people who are regarded as the essential heritage existing inside organizations. Remaining as a key element for organizations the fact that people grasp responsibility not only for their specific tasks, but also for comprising with product and innovation processes, acting thus as effective troubleshooters (FREY e DUARTE, 2009).

## **MANAGING INNOVATION PROCESS FACTORS**

Coombs (1994) declares that a broad recognition as for matters between technology and company strategies being strongly linked to each other. However, he points out that associating technology to company strategy depends on the context; in other words, it varies according to whether it is an individual business unit, a division comprising of a set of business related units or a corporation comprising various divisions and business units.

A contemporary approach to strategic technology management includes technology qualification evaluation of the employed tools rep for business plan development and strategy. The central characteristic of this approach lies on integrating the following components:

- Analysis of potential growth for private markets;
- Alternative analysis for positioning the company in these markets;
- An (explicit) analysis of potentially relevant technologies for competitive advantages of the company;

This strategic technology analysis may keep in consideration technological characteristics “outside the company”; as technological maturity, as well as characteristics “inside the company”; like its competencies and appropriation capacity for this technology and its contribution degree amid the competitive positioning of the company in a particular market and finally, how meaningful may this company be whether to a small or big number of markets, in its own business portfolio.

By doing so, it may be added to a business plan a technological portfolio notion as a set of assets that “creates new options” meanwhile it meets current goals. Such approach is useful to both; corporate and private business standards.

Coombs (1994) sums up the main factors configuring technology and strategy interaction:

- At what degree private market products are being “designated” through scientific or technical changes or based on “mature” technology;
- The structure of a company by means of the amount and diversity of units in business;
- Corporate "strategy style" and emphasis on financial control or on technology corporate administration, guiding business unit strategy;
- The presence or absence of a corporate “technological group” in charge of property and management of corporate technological assets, that also promotes its mobility among various businesses;
- The engagement of such “technological group” with business and corporate strategy development;
- Analytic control of tools and development degree to assess and map technologies, using this information as a whole for business strategy formulation;

Looking back and giving emphasis on how innovation has been being used, Coombs (1994) enumerates the following turning points: during the 70’s, the industrial innovation research focalized it individually as an analysis unit, assessing the relative importance of certain innovations approached as “propelled by technology” or “snatched by the market”. Besides the role of the “product champions” and of the innovation process management; analysis focus was afterwards directed to research on samples of innovative sets aiming distinctive behavioral pattern identifications of the well succeeded and innovative companies.

Freeman (1974) identified innovation strategies that could almost be understood as “ideal types” for companies’ behavior, though they indicated that this taxonomy could still be an insufficient foundation for the alternative company theory; forthwith, a series of factors contributed to the transformation of the company as the analysis unit of the innovation research, instead of individual innovations, among them: Nelson and Winter (1977) ascertain that innovations are frequently improvement steps along company’s technological path; these paths are rooted in skill apprenticeship produced by companies that have innovated; on that account, the innovative actions of the company – and its performance as a total – are “path-dependent” and conditioned by the acquired skills.



Parallel to this, a big amount of literature on the strategy subject was produced, with a reasonable independence from innovation researches and producing a large variety of theoretical references that support the analysis and construction of business strategies. Coombs (1994) declares that this convergence between these two traditions, has led to a synthesis that may be described in the following way: the former innovative activity of a company generates a technological assets specialization; these assets generate competitive advantages constituted by a superior ability to employ their specialized abilities. But they may also generate weaknesses (like rigidity) within the abilities of acquiring further specialized knowledge; as a result a new system of products and processes (and components) emerges employing a wider variety of technologies. A continuous tension between focusing on property technologies (which generate distinction, but an increasing specialization) and the clear demand to expand the range of technologies in their portfolio, whether as a manner to keep the existing product market positioned, or whether aiming product diversification.

Tensions between technology convergence and divergence should be managed through a dynamic process for reckoning future technical requirements that may enable a rebalance of the company's technological portfolio.

Business units in established markets have a tendency to benefit short term financial success and investments on technologies that have a direct relevancy with competition in these markets. Such attitude, excessively "pulled by the market", leads us to a smaller emphasis on technology prospecting with an uncertain and mostly long term return. Thus, a relation between generic competitive strategies (PORTER, 1999) and company's technological strategies exists. Companies who seek for leadership in costs may choose process innovations; meanwhile those who seek distinction may emphasize product innovations (COOMBS, 1994).

Along sectors, apt technical or scientific changes and typical "technologically lead" cases occur where companies must look for a fragile balance between strengths "pushed by technology" and "pulled by the market". But the author concludes that companies that are genuinely managed by technology are mostly the *exception* than the *rule*, being that the majority of business units; Research & Development is conducted through a

strategic context “managed by the market” among which the unit’s technological budget only depends on his own operational budget with a small approach from the company and a huge staff engagement; for their management and not solely Research & Development (COOMBS, 1994).

## **SERVICE INNOVATION IN HEALTH**

On the other hand, service innovation literature has its landmark with Barras (1986), highlighting the important role of information technologies for economic development. This author admits that service sectors have a most appropriate absorption of the technological artifacts, than the industrial sector, thus he proposes a reverse product cycle as a counterpoint to the neoclassic approach of industrial innovation (Utterback, 1996). According to Gallouj (2002), this approach made by Barras (1986) is featured as a technical envisage of the importance of Information Technology for companies’ successful growth, but it does not include a sufficing service innovation specialties and mostly because of its endogenous nature. As well as it demonstrates an innovation process reduction to the inverse notion of the industrial sector, keeping this sector’s priority while establishing service sector innovations.

Service based innovation approaches were originated as a solution to technical focuses. According to Hauknes (1996), service based approaches emphasize the strength that intangible and joint production qualities of exclusive service relations may produce on innovation, overcoming technological aspects. This approach also shows innovation as an endogenous responsive process, mainly to specificities of service related interactions between providers and users and presupposing that service and industrial sectors coexist, but with remaining differences as to product definition; among service and manufactured products.

A third innovation service approach would be fusions approach; presupposing service providers as the simultaneous mobilization of technical characteristics (material and immaterial) along with qualifications (internal and external) to produce service characteristics (GALLOUJ, 2007; GALLOUJ and WEINSTEIN, 1997). On the fusion approach, service innovations represent an addition of new elements or a combination

of the existent elements subject to replica, resulting new solutions or new manners to provide service (SUNDBO and GALLOUJ, 1998). Grounded on these propositions, various types of service innovations are defined: radical, improving, incremental, recombination, adhocracy and formalizing.

For Gallouj (2007) and Gallouj and Weinstein (1997), radical innovation is the creation of totally new services with absolutely different characteristics from former services and requiring different qualifications. Innovation improvement is an adjustment for better service characteristics without modifying the system as a whole. Incremental innovation is represented by the addition of any type of increment, marginal, efface or substitution to characteristics or qualifications, keeping the general structure of the system. Adhocracy innovation refers to: (a) a solution or set of original solutions of organizational, strategic, social, legal etc. nature, in response to a problem, or (b) producing knowledge and new qualifications that may be reused in other circumstances. Innovation done through rearrangement is based on the creation of novel services starting from different combinations for new applications of the already existing services or characteristics. Finally, innovation through formalizing represents characteristics formatting and standardization, attributing thus a certain degree of materiality to the service.

These different approaches on service innovations compose an interdependent theoretical understructure that supports hospital organization researches; like the current episode. Djellal and Gallouj (2005) declare that hospital innovations are related to a broader spectrum of actors, institutions, products and services. The hereby mentioned authors, further highlight innovation analysis enlargement at different hospital organizational levels and propose an organizational principle notion, managing innovations or according to Vargas (2006); innovation logics.

Djellal and Gallouj (2005, 2007b) state that innovation researches in hospitals are represented by four big groups where hospital organizations receive diverse emphasis as an object of study. Through the perspective of function roles, hospitals are companies as any other, thus subject to diverse economic and social variables where they mobilize and combine diverse production resources for the creation of a service. Through the perspective of technological and bio pharmacological capacities hospitals are settings or

contexts where technological and medical innovations are introduced and developed. Under the focus of information systems, hospitals are organizations subject to the effects of Information Technologies when it comes to its relations with new informational paradigms. Lastly, on the subject emphasizing health service distributors and providers, hospitals are organizations that provide various services other than health care (transportation, maintenance, servicing, etc.).

Djellal and Gallouj (2007a) affirm that the adoption of Information Technologies in back-office processes are positively impacting service productivity, but in terms of qualifications and jobs the result is inverse, since in this case there is a workstation diminishing with standardization procedures and an increase on economies of scale. On the other hand, the adoption of Information Technologies in front-office processes are positively impacting service productivity, qualifications and job, once it adds value to production and service delivery.

About researches on innovations supported by Information Technologies in hospitals, we can highlight some main results in order to support the making of the present study. The following described surveys show us the main explanations on hospital innovations, with a prime sample to the application of Hospital Information System and specially the Electronic Patient Record. While studying conditionings for applications of new technologies at a hospital, Kimberly and Evanisko (1981) identified that senior management commitment creates conditions for resource allocations and admits innovation as a fundamental element of improvement in healthcare for hospitals and performance.

Supporting the above authors, Damberg et. al. (2009) and Walker and Carayon (2009), recognized that the commitment of professionals among the adoption staff had a positive influence over innovation applications, because they mobilized support and apprenticeship to professionals in other hospitals, with the aim of utilizing new technological resources on patients' behalf. Furthermore, communication among those professionals engaged in the application and usability of an innovation, became a determinant for a successful Information Technology implementation in hospital services. Being that the choice for an Information Technology, identification of needs

and the allocation for resources for innovation, depends on how effective is this communication between the involved parts, between sectors and between the different systems of a hospital.

As officially stated by Boaden and Joyces (2006), Menachemi et. al. (2007) and Tomasi et. al. (2004), technological innovation in hospitals has generated opportunities for exchanging and creating knowledge and experiences between physicians and other healthcare professionals. Over and above, they permit a broader safety while recovering, protecting and controlling patients' information and healthcare procedures. Whereas, these authors show us that organizational structures as well as the technical equipment maturity degree may complicate the application of a new technology in hospitals.

According to researches done by Chaudhry et. al. (2006) and Tomasi et. al. (2004), a quick access to medicament prescriptions and to patient's medical records are a benefit closely related to patient's fast recovery, once that diagnosis and interventions become more effective and safer when there is information availability and security for decision-making by healthcare professionals and doctors. Surveys done by Boaden and Joyce (2006), Chaudhry et. al. (2006), Goldsweig et. al. (2009), Menachemi et. al. (2007) and Walker and Carayon (2009) demonstrated that Information Technology adoption by hospitals is favorable for diminishing medical errors (prescriptions and interventions).

## **RESEARCH METHOD**

The hereby research exploits the diverse aspects involved in hospital service innovations thus trying to feature a data base for future comparative works and theory formulation (EISENHARDT, 1989; GODOY, 2006). It is a qualitative research trying to identify through individual interviews the perception of employees on innovations supported by Information Technology, at three private hospitals in the central region of the city of São Paulo – Brazil. Data gathering was realized along the months of September and November of 2012.

Two criteria were established for selecting the organizations to be studied: (a) hospital had to provide at least three hospital services; and (b) hospital had had to adopt or develop for at least one year, some kind of Information Technology applied at some

kind of hospital service. The first criteria aimed to choose hospitals that would have had services at different levels of complexity and diverse specialties. While the second was established to benefit information rescue on identified innovations so to permit access for people who are directly involved and also to create conditions for monitoring each innovation and its effects over people and the surveyed organizations.

Among the 40 hospitals in the city of São Paulo – Brazil, to whom correspondence was sent requiring information about managing processes for the adopted Information Technologies resources; 26 hospital organizations – 18 public and 8 private – informed that they did attend both established criteria and so were invited to participate of the survey. Public hospitals refused to participate alleging diverse reasons. From the 8 private hospitals, 3 confirmed their participation of the survey and the same 3 composed the research's focus.

These hospitals don't have a provider from the Unified Health System (SUS - Sistema Único de Saúde), Brazil's publicly funded health care system, kept by the federal government - two of them participated with programs of accreditation and/or quality certification (A and C) and are linked to representative entities of hospital organizations. Hospital A operates since the beginning of the 70's and provides emergency healthcare services, commitment, outpatient care, maternity hospital, diagnosis, surgeries, obstetrics and other hospital services. Hospital B operates since 2008 with healthcare services, cardio/vascular and pulmonary pathologies, including emergency services, commitment, outpatient care, intensive care unit, nuclear medicine, diagnosis and surgeries, all of them give emphasis to cardiovascular. Hospital C operates since mid 80's and provides emergency services, commitment, outpatient care, intensive care unit, maternity hospital, diagnosis, surgeries, obstetrics, blood bank, human milk bank, dental surgery service and other hospital services. Hospitals A and B make part of the same business group, so they share administrative processes and hospital service support (human resources, billing, feeding, etc.).

Three innovations were identified in these hospitals: Intensive Care Unit Management System at hospital A, Electronic Patient Record at hospital B and an Intelligent Operation Theater at hospital C.

The Intensive Care Unit Management System at hospital A has computerized software that stores information about patients at the Intensive Care Unit, where it also registers all interventions made by the Intensive Care Unit staff during the treatment. The Intensive Care Unit Management System is similar to the Electronic Patient Record, though it has its use restricted to the Intensive Care Unit ambience. Its main function is to support patient information registrations and interventions made by physicians, hospital nurses, physiotherapists and nutritionists, as well as supporting diagnosis and interventions amid the Intensive Care Unit environment. In hospital A, the Intensive Care Unit Management System was implemented in 2005 and its adoption was conducted by an internal staff of the hospital, composed by two nursing managers from the Intensive Care Unit, a computing expert and a doctor in charge of the Intensive Care Unit. This professional team also trained the Intensive Care Unit staff for handling with the innovation.

The Electronic Patient Record processes adopted by hospital B are: supporting healthcare attendance process, working as a source of clinic and administrative information for decision making and a means of communication shared by all professionals; registering all medical actions; supplying data for research and cost management. At hospital B, the Electronic Patient Record was totally implemented in the year 2009 and the adoption was conducted by a team formed by: a strategic planning administrator, two nursing managers and an external consultant. In addition to these professionals participating of the innovation implementation, there were two agents from the company that holds the property rights, who were in charge of developing the Electronic Patient Record. Three professionals working at the hospital and members of the adoption staff were individually interviewed.

The Intelligent Operation Theater in hospital C is specifically equipped (video monitoring system, video cameras, microphones, lighting and sound system) and integrated in order to offer physicians-surgeons an amplified vision from various angles as well as follow-up information during the surgery, as for example; exams, diagnosis, blood flow and anesthetic conditions. Hospital C acquired the Intelligent Operation Theater in the year 2010 from a North American supplier that participated of equipment's installation, training for the implementation staff and has also been offering technical support since then. The main function of the Intelligent Operation

Theater is adding technological resources to the surgery ambience in order to diminish risks and increase effectively in surgical interventions. The Intelligent Operation Theater implementation team was composed by two supervisor nurses of the surgery center, a chief physician officer of the surgery center and a technology supervisor of the hospital.

The research sample was composed by 11 subjects; seven women and four men, all of them with high education, an average age of 34 and with at least three years services time at the researched hospitals. These professionals filled in the following positions: two nursing managers of the Intensive Care Unit, a health informatics expert and a chief physician officer of the Intensive Care Unit, that were interviewed on the Management System of the Intensive Care Unit; a people development manager and two manager nurses, interviewed on the Electronic Patient Records; two nurse practitioners of the surgery center, a chief physician officer from the surgery center and a technology manager, interviewed over the Intelligent Operation Theater.

Each interview lasted a medium time of fifty minutes. The semi-structured interview script was elaborated according to Vargas (2006) and it contained items about hospitals and characteristics related to the interviewed on the subject of implemented innovations in these hospitals; like descriptions and features of innovations, sectors and involved professionals, barriers and facilitators for the adoption of innovation and benefits and challenges after the implementation. The script also contained items on professional qualifications resulting from the described innovations. Along with each interview qualification, concepts were presented so to facilitate the interviewers' report.

The collected data was analyzed as suggested by Bardin (2009), by means of content analysis done through three different phases: pre-analysis; material exploration and treatment results. Along with the pre-analysis, data was organized and systematized in accordance to objectives of the survey, aiming to culminate interpretations for the final results. While exploring the information, data was codified according to the described variables in the interview script. When dealing with results the raw data was interpreted as to make it understandable, thus elaborating it into charts describing results through analytical categories.



## RESULTS AND DISCUSSION

Among the three surveyed hospitals it was finally determined that innovations were adopted to improve service quality. A recurring term used by the interviewees, mainly by managers, was that improvement was characterized by value addition, whether through managing patient information – Electronic Patient Record – towards healthcare quality in intensive care units (Intensive Care Unit Management System), or through quality of surgery procedures (Intelligent Operation Theater).

According to the Gallouj and Weinstein (1997) classification, The Electronic Patient Record and the Intensive Care Unit Management System may be characterized by improvement of innovations and the Intelligent Operation Theater by incremental innovation. Research results showed that in all three cases an alteration happened in one of the constituent service elements, where patient information registration began to be done in a most agile and secure manner through software (Electronic Patient Record/Intensive Care Unit Management System). In the case of the Intelligent Operation Theater, new marginal technological resources were added (monitors and video cameras, etc.) to assist doctors and other professionals involved in surgical procedures.

The barriers for the surveyed innovations are related to individual and organizational variables that had a negative concern over the adoption of innovations. Among these barriers reported by the interviewees, those with occurrences in the three surveyed hospitals are detached. The barrier means a resistance in using computers and technological resources. The need to learn how to utilize new equipment represents a rupture in informational paradigms (DJELLAL and GALLOUJ, 2007b) and new demands for qualifications on hospital professionals behalf. The lack of knowledge in operating innovations has been another barrier identified through accounts interviewees. Being that repeatedly those professionals directly concerned in the application of innovations do not understand the available resources and instead stay focused on specific tasks to which they may fit in. Another accounted barrier was the insufficient amount of professionals for technical support which are needed for the solution of problems with equipments and software related to innovations.

Related to the Electronic Patient Record and to the Management System of the Intensive Care Unit, three common barriers were shown: the limited number of computers available at hospitals, the frequent occurrences with technical problems (hardware and software) and typos which mainly occurred in the initial months after innovation implementation. According to reports made by the interviewees, these barriers have been adding rework, loss of information and slowness throughout the healthcare process. However according to accounts, some months later while utilizing these innovations, those technical and digital problems were minimized. These encountered barriers confirm Boaden and Joyce's (2006) findings, as well as the fact that the identified barriers found in this research bring us back to organizational support conditions.

The facilitators of the surveyed innovations may be classified as individual and organizational factors, which have reflected positively over the adoption of innovations, thus favoring a successful implementation and its utilization. These factors found throughout the three researched cases, have references with: support for hospital senior management on the adoption of innovation processes; commitment from all professionals involved in the innovation adoption staff and handling in hospitals. These results further prove those from previous surveys. According to a survey from Kimberly and Evanisko (1981), senior management commitment creates favorable conditions for hospital innovations. Supplementing, dedicated professionals in charge of innovation adoptions, permit support and traineeship mobilization of other hospital professional users of the new Information Technologies favoring healthcare service costumers (WALKER and CARAYON, 2009).

Handiness for the use of technological resources has had an important role as a facilitator of the studied innovations, since according to what has been reported by interviewees, the implemented systems presented similar interfaces to other systems existing in hospitals. Furthermore, the adopted software was constructed based on intuitive streams where utilization procedures are showered in a pre-determined logic sequence done by the same staff members of the adoption. In the instance of the Electronic Patient Record and the Intelligent Operation Theater, technical support done

by the suppliers for these technologies was conclusive for the innovation implementation, since they permitted the customization of functions and system procedures according to the already adopted pattern at hospitals.

On the subject of benefits for the surveyed innovations, it was defined as a positive consequences or impact on healthcare quality of hospitals. According to what was reported by the interviewees, the main benefit of the surveyed innovations was the generation of knowledge and apprenticeship, originated from information resulting from clinic cases. Information available at database from hospitals was certainly being used for discussions by academic/professionals internal and external, thus improving diagnosis, prescriptions and intervention protocols.

Another benefit shared by the three surveyed cases, concerns with security for patient information, interventions, diagnosis and prescriptions. These results confirm discoveries done by Boaden and Joyce (2006), Chaudhry et. al. (2006) e Goldsweig et. al. (2009). These authors demonstrated that innovations: (a) generate exchange opportunities for knowledge creation and experiences between physicians and other healthcare professionals; (b) enables wider secure retrieval information, information control of patient and healthcare procedures protection; (c) encourages lessening of medical errors for prescriptions as well as for interventions, as demonstrated by Menachemi et. al. (2007) and Walker and Carayon (2009).

The usual benefits resulting from the adoption of the Electronic Patient Record and the Intensive Care Unit Management System, was that of a rapid access to patient's clinic Record, effective communication between healthcare staff and speed for prescribing medicine. These results confirm the main findings of Damberg et. al. (2009) and Walker and Carayon (2009), which demonstrated that communication among professionals, which are participating directly with the adoption and utilizing an innovation, favors the implementation of Information Technologies in hospitals.

The speed on medicine prescriptions and access to patient's records is a welfare closely related to the recovery period of a patient, once diagnosis and interventions become securer and more effective, when information is safe and available for doctor's fast decision making along with other healthcare professionals, as emphasized by Chaudhry

et. al. (2006) and Tomasi et. al. (2004). With this we can notice an advantage which extends along to the client himself. The value addition to services becomes evident starting from improvements within its technical characteristics caused by technological innovations, as shown by Länsisalmi et. al. (2006).

The research also enabled identifying future challenges for hospitals after having adopted innovations. Reports were unanimous as to the importance of the new skills viewing a correct utilization for new technological resources in the surveyed hospitals. The interviewees were consensual as to the challenge assigned after implementation of innovations, being mainly professional training direct or indirectly involved in the utilization of new technologies; on the functioning of each equipment or system, on the knowledge of correct handling with technological resources, on how to insert and access information, on how does each technology impact the other sectors of the hospital, among many other qualifications. The above mentioned data is consistent with the propositions of Djellal and Gallouj (2007a), about the impact of Information Technologies over productivity and professional's qualification in hospitals.

Professional qualifications identified during the interviews, were described in terms of productive behaviors at work: (1) handling correctly in the day to day work: systems, equipments and technological resources suggested for hospital service delivery; (2) describing product characteristics and services offered by the hospital; (3) inserting information into systems in a correct and conforming manner to the required hospital patterns; (4) describing correctly system functionalities, equipments and technological resources used daily at hospitals; (5) rapidly finding information in systems or technological resources used at work; (6) keeping the utilized systems in the hospital properly updated; (7) identifying solutions for problems caused by the inadequate use of systems and working equipments; (8) demonstrating attention while using systems and equipments in the day to day job; (9) taking fast decisions facing problems while performing activities; (10) identifying contributions of implementing new technologies for the service quality of the hospital; (11) identifying potential operation errors of systems, equipments and technological resources used in the day to day tasks;(12) sharing important information with fellow workers; (13) demonstrating openness while working as a team; (14) communicating in a clear and objective manner with working

colleagues; (15) demonstrating aptitude to learning new knowledge and necessary abilities for performing your activities in the hospital; (16) describing the contribution that tasks from the sector you work in may supply to the service quality of the hospital; (17) looking up for integration with the other sectors of the hospital; (18) identifying how your work impacts the other sectors of the hospital; (19) identifying the contributions of your work to the service quality of the hospital; (20) contributing to service quality of the hospital through the exemplar performance of your activities.

According to the above described qualifications, some connections may be established between those innovations and the surveyed ones. Qualifications 1 and 6 have in common the barrier made by resisting computers use as well as other technological resources. Being that the this difficultness of adaption to new informational paradigms requires, mainly on behalf of physicians, qualification developments that may permit a correct use of the new support technologies for hospital services (TOMASI et. al., 2004). Qualifications 2, 4, 5 and 11 are related to the barrier made by lack of knowledge on innovation operation. Since once Information Technology is adopted, hospital professionals need to know its mechanisms and how these may impact their day to day work. Furthermore, according to accounts of interviewees, technical problems are common among technological resources. Thus having the ability of identifying them may contribute for viable solutions to these problems. While the other barriers mentioned in the interviews, as for the insufficient number of professionals for technical support and the limited number of computers, these stimulate the pointed out qualifications.

Qualifications 3, 7, 8 and 9 are related to the barrier through typos and benefits derived from innovation adoption. According to Goldsweig et. al. (2009), Tomasi et. al. (2004) and Walker and Carayon (2009), the adoption of Information Technologies in hospitals contributes to errors decrease while recording information, thus they consequently support error mitigation in diagnosis, prescription and intervention. However, it may be emphasized that implementing a new technology is not enough to guarantee these results, since it seems that qualification development is essential to support the correct usage of innovations in hospitals.

Qualifications 12, 13, 14 and 15 are related to the barrier of professional commitment and to the benefit of effective communication among healthcare professionals, since

according to Damberg et. al. (2009) and Walker and Carayon (2009), communication is an important variable in the process of Information Technologies adoption. According to Tomasi et. al. (2004), the recovery period of a patient may be related to these qualifications. Since that, communications, information sharing and team work contribute for a most securer and effective healthcare. Surveys on Information Technology adoption in hospitals have shown that in the process of innovating a hospital, there is a contribution value to production and delivery of its services starting from the qualification mobilization of their professionals. Resulting thus, that qualifications 16, 17, 18, 19 and 20 show that Information Technologies stimulate a behavior that contributes for the utilization of innovations and consequently for quality improvements in hospital healthcare, as stated by Fleuren et. al. (2004).

The above described qualifications, demonstrate how the recognition of the importance of an innovation is fundamental to the aim of making benefits tangible for providers and costumers of hospital services. Furthermore, as Damberg et. al. (2009), Djellal and Gallouj (2007a) and Walker and Carayon (2009) have already pointed out, the complete integration of all sectors in a hospital favors the creation of a service mix containing a better alignment towards costumers' needs. In short, results have demonstrated that Information Technology has an important catalyst role over structural changes, methods, procedures and qualifications at hospital organizations.

## **CONCLUSIONS AND RECOMMENDATIONS**

The target of the hereby article is to describe innovation adoption supported by Information Technologies and its causal factors in three private hospitals. In order to reach the general objective of the research, three innovations were identified, one in each hospital and already totally implemented for a period of at least one year: Electronic Patient Record, Intensive Care Unit Management System and the Intelligent Operation Theater.

The principal function of the surveyed innovations is to promote improvements for the hospital healthcare quality. Among the identified barriers; resistance to apply it and lack of knowledge on new technologies were common for all three innovations, a common

aspect of recurrence in Information Technology implementations (DJELLAL and GALLOUJ, 2005; TOMASI et. al., 2004). As to innovation facilitators, two results confirmed what has been published remarking on the importance of commitment on behalf of senior managements (KIMBERLY and EVANISKO, 1981) and on communication (WALKER and CARAYON, 2009) for Information Technology adoption in hospitals.

Benefits resulting from innovations, confirms the survey outcomes from Goldsweig et. al. (2009) and Walker and Carayon (2009). These surveys demonstrated that adoption of new technologies as a support for hospital services, contributes for a decrease in errors for diagnosis, prescriptions and interventions, including for patients' faster recovery. It is important to highlight that before such context, where intensive changes occur, a necessity for new professional qualifications aligned to technical service characteristics as well as to the impact these changes cause on structures, processes and on hospital organizational procedures. Thus, the surveyed challenges of the observed hospitals were towards training professionals to deal with new Information Technologies.

The identified qualifications among the accounts of interviewees, made changes in the behavioral profile of hospital professionals become evident, concerning the use of new technologies as well as to hospital services as a whole, as hinted by Djellal and Gallouj (2005). Thereby, the relevance of integration for apprenticeship action, may be understood through innovation strategies, in such a way as to favor training able professionals to act in an intensive innovation environment.

The final results of this survey allow us to relate some recommendations for future researches. The realization of a research that combines qualitative methods is recommended: (a) the relation between adoption of innovations and hospital productivity; (b) the effects of Information Technology over hospital work; (c) innovation impact on hospital healthcare quality noticed by costumers; (d) return on investment preordained to innovations; (e) the role of costumers on Information Technology adoption. It is further advised the realizations of an in depth longitudinal research, on innovations in order to identify nuances inherent to the adoption process, in

terms of incidental internal and external forces in the role of the engaged actors of the existing power relations, of decision making and of the innovation adoption scheduling.

Still accordingly to research data, further new surveys and managerial oriented recommendations may be proposed. It is initially important to research the qualifications originated from the Information Technology adoption throughout the different sectors of the hospital, in order to identify the impact extension innovation has caused over professional profiles in these organizations. It would also be significant to analyze the association between the identified qualifications and apprenticeship strategies adopted by hospital professionals, so that it could be distinguished how to acquire knowledge amid a dynamic, complex and intensive innovation surrounding supported by Information Technologies. In addition, identifying support variables for apprenticeship may contribute for knowledge production on individual and organizational processes of apprenticeship in a hospital context. Finally, analyzing how organizational variables, like; size, nature, level of complexity and number of employees, may impact the way people learn and the degree of expression of the qualifications resulting from hospital innovations.

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