# The Use of Information Systems in Health Care Facilities:
# A Brazilian Case

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## Abstract

Information technologies are increasingly incorporated into organizational functions. Also in the health sector, the incorporation of new medical technologies brings new challenges for IT managers to gather more and more information about patients. Thus, the aim of this paper is to assess the degree of maturity which healthcare institutions are and have with information technology, ie, how institutions use information systems, if computerized, and how they apply this system in the information management. Through closed questionnaire, 16 healthcare institutions in the north and northeast of the state of Santa Catarina were surveyed. Results show that there is a concern when using information strategically to decision making, even though the development does not follow a curvilinear shape ascending and Information Systems do not include features for analyzing complex data.

**Keywords:** technology; health; information systems.

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## Introduction

In the current economy, the information has value, and the commerce often comes to the exchange of information rather than tangible goods (STAIR; REYNOLDS, 2006). With that information technology has an increasingly strategic role in the design of metrics for measuring the achievement of organizational goals.

In private institutions as well as in public, information systems have as role, the organization, the analysis and dissemination of data and information between all business spheres. The systems connect and communicate through different areas of business processes. The importance of managing these systems competes with the need for dissemination of information right at your appropriate hierarchical level.

Managers need information tactics of the ongoing process indicators as to stipulate profit and loss regarding the objectives informed by the board. This same board needs to broadly and concentrated view information concerning the organization's navigation. In this line, each organization hierarchy has access to different systems and viewing data differently arranged.

Health institutions as well as service providers also need information hierarchy. Simply put, doctors and operators feed systems with different information about the patients. Supervisors and managers are responsible for the allocation and management of resources. Directors, finally, take care of the evaluation of return to the investments made.

As service providers, their focus should be on quality of care and continuous improvement of staff. It is known therefore that hospitals are major consumers of new technologies, using these as a differentiator. Thus, the technology kicks in to provide better support for hospital care.

These technological advancements have brought improvements to medical practice. However, companies in the health field have difficulty providing enhancements to customers, whether in service delivery or in its marketing (ALMEIDA; MELLO, 2004). For this reason, through the way other areas suffer outrage technological changes experienced by the medical industry as vital the population needs to walk at the pace of progress in service delivery.

Considering that, the purpose of this article is to verify the use and the information technology development in the health sector. Furthermore, it is intend to analyze the degree of familiarity which hospitals have with information technology in their business strategy.

This paper is structured as follows: Chapter two presents the theoretical basis that supports the theme, conceptualizing information systems and the Brazilian health sector. The following presents the methodology used in the study followed by data analysis. It is concluded with its the results, limitations and future suggestions.

## Theoretical base

In speaking of Information Systems, emphasis on a systematic basis will be given: the data, the information and the recently much discussed, the knowledge. The data consist of basic facts, simple observations about the state of the world, easily structured, measurable and transferable. These become information to be added meanings, as in a message. This message must provide a change of behavior on the receiver. To the value added information and experiences to an actor in a given context is given the name of knowledge. In organizations this knowledge is typically embedded in routines, processes, practices and norms (Davenport, Prusak, 1998).

## Information Systems

Computers and information systems are constantly changing the way organizations conduct their business (STAIR; REYNOLDS, 2006). The use of information systems (IS) by enterprises is already common factor and its concepts redefined the foundations of modern management. The use of IS became vital to the success of businesses and organizations (O'BRIEN, 2001) as inputs, processes and outputs - basic concept of a IS - are present throughout the organizational structure.

An information system is a set of interrelated components that collect, manipulate, and disseminate data and information (STAI; REYNOLDS, 2006) in order to facilitate planning, control, coordination, analysis and decision making in companies and other organizations (Laudon, Laudon, 1999). This set is composed of people, hardware, software, communication networks and data resources (O'Brien, 2001).

As fundamental role of IS in organizations, it can be considered: support for operations at the operational level; support for management decision making at the tactical level and; support for strategic advantage, at the strategic level (O'BRIEN, 2001).

The classical view of information systems found in the books of the 80s was a pyramid of systems that reflected the organization's hierarchy. Even though the pyramid is still useful, since it was formulated, a large number of new technologies have been developed and new categories of information systems emerged, in which some do not fit perfectly into the

original pyramid (SORDI, 2003). In this form of classification, it is adopted the concepts of: Legacy Systems, Integrated Systems and Collaborative Systems.

As Legacy Systems – from the English term meaning with inheritance - those inherited from one generation to another. Characterized mainly as the oldest for both, batch processes and online transactional systems. Usually, these systems still run on large computers - mainframes - and were developed during the decades of 70 and 80 from structured languages like Cobol and Fortran. Factors that indicate the survival of these systems are mainly its high replacement cost and the organization's dependency of business rules (SORDI, 2003). The Integrated Systems, as its name says, are those systems that integrate different areas of the organization. Modernly are considered developed from the philosophy ERP - Enterprise Resource Planning (MPR, MRPII and ERP). The proposed integration of systems occurs from common databases and distributed applications from various organizational sectors (LEON, 2007).

In the current knowledge era, focused organizations geared to the value of human capital, the Collaborative Systems are presented as a knowledge organizational tool. These have emerged to meet the communications needs of internal and external users to the organization and are characterized by ease connection of different IS and the interactivity between users in the execution of various activities (SORDI, 2003).

The amount of information generated is directly linked to how it helps decision makers achieve their organizational goals (STAIR; REYNOLDS, 2006). The measurement of this value is often made from Management Information Systems (MIS). Systems that offer a set of summary reports on the performance of the company, which are used for the feedback of operational planning (BATISTA, 2004).

In particular in the service sector, in terms of firm-client relationship, and vice versa, there are the customer relationship software (CRM - Consumer Relationship Manager). These systems have as a fundamental characteristic the storage of information and customer preferences and also previous interactions between the organization and its public.

In the medical sector, the generation, control and evaluation of information weighs heavily on the doctor-patient relationship. Since historical profile, medical records and daily monitoring of patients can be made by using information technologies. This use provides assertiveness and reliability to the service, regardless of the current actor - in this case the doctor. However, the human factor disassociation of the medical service provided - reinforced by reduced costs for care and vision for resource management - have led to a decrease in the quality of medical care (ALMEIDA; MELLO,

2004). For services, the elements to be observed as value aggregators to customers are: the results; process; employees (humans) and the reliability and the price (TABOUL, 1999).

**Information systems in healthcare**

According to Carvalho and Eduardo (1998), the penultimate two decades were marked by intense transformations in the Brazilian health system, closely related to the changes in the political-institutional sphere. Propositions to build a new health policy effectively democratic dating from the military regime, decentralized, unified and universalized. In the 1988 constitution, the results of the whole process developed over these two decades is materialized, creating the Unified Health System (SUS), determining that "health is everyone's right and duty of the State" (196th Article).

However a decade passed by with investments in the public sector not yet sufficient for health. As presents White (1996), in defense of decentralization of information in the health sector: "the health information system model ongoing does not meet the constitutional principles set for the industry."

In 2010, the Federal Council of Medicine (Conselho Federal de Medicina - CFM) issued a statement pointing out the "chronic underfunding" and "need for modernization of management tools" of public health in the country as the main reasons for the problems of the lack of doctors and the delay between scheduling and execution of consultations and examinations (Rossi, 2011).

Still, both in Brazil and worldwide, investments in computer information systems in healthcare (PCIS) are quite large, such as telemedicine (ALMEIDA; MELLO, 2004). The estimate is that for every large hospital is invested about 50 million dollars (Littlejohns; WYATT; GARVICAN, 2003). In contrast, the use of information technologies in the health sector in Brazil is still strongly associated with supporting the activities of control and accountability, given the tax requirements (ALMEIDA; MELLO, 2004).

The pressure to relieve private health costs in the U.S. forced the creation of coding and classification systems for cases that are statistically comparable (KUHN; Giuse, 2001). Health organizations are shifting focus to a more integrated health. This change has professional networks feeding shared databases and medical records.

Electronic charts and the creation of medical information from patients databases, succinct ethical questions and doubts about the safety and privacy of information. Viewed from the perspective of medical improvement, the possible contributions are enormous and rapid dissemination of in-

formation and in-patient medical care by integrating medical data dispersed (KUHN; Giuse, 2001). However, some studies (HSA; BERG; COIERA, 2004) showed that introduction of PCIS have weakened, rather than strengthen medical practice in order to promote errors.

In Brazil, the DATASUS as the responsible body for IT at the Ministry of Health, states that information technology "strategic and essential for the consolidation of a system of health information for the solvability of the actions and health services within SUS tool and how inducing the organization of networks of health care throughout the national territory "(PDTI, 2010). This plan of development of information technology aims at "aligning the business area of the organization, difficult but necessary task" (PDTI, 2010). The main difficulties of this alignment involve the need to transform the professionals to understand the changes. For some of the reasons for failure in implementing projects IS include lack of understanding of the reasons for users to implement and disregard the complexity of tasks in the health sector (LITTLEJOHNS; WYATT; GARVICAN, 2003).

Other important issues concerning the integration of medical data still often involve silent errors. These are mainly characterized by bad data entry - not exclusive to the medical field, with annually expenses of 38 billion in the U.S. - (ASH; BERG; COIERA, 2004), by the complexity of hospital systems with different interfaces and often several systems ( KUHN; Giuse, 2001) and to the absence of organizational change prediction with the introduction of new user-centric technologies (Berg, 2001).

## Method

This study is characterized as quantitative, with descriptive character and a survey type. According to Gil (2009), descriptive research has as its primary aim, the description of the characteristics of a given population. Still, surveys are characterized by direct interrogation of individuals whose behavior you want to know about.

As this paper aims to review the use of information systems for health institutions, a census was done with the institutions affiliated to the Union of Health Services Establishments in the North-Northeast of Santa Catarina (SIND-HOSP), which is composed by 16 institutions. All medium to large public and private hospitals.

To collect the data along with selected subjects, a structured questionnaire containing mostly questions to be answered within the range of quantitative evaluation was used. The completion of the questionnaire was conducted through indirect assistance from the researcher. The questionnaires were sent by electronic means (email), answered and re-

turned the same way. Since this is an adaptation of the work of Azambuja (2001) where the research was conducted in the textile sector.

After collection, the data were tabulated and analyzed using the SPSS statistical tool in its latest version 19. Regarding the statistical treatment was analyzed using descriptive results.

## Results

From the data gathered by the questionnaire, primarily developed by Azambuja (2001), it was possible to evaluate that all hospitals have IS and also that all have it in computerized format. This information demonstrates that surveyed hospitals are following the influences of marketing and the constant need fast information flow, this, provided by the IS in an integrated manner.

When inquired about their financial planning, ten (62.5%) reported making formal financial planning, five (31.3%) who do informal financial planning and only one (6.3%) did not make any kind of financial planning.

Regarding Information Systems, Table 1 shows the main functions for which the IS are used within healthcare institutions.

It could be seen that most of the systems serve to executives, to support both decision making and management information, which demonstrates the strategic concern of institutions. This information points to the need to focus on management of hospital resources (ALMEIDA; MELLO, 2004). It is noteworthy that among the 16 hospitals surveyed, all except one have information to executives or information used to support decision making. Still, fewer than 50% are used for simple automation systems business as a way to streamline internal processes.

Table 2 shows the features and technologies present in the IS of health institutions.

In this table, it is possible to be seen a disparity with the results in Table 1. In the first table, the majority indicates that the information is available to the company's strategy for de-

| Routinely used functions | N | % |
|---|---|---|
| Information for Executives | 10 | 62,50% |
| Information to Support Decision Making | 14 | 87,50% |
| Offices' Automation Information | 7 | 43,75% |
| Management Information - MI | 13 | 81,25% |
| Specialized Information Tasks | 8 | 50,00% |
| Other | 1 | 6,25% |

Table 1 - Functions of Information Systems. Source: research.

| Uses / Technology | N | % |
|---|---|---|
| Dataware House | 2 | 12,50% |
| Business Applications | 9 | 56,30% |
| Data mining | 2 | 12,50% |
| Neural Networks | 0 | 0% |
| Case Based Reasoning | 0 | 0% |
| Special System | 13 | 81,30% |
| Has no system | 0 | 0 |

Table 2 - Information System's Characteristics. Source: research.

cision making. In Table 2, it was found that the vast majority has special system (specialist) as a feature in the background and business applications. Only two hospitals hold feature as data mining and present no technical neural networks or case-based reasoning.

In particular in the health sector, case-based reasoning can be an excellent resource for troubleshooting through the causes given by patients (Dalfovo, 2004). The aim with this work is to point out the possible implementation of mining techniques and heuristics already present in databases of expert systems for extracting knowledge from information available (Barbieri, 2001). In its practical application, Dalfovo and Tamborlin (2010) found that neural networks enable systems to be agile and confident in their specific roles. Still, this result points to the vision that systems shall be targeted to hospital management and its vision of management of organizational resources (ALMEIDA; MELLO, 2004).

Table 3 presents the characteristics of health institutions IS.

One can see that the vast majority (81.25%) have information at a strategic level - focus on resource management (ALMEIDA; MELLO, 2004) - followed by ease of use with minimal training (75%) and the fact that IS has been implemented to meet executives (62.50%). According to Furlan (1999), a basic component of success is not applied: macroenvironment intensive data business for decision making. This same item was also identified as deficient by Azambuja (2001) in their research in the textile sector.

| Characteristics | N | % |
|---|---|---|
| Information on the strategic level | 13 | 81,25% |
| Project to meet 10 executives | 10 | 62,50% |
| Ease of use with minimal training | 12 | 75,00% |
| Macroenvironment intensive data business use | 4 | 25% |
| Using graphical features | 9 | 56,25% |
| They are mainly used for monitoring and control | 9 | 56,25% |
| Other | 0 | 0% |

Table 3 - Features of IS. Source: research.

| Level / Company /Serve | N | % |
|---|---|---|
| Board | 11 | 68,75% |
| Sector Managers | 10 | 62,50% |
| Departments Managers | 9 | 56,25% |
| Other | 1 | 6,25% |

Table 4 - Internal public served by the Information System. Source: research.

Table 4 shows the internal audience in which IS serves information.

It is noticed that the IS were deployed in order to provide managers (directors and managers) solid basis for strategic decisions, both in direction and control of the institution. However, information and knowledge in its broad form are not entrenched through organizational meanders disseminated by the hierarchy. These, better results than the ones found by Azambuja (2001), where low resource utilization graphs, and low data usage of macro business environment, indicated that the design of the IS, the topic on the strategic management was relegated to a minor importance sphere. In this research, we realized an improvement in terms of organizational strategic management. But it is still worth pointing out that the lack of appropriate heuristics to data mining makes up the deficiency in the extraction of knowledge from sedimented organizational information.

In Table 5, the results according to the source of data to be presented in IS can be seen.

One can contemplate a draw on information from the IS of the 16 companies surveyed. Half said only get the information of internal origin and the other half said to get it from both internal and external. Compared to the work of Azambuja (2001) there was an improvement in the sense of relevance given by the companies in the data source of external origin. This factor shows that at least half of the organizations consulted have focused on the market and, if followed Behlolav (1993), survive in the race.

Another factor that may have increased the display of information available from external sources, is the IS institutions data input with data from laboratories and imaging cent-

| Available | N | % |
|---|---|---|
| Both internal and external source | 8 | 50% |
| Exclusive internal Source | 8 | 50% |
| Exclusive external source | 0 | 0% |
| Total | 16 | 100% |

Table 5 - Information Availability. Source: research.

ers. The integration of data between healthcare institutions - as well as service providers - indicates a strong tendency of hospitals to act collaboratively in the production chain.

Table 6 presents the information processed by external surveyed institutions.

Table 6 shows, as well as the work of Azambuja (2001), that the data coming from suppliers are among the most cited. Corroborating with what was indicated by Table 5 as the source of the information. However, in this work, the vision pro-customer surpassed the previous work. This fact comes to finding new ways in which organizations had to fit, moving its strategic focus to the customer especially in the medical sector (Berg, 2001).

Table 7 shows how the health institutions monitor their clients.

It can be noticed that all institutions have a Consumer Service Call Centers (CSCC), a direct channel of communication between organization and client. Similarly, 87.50% claims to have e-mail and websites on the internet. On the other hand, there is a huge deficiency in new approach techniques towards the client, such as: Data Base Marketing and Knowledge Base and even the Call Center.

| External / Processed | N | % |
| --- | --- | --- |
| Competitors | 6 | 37,50% |
| Suppliers | 11 | 68,75% |
| Economic data | 8 | 50,00% |
| Customers | 12 | 75,00% |
| Other | 0 | 0% |

Table 6 - Processed Foreign Intelligence Source: research.

| Monitoring tool | N | % |
| --- | --- | --- |
| Sales force automation | 5 | 31,25% |
| E-mail | 14 | 87,50% |
| CRM | 8 | 50,00% |
| Call Center | 7 | 43,75% |
| Internet Sites | 14 | 87,50% |
| ECR | 7 | 43,75% |
| Telemarketing | 9 | 56,25% |
| Mailing | 11 | 68,75% |
| Knowledge base | 1 | 6,25% |
| Data base marketing | 1 | 6,25% |
| SAC | 16 | 100,00% |
| Helpdesk | 0 | 0 |
| None | 0 | 0 |

Table 7 - Client Monitoring Source: research.

To the detriment of the many custom data about their customers, Data Base Marketing should be a strong communication channel between the client and the health institution. So much for sending intra and extra institutional and organizational information to act as early warning system for customer inquiries and examinations. Allied to alerts by e-mail, could be included systems sending SMS (short message system) to unavailable customers by email.

Likewise, the call center, used by 43.75%, could be the channel of communication between the institution and its customers without access to email. It could be used either as a source of customer acquisition and retention as maintaining existing ones.

Table 8 presents notes of respondents regarding their monitoring done with competitors.

It is noticed that most of the institutions involved in this research participates in fairs (87.50%). The fairs are used to monitor the actions of competitors. Then it is seen what promotional material and associations fits in second place (68.75%) and third (62.50%) placement, respectively.

Likewise in which the work of Azambuja (2001), responses to forms of monitoring competition indicate that the institutions surveyed are almost indirectly monitoring the movements and marketing strategies of competitors. The information they capture from the competition is not necessarily obtained in a planned and deliberate market intelligence. Their information source competition is almost exclusively from Friday, brochures and printed material. Besides being this information largely fallacious, because its goal to create attractive and sell a powerful image of the organization, its validity is at the mercy of the playability of those who search. Viewing the way Health Institutions use information technology, it was sought to learn more about the respondent's strategic policies. Table 9 shows the response of institutions as the most important items in the assessment of their business. Respondents were announced marking up to top three options.

| Monitoring mode | N | % |
| --- | --- | --- |
| Benchmarking | 6 | 37,50% |
| Fairs | 14 | 87,50% |
| Releases | 7 | 43,75% |
| Marketing materials (brochures, flyers) | 10 | 62,50% |
| Class Associations | 11 | 68,75% |
| None | 0 | 0% |

Table 8 - Competitors Monitoring. Source: research.

It can be noticed that, through the respondents' view, only two (12.50%) of respondents claimed to be investing in the business name or prestige - doctors - an important factor in the evaluation of their business. This data shows homogeneity of respondents regarding important items in the administration of health institutions. Another fact that stands out is the fact that investment in service quality - the quality of medical service provided - as being the main item for all respondents.

Table 10 presents the strategies adopted competitive forces in the institution. In questioning, it was again asked respondents to mark a maximum of three items.

Regarding the competitive strategies used by healthcare institutions, it is clear that the formal partnership between suppliers and customers include most (75%) of the institutions surveyed. In the background, there is the leading by cost of services (68.80%), having been appointed by the textile sector differently (AZAMBUJA, 2001). The focus on niche market was presented in 8 (50%) of the institutions surveyed, this focus can be given to certain hospitals being specialized in certain types of treatments (eg maternity). The formal partnership and leadership by cost results can also represent the focus on resource management and reducing expenditure by the board of the institution (ALMEIDA; MELLO, 2004).

Table 11 presents the strategies adopted by institutions in the value chain. Question with a maximum of three items to be chosen by respondents.

| Evaluation of business | N | % |
|---|---|---|
| Investment in service quality | 16 | 100% |
| Investment in the name of businessmen's reputation | 2 | 12,50% |
| Investment in the company's brand | 15 | 93,80% |
| Compliance with the proposed negotiating with suppliers and customers | 15 | 93,80% |

Table 9 - Important items in assessing business. Source: research.

| Competitive strategies | N | % |
|---|---|---|
| Leadership at cost | 11 | 68,80% |
| Formal partnership between suppliers and customers | 12 | 75% |
| Niche differentiation by service | 7 | 43,80% |
| Focus on niche | 8 | 50% |
| None | 0 | 0% |

Table 10 - Adopted competitive forces strategies in the institution. Source: research.

| Strategies for value chain | N | % |
|---|---|---|
| Technological upgrading | 12 | 75% |
| Marketing and Sales | 9 | 56,30% |
| Financial strategy (cost / investment) | 10 | 62,50% |
| Post sale service | 5 | 31,30% |
| None | 0 | 0% |

Table 11 - Chain value strategies. Source: research.

The strategies of value chain presented in Table 11 show that 75% of hospitals have their focus to the technological updating financial strategy followed by the balance between cost and investment (62.50%) and the Strategy, Marketing and Sales (56, 30%). The technology upgrade confirms the strong need of hospitals to be continuously updating technologically, confirming the answers as to focus on improving the provided service. Allied to this, in the background there is the financial strategy of lowering operating costs of institutions (ALMEIDA; MELLO, 2004).

## Discussion

This study aimed to evaluate the use and development of Information Technology by health institutions affiliated to the Union of Health Services Establishments in the North East of Santa Catarina state.

Among the 16 institutions surveyed, it could be noticed that there is a concern on their part for the use of available information in a strategic manner, meeting the needs for management decision making. It was also perceived that

continuously, the use of Information Technology is expanding also in the health sector as in other sectors of the economy. It is noticed a big focus on investment in new medical technologies. However, the evaluation also contemplated that the development does not follow a curvilinear shape up as imagined, and that information systems do not include features for complex analysis of information in order to better meet the managers decision making. Techniques such as case-based reasoning and neural networks are not present in the medical institutions surveyed.

This also corroborates with the findings of Almeida and Mello (2004), confirming that the use of technology is a trend of physicians surveyed population. Still, revealing the relevant impact that can be provided by the adoption of new technologies in the health sector in the future.

It is also possible to perceive a growing incorporation of IS to the strategic management of the company. Each round in which this research is annually conducted and independently from the sector of application, it is noticed that most information technology and communication (ITC) in busi-

ness management is both fundamental and observed by managers of organizations. Attentive to the fact that the increasing incorporation of technology embedded in equipment used in the health sector, the greater the flow of data and information available for storage and analysis. Thus, there is a growing need for heuristic analysis and processing of this information to ensure competitive advantage to health care institutions.

Pointing as perspective for further work recurrence thereof, to provide a historical line and thus evaluate the growing use. Still, surveys of IT users could emerge new questions about the delay in the use of IS with more complex features.

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