

## HOSPITAL INFORMATION SYSTEMS: A STUDY OF ELECTRONIC PATIENT RECORDS

**Pedro Luiz Côrtes**

University of São Paulo – USP & University Nove de Julho – UNINOVE, Brazil

**Eliana Golfette de Paula Côrtes**

Unimed Paulistana & Universidade Gama Filho, Brazil

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### ABSTRACT

The importance of patient records, also known as medical records, is related to different needs and objectives, as they constitute permanent documents on the health of patients. With the advancement of information technologies and systems, patient records can be stored in databases, resulting in a positive impact on patient care. Based on these considerations, a research question that arises is “*what are the benefits and problems that can be seen with the use of electronic versions of medical records?*” This question leads to the formulation of the following hypothesis: although problems can be identified during the process of using electronic record systems, the benefits outweigh the difficulties, thereby justifying their use. To respond to the question and test the presented hypothesis, a research study was developed with users of the same electronic record system, consisting of doctors, nurses, and administrative personnel in three hospitals located in the city of São Paulo, Brazil. The results show that, despite some problems in their usage, the benefits of electronic patient records outweigh possible disadvantages.

**Keywords:** Hospital information systems, Patient records, Electronic record.

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Endereço para correspondência/ *Address for correspondence*

*Pedro Luiz Côrtes*, Associate Professor of the School of Communications and Arts – University of São Paulo – USP; Professor of the University Nove de Julho – UNINOVE University of São Paulo - USP - ECA – CBD Av. Prof. Lúcio Martins Rodrigues, 443 Cidade Universitária CEP 05508-020 – São Paulo – SP – Brasil Tel (11) 8236-8197 – fax (11) 3091-4325 E-mail: [plcortes@usp.br](mailto:plcortes@usp.br)

*Eliana Golfette de Paula Côrtes*, Medical Auditor of Unimed Paulistana, Specialist in Auditing and Regulation Mechanisms of Universidade Gama Filho, E-mail: [eliana@greensoft.com.br](mailto:eliana@greensoft.com.br)

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## 1. INTRODUCTION

The importance of patient records is related to different needs and objectives. They constitute the permanent documentation of patient health, permitting the medical professional to evaluate symptoms and signs within a broader temporal perspective, contributing to improvements in making diagnoses and providing treatment. The value of the patient record is also understood within the legal scope because it can be taken to trial, allowing doubts to be clarified and behaviors to be discerned, which, in turn, can protect patients, medical professionals, and other involved parties.

In addition to the medical and legal considerations, the records provide research assistance because they contain information that helps to contextualize the evolution of patients, allowing procedures and consequences to be evaluated.

The Federal Council of Medicine (FCM), by means of Resolution 1.638, defines patient records as “*a unique document made up of a set of recorded information, signs, and images, generated based on facts, occurrences, and situations on the health of the patient and the care that he is given, which is of legal, confidential, and scientific character, and which makes it possible to have communication among members of the multi-professional team and the continuity of the care given to the individual*” (FCM, 2002). To satisfy these functions, patient records need to be legible, organized, documented, without erasures, and appropriately archived for several years.

In large hospitals, there is a significant demand for space used for the storage of conventional records (printed records), which may make it difficult to maintain them or even to access the information. Furthermore, it is not rare to find that these documents are incomplete or have problems with legibility (Rodrigues Filho, Xavier, and Adriano, 2001).

As an example of this situation, Stumpf and Freitas (1997) reported the case of the Clinical Hospital of Porto Alegre, which, at the end of the 1990s, stored 680,000 records in a 665-m<sup>2</sup> area. The authors identified recurrent problems such as the low quality of information, illegible descriptive notes, examinations glued to the records (causing difficulties in checking the records of patients with long periods of hospitalization), excessive use of paper, and inadequate storage. Such complications make it difficult to handle these documents, with negative repercussions for patient care.

The consequences of the low quality of the available information and the problems of storage of and access to a large number of records extend to scientific research, impeding the development of retrospective and epidemiological analyses. As a result, Santos, Paula, and Lima (2003, p. 86) asserted that the manual information system is seen “*as a limited vehicle of communication that has been surpassed by modern digital technology.*”

With the evolution of information technology systems (generically denoted as IT), it would be expected that solutions for the electronic and digital storing of these documents would be rapidly developed to facilitate their handling. Burt and Sisk (2005) considered that while policy analysts and policy makers have perceived the potential use

of IT in the healthcare field, this did not occur with the same speed observed in other areas. Côrtes (2008) noted that there are still only a few hospitals that use electronic records, which was also mentioned by Cerqueira and Mac-Allister (2005).

Hing, Burt, and Woodwell (2007) have reported promising trends. The authors indicated that while the quantity of physicians who use electronic records is still low, the use of these records has increased each year.

This growth is a reflection of the impact of hospital initiatives in broadening the use of IT as a way to improve the quality of services offered to the patients, to control the consumption of medical-hospital inputs, and to reduce costs (Shachak *et al.*, 2009; Uslu and Stausberg, 2008; Santos, Paula and Lima, 2003; Rodrigues Filho, Xavier and Adriano, 2001; Stumpf and Freitas, 1997).

Even though the literature presents various reports related to the use of electronic records within hospital information systems, benefits are not the only issues reported regarding the use of such systems. Kemper, Uren, and Clark (2006) stated that the cost of installing and maintaining these records is the main barrier preventing the adoption of electronic health records, a situation also indicated by Balfour III *et al.* (2009) as one of the major problems that hampers the dissemination of these systems. Another issue noted by these authors is the lack of standardization, which leads to difficulties in communication and interoperability of these systems (Balfour III *et al.*, 2009).

Arnhold, Schmidt, and Bohnenberger (2008), in studying an integrated system for the medical field, identified problems such as disbursement rates that were 159% greater than those originally predicted and long time periods needed for installation. Carvalho *et al.* (2008), upon analyzing the implementation of an integrated management system in a large hospital, found that it provided important benefits that outweighed potential difficulties, facilitating the execution and improving the quality of the services offered. The two cases demonstrated the influence of the chosen system supplier (especially with regard to care, training, and customization capacity) and of the way in which the implementation project was managed, resulting in the generation of different results for both projects (Arnhold, Schmidt, and Bohnenberger, 2008; Carvalho *et al.*, 2008).

Additionally, it is important to consider that the interaction of medical professionals with these systems is perhaps not very satisfactory, at least initially. This may compromise the implementation success of electronic records and of similar solutions, which is usually achieved with the use of integrated management systems (Biehl, 2007; Kansal, 2006; Shepherd, 2006). The focus of resistance may be even greater in hospitals because this requires certain changes in the ways in which doctors conduct their activities. Dawidowski *et al.* (2007) reported that difficulties were encountered by doctors, such as handling appointment times and interacting with the patients while concurrently handling the computer or the system (which generated a certain degree of distance in the doctor-patient relationship), in addition to failures in the system that caused delays and hindered the progress of the appointments.

As such, it has been shown that electronic records may become an important work tool, allowing not only the monitoring of patients, but also the analysis and the

control of the costs, in addition to facilitating access to information for the auditing of hospital accounts.

Based on these considerations, a research question that arises is, “*what are the benefits and the problems that can be seen in the use of electronic versions of patient records (electronic records)?*” This question leads to the formulation of the following hypothesis: *although problems may be identified during the process of using electronic record systems, the benefits outweigh the difficulties, thereby justifying their use.*

With the development of this work, an attempt was made to assess the perception of electronic record system users, evaluate the benefits and difficulties found, check how the use of these systems may contribute to better performance of the medical-administrative processes, improve management, and allow for higher quality decision making.

To respond to the research question and to test the presented hypothesis, a study was developed with users of an electronic record system consisting of doctors, nurses, and administrative personnel who worked with the same system (identified as the Alpha System) across three private hospitals (identified as hospitals A, B, and C) located in the city of São Paulo. This group comprised the surveyed population. The sample used in the data collection phase consisted of 37 users. In light of the above discussion, it is believed that the obtained results are representative only of the surveyed population and within the context of using the Alpha System in hospitals A, B, and C. Possible analogies and correlations with other systems and other hospitals are up to the reader, as they are not contemplated as an objective of this research.

## 2. LITERATURE REVIEW

### 2.1. CONSIDERATIONS REGARDING HOSPITAL INFORMATION SYSTEMS

The use of computers in medicine dates back to the 1950s with studies that attempted to expand the mental capacity of physicians (Stumpf and Freitas, 1997) or dealt with research on electrophysiology (Collen, 1986). With the evolution of this equipment, especially with the capacity to simultaneously execute various tasks beginning in the 1960s, computers began to be used in the processing of information in large hospitals, in both administrative and financial functions for the collection of statistics and the development of research projects (Stead, 2007; Stumpf and Freitas, 1997). The use of microcomputers, beginning in the 1970s, introduced the concept of distributed processing, increasing the number of systems in use in large hospitals (Stumpf and Freitas, 1997).

Because this diffusion did not always occur in an organized or homogeneous manner, the initial diffusion of computers in hospitals led to the emergence of islands of computerization, with isolated systems that lacked any form of interconnection and were developed by different teams. The redundancy and the lack of data integrity

deterred health professionals, who saw these systems as developed by systems professionals for systems professionals (Stumpf and Freitas, 1997). This situation was also investigated by McDonald (1997), who analyzed the lack of interconnection of the different systems used by the hospitals, laboratories, and service providers in the healthcare field.

Collen (1986) described the development of approaches in the 1970s that sought to approximate the habitual processes of decision-making with the use of artificial intelligence in differential diagnoses. In the same decade, studies were undertaken in search of a better organization of the healthcare system (Kaihara, 1978). With the help of computer-processed simulations, the author established an ideal relationship between medical centers and population demands.

The distributed processing was expanded during the 1980s with the development and greater availability of microcomputers, and the possibility of network communication of such equipment increased in the 1990s (Stumpf and Freitas, 1997). This allowed for the emergence of hospital information systems (HIS), covering medical, administrative, and hospitality areas, although hospitality may be considered as integrated into the administrative area (Cortes, 2008). These three areas are interlinked by horizontal data and information flows, providing support to the developed activities. Figure 1 shows a sample record for use in the medical, administrative, and hospitality areas, generating inter-related demands and actions. In the proposed scheme, the information on the electronic records, which contain the procedures, prescriptions, laboratory examinations, professionals involved, and hospitalizations (when applicable), is fundamental for an HIS (Wakamiya and Yamauchib, 2009; Pinochet and Albertin, 2008).

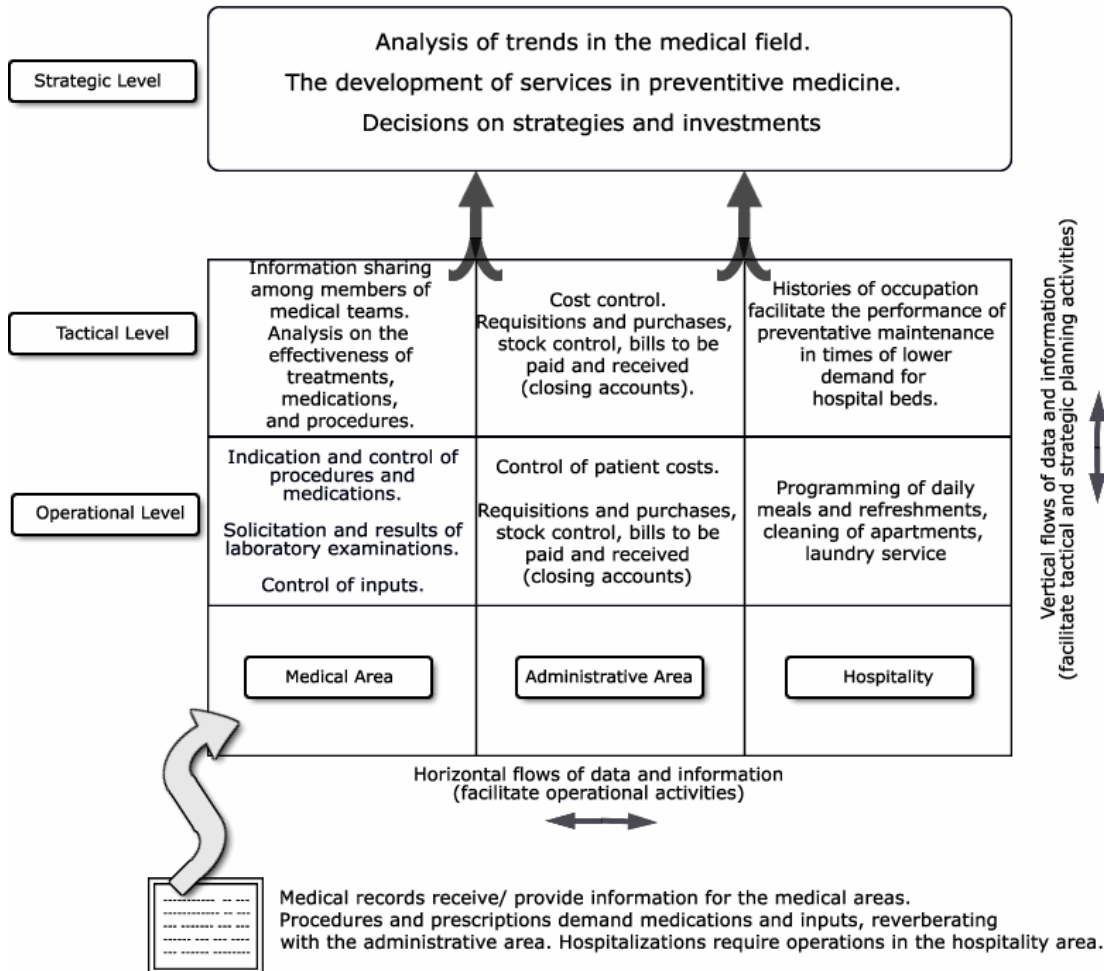


Figure 1 – Medical records as a generator of medical, administrative, and hospitality actions.

Source: based on Côrtes (2008), adapted by the authors

## 2.2. ELECTRONIC RECORDS

A patient’s medical record contains fundamental information for incorporation into a hospital information system, yet it is necessary to consider that not all hospitals adopt medical records, even though they may use administrative systems or even hospitality systems. While specific information is not available, professional practice shows that, in general, the administrative area benefits the most from information systems in hospitals. This use includes inventory management systems, accounts payable and receivable, financial services, and accounting services. In these cases, the traditional record (hand-written) should have part of its information inserted into administrative systems so that hospital bills can be processed. Similarly, hospital pharmacies use information systems to control stocks of prescriptions that are recorded in the medical records of patients.



This generates excess work that, in addition to consuming time and human resources, leaves the process susceptible to errors, delays, and failures, with repercussions that include the scheduling of exams, errors in forwarding requirements, and mistakes in billing that may lead to item disallowances, billing delays, or even missing charges for procedures or exams that have been performed.

Electronic records, when duly integrated with other systems, may reduce the occurrence of these problems, while also expediting the recovery of information for use by health professionals. This information can be used in statistical surveys, help with the analysis of procedures, be applied to preventative medicine, and be utilized for the control of hospital infections.

However, greater agility in the administrative processes and hospital procedures causes controversy, as one of the problems related to the use of HIS is that in order to deal with medical information, many systems end up demanding a change in the work methods of physicians who have always recorded their observations in structured and codified ways. Although some studies have considered this standardization and structuring to be necessary for the organization of and increase in the quality of information (e.g., Setz and D'innocenzo, 2009; Hoff, 2009; Wakamiya and Yamauchib, 2009; Chaudhry *et al.*, 2006; Shekelle, Morton, and Keeler, 2006), other studies concluded that this could harm the transmission of information among medical teams, imposing restrictions on the medical information that is input into the system (e.g., Warwick, 2009; Dawidowski *et al.*, 2007; Stead, 2007; Walsh, 2004; Stumpf and Freitas, 1997).

Adler-Milstein (2009) stated that the potential benefits of using IT in the healthcare field, including efficiency and quality gains, will only be possible if the hospitals and clinics promote organizational changes, including greater autonomy for the individuals in the decision-making process and an increase in training programs. This situation is similar to that recommended by Goldzweig (2008), who concluded that the impact of the implementation of HIS depends on the context of the implementation and applications, as well as on the clinical problems and the patient population.

Another possibility presented by electronic records within HIS is the electronic prescription. Balfour III *et al.* (2009) concluded that this improves the level of care given to patients by eliminating the need to interpret handwritten prescriptions, reducing the possibility of errors regarding dosages and increasing communication speeds with hospital pharmacies. The presentation of the available drugs facilitates the indication of generic medications, potentially decreasing the costs for the patients (BALFOUR III *et al.*, 2009), reducing the dosages prescribed when associating the support systems with clinical decisions (Shekelle, Morton and Keeler, 2006) and permitting a more rapid renewal of prescriptions and dosage changes (Weingart *et al.*, 2009).

Despite the abovementioned benefits, some problems were identified in studies focusing on electronic prescriptions. Physicians did not always check the prescription before its transmission (Hellström *et al.*, 2009) and also did not pay attention to the warnings regarding interactions among medications because many warnings referred to drugs that were no longer used (Weingart *et al.*, 2009).

Another general benefit provided by HIS and especially by electronic records is

the medical and nursing audits of the accounts presented to health insurance carriers. This analysis constitutes one of the main resources used by the carriers to better manage their costs with hospital care (Ribeiro *et al.*, 2008; FARIAS and Melamed, 2003). As a result, the auditor ends up adopting a financial approach and a vision of controllership, seeking the economic viability of the business and analyzing unauthorized charges for hospital costs. In this process, medical records will be able to reduce the number of errors, as they can set rules for the performance of procedures in addition to facilitating the investigation of conduct, inputs, and medical-hospital costs for the patients (Scarparo and Ferraz, 2008).

This action ends up impacting the price charged by the health insurance carrier, which is one of the items contemplated by consumers when choosing a health insurance plan. Along with medical care, structure of the operator, medical staff, communication, and convenience, price was one of the seven constructs identified in the research conducted by Milan and Trez (2005) that influenced the satisfaction levels of health insurance members.

### 3. METHODOLOGY

In search of a better understanding of the use of medical records, the research was divided into three phases: *a)* literature review, *b)* data collection and treatment, and *c)* interpretation of the results.

To respond to the research question (*What are the benefits and problems that can be verified in the use of electronic versions of patient records (electronic records)?*) and to test the presented hypothesis (*Although problems can be identified during the process of using electronic record systems, the benefits outweigh the difficulties, thereby justifying their use.*), a study was developed with users of an electronic records system, specifically with a group consisting of doctors, nurses, and administrative staff who worked with the same system (in this case identified as the Alpha System) across three hospitals (identified as hospitals A, B, and C) located in the city of São Paulo. This group constituted the surveyed population. The sample population used in the data collection phase consisted of 37 users of the Alpha System, including physicians (assistants and auditors), the nursing team (assistants and auditors), and the administrative staff of hospitals A, B, and C. This sample population can be considered as causal (Bisquerra, Sarriera and Martinez, 2004) or as a matter of convenience (Appolinário, 2004), and it is characterized as non-probabilistic. The survey was funded by bibliographic research, allowing for better development of the research instrument (Appendix I) with which, for each question or assertion made, the interviewees could express their opinion by means of the application of Likert-type scales (Cooper and Schindler, 2003; Hill and Hill, 2002; Malhotra, 2005). The institutions involved authorized the performance of the research; the interviewees expressed, by means of a free and informed consent form, their willingness to participate in the study.

The responses were tabulated and processed with the use of the Statistical Package for the Social Sciences (SPSS), with the goal of obtaining descriptive statistical



parameters and interpreting the collected opinions. For this, we utilized a specialized bibliography to support the use of the chosen software and allow for the correct interpretation of the results (Dancey and Reidy, 2006; Bisqueira, Sarriera, and Martínez, 2004; Costa Neto, 1977; Carver and Nash, 2000; Pestana and Gageiro, 2000; Fonseca and Martins, 1996; Morettin and Bussab, 1981).

Due to the investigative nature of this research, this study assumes an exploratory approach that seeks to increase the understanding of a phenomenon that warrants understanding and evaluation. It is noteworthy that the obtained results and their interpretations are limited to the surveyed sample population. Thus, possible generalizations should be made with due caution.

## 4. DISCUSSION

### 4.1. CHARACTERIZATION OF THE SAMPLE POPULATION

In the studied sample population, there was a predominance of physicians (51.4%) and nurses (43.2%) and a reduced number of administrative personnel (5.4%), with 75.7% of the respondents performing auditing functions. Regarding their age, the majority of the sample population (72.9%) was aged 40 years or older. This distribution is similar to that shown by Hing, Burt, and Woodwell (2007), enabling the conclusion that the age of the users is not considered a barrier for the adoption of information systems as an aid for medical procedures. To test the hypothesis that age is not an obstacle in the use of electronic records, a possible correlation was verified between the age range and the ease of use via a Pearson's coefficient that equaled 0.050. This value indicates that the perception in terms of ease of use is not related to the age of the sample population. These results contrast with those found by Joia and Magalhães (2007), who indicated that age is an important factor for the acceptance and use of this type of system.

In relation to the use of computers, 67.6% of the respondents reported using a computer for more than six years. When asked about how they would qualify their experience, the majority chose the option "average" (54.1%), followed by "good" (40.5%). A similar distribution was found in relation to the question regarding knowledge of the Internet. There was a predominance of the options "average" (48.6%) and "good" (35.1%). A possible relationship was shown between computer knowledge and the ease of use of the system, yet the Pearson's coefficient obtained was very low (0.107). This shows that computer knowledge, even when qualified by the user as regular, does not constitute a hindrance in the effective usage of the Alpha System, showing that the operation of this system is simple.

### 4.2. CHARACTERIZATION OF THE USE OF ELECTRONIC RECORDS

The majority of the respondents (67.6%) indicated that they had been using electronic records for more than 12 months. This was part of the daily routine for the majority of the sample population, as 56.8% used the system many times during the

day, whereas 13.5% accessed electronic records a few times a day for research (48.6% of the respondents) or research and typing (51.4%).

In relation to the average time spent when a person used the system, the distribution shows the existence of two distinct groups (Figure 2). To better understand this behavior, an analysis was performed to determine whether there was a possible correlation among the average time of each use and the auditing activity, professional occupation, type of system use, and frequency of use. The Pearson coefficients obtained were very low (less than 0.1), showing that there was no correlation among these variables and the average time spent on each system use.

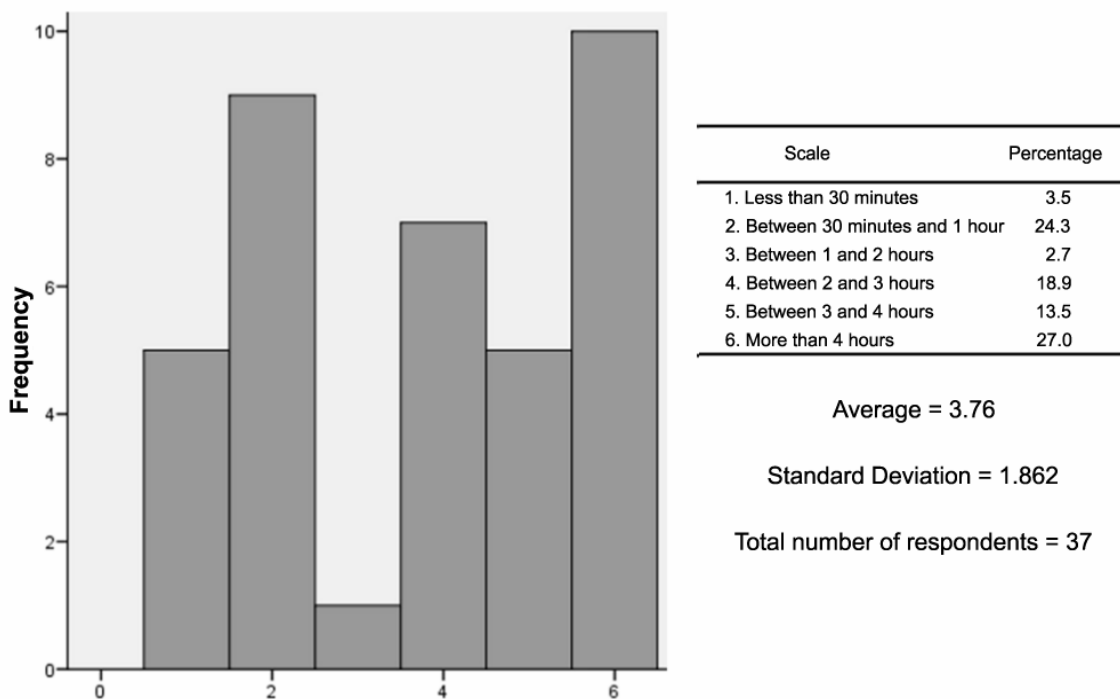


Figure 2 – Distribution of the sample population according to the duration of each system use.

The studied sample population reported good experiences in using electronic records (mostly over 12 months), many of whom used the system many times during the day. The duration spent on each use varied from less than 30 minutes to a few hours at a time.

### 4.3. EVALUATION OF ELECTRONIC RECORDS

The majority of respondents (64.9%) considered the system to be easy to use and to function well (59.5%), as seen in Table 1. However, there was no consensus in terms of the speed and occurrence of the few interruptions. There was a possible correlation

between the people who considered the speed to be inadequate and those who expressed the existence of interruptions, although the Pearson's coefficient obtained was very low (0.397). This shows that the perception of the speed of electronic records does not have a direct relationship with the occurrence of interruptions. It is possible that these evaluations (speed and interruptions) are the result of differences in the IT infrastructure available in the respective hospitals, a factor that was not studied in this research.

The ease of inputting information into the electronic records was evaluated as "good" by the majority (57.7%) of the sample population, with the results similar to those obtained in the analysis of the ease of use and adequate functioning.

The general perception that indicates the ease of use (statements related to the ease of use, the adequate functioning of a system, and the ease of inputting information) shows results consistent with those verified by Hellström *et al.* (2009). In their research, the authors claimed that the majority of physicians interviewed considered electronic records easy to manage. In the sample population studied in this research, the perception of the ease of use of the system did not present a relationship with age or with the degree of computer knowledge. This shows that age is not a factor in the use of electronic records (Alpha System) and that the records can be adequately utilized even by users with only an average level of computer knowledge.

This result contrasts with those obtained by Santos, Paula, and Lima (2003), who identified the difficulty of nursing professionals regarding the use of technology or information systems. The authors concluded that this difficulty could be attributed to the fact that the respondents had graduated more than ten years earlier. In this study, however, a correlation was not found between the age of the respondents and any possible difficulties in the use of the system.

It should be mentioned that the ease of implementing of internal protocols is facilitated by the adoption of electronic records, with 79.5% of the respondents expressing agreement, as observed in Table 1 (47.1% agree and 32.4% completely agree). Chaudhry *et al.* (2006) concluded that the greater adherence to the pre-established protocols and guidelines leads to an increase in quality. The results obtained in this research contrast with those obtained by Kemper, Uren, and Clark (2006) and Dawidowski *et al.* (2007), which verified the claims of physicians regarding the need to adopt new procedures.

Table 1 – General evaluation of the operation of the system.

Scale	It is easy to use	The system works well	The system's speed is good	The system has few interruptions	It is easy to input information into the electronic record	It facilitates the implementation of internal protocols
1- Completely disagree	2.7	0.0	8.1	5.7	3.8	0.0
2- Disagree	13.5	21.6	37.8	45.7	19.2	5.9
3- Indifferent	8.1	16.2	5.4	2.9	15.4	14.7
4- Agree	64.9	59.5	43.2	42.9	57.7	47.1
5- Completely agree	10.8	2.7	5.4	2.9	3.8	32.4
General perception	✓	✓	○	○	✓	✓

Legend: ✓ there is a consensus ○ there is no consensus Source: research data

The information made available by the Alpha System is not always presented (or divided) in a consistent manner. In the sample population studied, 38.9% demonstrated discontent with the division of information, while 44.4% indicated that the information is divided in a consistent manner (Table 2). While the division of information may be the target of criticism, the system was positively evaluated in the statements regarding the presentation of clear, reliable, and useful information. Despite the positive evaluation, it is necessary to consider that for 40.0% of the sample population, the system did not provide complete information. However, no correlation was found among the responses for the statement “*The information is divided in a consistent manner*” and the statement “*The system provides complete information,*” because the Pearson’s coefficient was equal to 0.196. This indicates that there is a distinction among the sample population between the way in which the information is divided and whether or not it is complete.

Table 2 – Evaluation of the information made available by the system.

Scale	The information is divided in a consistent manner	The system provides clear information	The system provides reliable information	The system provides useful information	The system provides complete information
1- Completely disagree	0.0	0.0	0.0	0.0	0.0
2- Disagree	38.9	13.9	6.1	0.0	40.0
3- Indifferent	11.1	8.3	6.1	16.7	8.6
4- Agree	44.4	75.0	81.8	69.4	51.4
5- Completely agree	5.6	2.8	6.1	13.9	0.0
General perception	○	✓	✓	✓	○

Legend: ✓ there is a consensus ○ there is no consensus Source: research data

To better understand the quality of the information presented by the electronic records, it is necessary to consider the two basic forms in which this information is presented: the screens (for more simple and direct contact) and the reports (for analysis and conferences). The screens of the hospital information systems were studied by Wakamiya and Yamauchi (2009); Hyun *et al.* (2009); Shekelle, Morton and Keeler (2006); and Carroll, Saluja and Tarczy-Hornoch (2002), among others.

While Shekelle, Morton, and Keeler (2006) suggested that not all information can be adequately presented on a computer screen, which resulted in the suppliers of the systems promoting simplifications that considerably limit the options offered, Wakamiya and Yamauchi (2009) stated that important advances have been promoted in the forms presented on the screens.

Hyun *et al.* (2009) analyzed the screens used with electronic records from the perspective of the nursing routines, whereas Carroll, Saluja, and Tarczy-Hornoch (2002) studied the use of personal digital assistants (PDAs) with electronic records.

In the present study, the results of the evaluations on the screens of the Alpha System (Table 3) show that there is no consensus for a majority of the statements. In an initial analysis, the format of the screen, the quantity of information presented, the way in which the screens are organized, and the way in which they were ordered had the approval of the majority of the respondents. However, it is noteworthy that the statements that analyzed these questions also showed the existence of dissenting groups that varied between 19.4% and 32.4% of the respondents. The only consensus found was in the ease of the screens in terms of researching information.

These results are consistent with those of Shekelle, Morton, and Keeler (2006), as there is always the need to synthesize information into a single screen (or on a reduced set of screens). Hyun *et al.* (2009) indicated that while necessary information may be available on a screen, there is a natural preference in relation to their organization that impacts the evaluation of the system.

Table 3 – Evaluation of the screens of the system.

Scale	The format of the screens is agreeable	The system has enough screens for its activity	The screens of the system present good organization	The order of the information presented on the screen is in accordance with the need	The screens of the system facilitate research of the information
1- Completely disagree	0.0	0.0	0.0	0.0	0.0
2- Disagree	19.4	27.8	32.4	25.0	11.1
3- Indifferent	13.9	5.6	8.8	5.6	16.7
4- Agree	63.9	63.9	52.9	63.9	61.1
5- Completely agree	2.8	2.8	5.9	5.6	11.1
General perception	○	○	○	○	✓

Legend: ✓ there is a consensus ○ there is no consensus Source: research data

It may be correct to assume that the reports generated by an electronic record system would present, at least in principle, a tendency to receive better assessments compared to the screens of the same system. This assumption is based on the fact that printed documents need more space for the distribution of information, facilitating the formatting and the presentation of the information. The results obtained in this research corroborate this possibility for the Alpha System. While there was only a consensus for one question (of the five questions used) in the evaluation of the screens, there was a consensus for four out of the seven statements presented regarding the records (Table 4).

Despite the better assessment of records (compared with the screens of the system), some possibilities for improvement were identified, which could facilitate the use of the system. While the respondents stated that the generation of records was fast, that the reports were useful, and that they presented updated information, a consensus was not obtained regarding the ease of the configuration (Table 4).

While 51.9% believed that the records were easily configured, 29.6% disagreed. Because the Alpha System allows for the configuration of records by the users, this difference in perception could be a response to a possible flaw or deficiency in training, causing some users to be unable to explore all of the possibilities with regard to the generation of these documents. This is ultimately reflected in the organization of records (evaluated as good by 58.1% of the respondents, while 25.8% disagreed).

To better assess the repercussions of not knowing the formatting resource for records in other questions, there was a correlation among the responses to the statements “*the records are configurable*” and “*the system has sufficient records for its activity*,” resulting in a Pearson’s coefficient of 0.431. This result, while not very significant, allows for the assumption that some of the respondents thought that there were not enough records because they were not familiar with the configuration resources that allow for the generation of outputs that better serve their needs.

Additionally, there was a correlation between the statements “*the records are easily configured*” and “*the records of the system present good organization (with adequate use of tables, figures, graphics, and text)*.” The Pearson’s coefficient obtained (0.293) shows that there is practically no correlation between the responses to these two questions. There is also a relationship between the statements “*the records are easily configured*” and “*the records of the system have an appropriate format*,” resulting in a Pearson’s coefficient of 0.411. This, although not very significant, indicates that some of the users evaluated the formatting of the records of the known configuration resources.

The results obtained indicate that, at least for some of the respondents, difficulties with the configuration of the results end up being reflected in the assessment of the questions related to the formatting and quantity of these documents. This difficulty would be mitigated by timely training programs, recycling, or with additional support from the IT teams in the analyzed hospitals. A similar situation was reported by Joia and Magalhães (2007), who showed the lack of instrumental training as a barrier to the adoption of electronic records.



Table 4 – General evaluation of the records.

Scale	The generation of records is fast	The records are useful	The records present updated information	The records are easily configured	The records of the system present good organization	The records of the system present an appropriate format	The system has enough records for its activity
1- Completely disagree	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2- Disagree	16.7	0.0	10.0	29.6	25.8	5.9	23.5
3- Indifferent	13.3	19.4	13.3	14.8	12.9	20.6	14.7
4- Agree	66.7	71.0	70.0	51.9	58.1	67.6	55.9
5- Completely disagree	3.3	9.7	6.7	3.7	3.2	5.9	5.9
General perception	✓	✓	✓	○	○	✓	○

Legend: ✓ there is a consensus ○ there is no consensus Source: research data

The good evaluation obtained by the records in relation to their usefulness is better explored by the results presented in Table 5. These documents facilitate the decision-making process, improving their reliability. Similar results were obtained by Carvalho *et al.* (2008), who showed that the records help in the decision-making process and promote a significant improvement of internal controls. A similar situation was found in operations, with the records increasing the level of control of these activities and facilitating the coordination of tasks.

In relation to the activities of control, the studied sample population agreed that the records offer reliability, although there was no agreement in relation to the reduction of the need for control and surveillance. This may be explained by the fact that the records showed day-to-day situations that need to be analyzed and interpreted, which implies the performance of control, surveillance, and conferencing.

Table 5 – Utility of records.

Scale	Decision Process		Operations		Control	
	The records facilitate the decision process	The records improve the reliability of the decision process	The records increase the level of control over operations	The records facilitate the coordination of tasks	The records offer reliability	The records reduce the need for control, surveillance, and conferencing
1- Completely disagree	0.0	0.0	0.0	0.0	3.1	12.5
2- Disagree	6.1	9.4	6.7	6.5	15.6	25.0
3- Indifferent	12.1	15.6	16.7	9.7	12.5	18.8
4- Agree	66.7	59.4	63.3	67.7	62.5	37.5
5- Completely agree	15.2	15.6	13.3	16.1	6.3	6.3
General perception	✓	✓	✓	✓	✓	○

Legend: ✓ there is a consensus ○ there is no consensus Source: research data

To better assess the importance of electronic records, their utility was shown both for medical and nursing work (Table 6), as well as for the processes of billing and auditing (Table 7). In the sample population studied, there was a broad agreement that the Alpha System facilitated work in the fields of guidelines, authorizations, and patient care, promoting medical and nursing improvements. Medical prescriptions were also facilitated by the use of electronic records, allowing medications to be directly requested from the pharmacy and to be subsequently checked. Studies have demonstrated that electronic prescriptions may decrease the costs for the patients, as the list of available drugs facilitates the indication of generic medications (Balfour III *et al.*, 2009) and can lead to a reduction in the prescribed doses (Shekelle, Morton, and Keeler, 2006). This also facilitates the renewal of prescriptions and subsequent alterations of the doses (Weingart *et al.*, 2009).

The use of hospital information systems, which allows for access to a more structured set of information and which implies the adoption of better-defined protocols, may improve the quality of prescriptions and reduce the consumption of certain medications (Shekelle, Morton, and Keeler, 2006). The evaluated system, according to the respondents, presents a good level of integration with the Auxiliary Services for Diagnosis and Therapy (ASDT). This integration is important, constituting a critical factor for the success in the installment and use of electronic records (Bahensky, Jaana and Ward, 2008).

Table 6 - Utility of the system for medical and nursing work.

Scale	Facilitate s work in the sector of guideline s and authorizat ions	Facilitates patient care	Facilitate s work in the medical evolution of patients	Facilitate s nursing work in the evolution of patients	Facilitates the work of medical prescriptio ns for patients	Allows medications to be directly requested from pharmacies	Facilitates nursing work and checking prescripti ons	Presents a good level of integration with the units responsible for ASDT*
1-Completely disagree	0.0	2.9	0.0	0.0	0.0	0.0	3.4	2.9
2- Disagree	3.0	11.4	9.4	10.0	12.1	0.0	24.1	14.7
3- Indifferent	9.1	20.0	3.1	13.3	9.1	0.0	17.2	8.8
4- Agree	51.5	45.7	65.6	56.7	60.6	60.0	44.8	55.9
5- Completely agree	36.4	20.0	21.9	20.0	18.2	40.0	10.3	17.6
General perception		✓	✓	✓	✓	✓	✓	✓

Legend: ✓ there is a consensus    ○ there is no consensus    \*Auxiliary Services for Diagnosis and Therapy (ASDT) Source: research data

The utility of electronic records for billing and auditing activities is shown by the results in Table 7. There is a general consensus that the system facilitates the charging of hospital bills (87.9% agree or completely agree), allows for a better analysis of hospital bills (82.8%), decreases the occurrence of frauds (60%), makes auditing simpler for the processes of authorization and releasing procedures (84.8%), allows for better verification of the materials and medications used in the surgical center (78.6%), and provides better control over the consumption of medications (73.6%). The results obtained are consistent with the considerations of Scarparo and Ferraz (2008), Ribeiro *et al.* (2008), and Notolini *et al.* (2006), as mentioned above.

Table 7 – Utility of the system for the processes of billing and auditing.

Scale	Facilitates hospital billing	Facilitates analysis of hospital bills	Reduces the occurrence of frauds	Facilitates auditing in the authorization and release of procedures	Facilitates verification of the materials and medications used in the surgical center	Provides better control over the consumption of medications
1- Completely disagree	0.0	0.0	5.7	0.0	3.6	
2- Disagree	3.0	5.7	17.1	3.0	3.6	11.8
3- Indifferent	9.1	11.4	17.1	12.1	14.3	14.7
4- Agree	51.5	45.7	45.7	51.5	50.0	47.1
5- Completely agree	36.4	37.1	14.3	33.3	28.6	26.5
General perception	✓	✓	✓	✓	✓	✓

Legend: ✓ there is a consensus ○ there is no consensus Source: research data

## 5. CONCLUSION

The research question presented at the beginning of this work addressed the benefits and problems that could be verified with the use of electronic records. As discussed throughout the literature review and in relation to the results of the present study, the main benefits verified include the standardization of processes; the ease and agility in the recovery of information; better control over prescriptions, materials, and procedures; and better adherence to protocols and standards established by the hospital. Despite these benefits, certain problems were found, such as the difficulty organizing the information on the screens of the system, interruption of the system, and the difficulty in the formatting and adequacy of the reports.

Considering that a large number of the respondents were auditors in the medical field, some benefits were observed such as greater control over hospital inputs and procedures and a greater ease in the auditing of bills, which indicated plausibility for the formulated hypothesis (*“although some problems may be identified during the process of using the electronic records system, the benefits outweigh the difficulties, thereby justifying the system’s use”*).

It is important to consider that this study is of an exploratory nature, with no intention of exhausting the subject. Nevertheless, the results enable an initial approach that can be extended by continued research and further analysis, thereby serving as a baseline for future studies.

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### Appendix I – Research Survey

Medicine Doctor	<input type="checkbox"/>
Nurse	<input type="checkbox"/>
Administration	<input type="checkbox"/>

The respondent is an auditor	
<input type="checkbox"/> Yes	<input type="checkbox"/> No

Age range
<input type="checkbox"/> 20 years old or younger   <input type="checkbox"/> 21 to 30   <input type="checkbox"/> 31 to 40   <input type="checkbox"/> 41 to 50   <input type="checkbox"/> 51 to 60   <input type="checkbox"/> older than 60

	Less than 1 year	Between 1 and 2 years	Between 3 and 4 years	Between 5 and 6 years	More than 6 years
How long have you used a computer?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Terrible	Bad	Regular	Good	Excellent
How would you classify your knowledge of computers?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How would you classify your knowledge of the internet?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Longer than 12 months	Between 6 and 12 months	Between 1 and 5 months
How long have you used electronic records?			

	Less than once a month	Once a month	A few times a month	A few times a week	A few times a day	Many times during the day
How often do you use the system?						

	Less than 30 minutes	Between 30 minutes and 1 hour	Between 1 and 2 hours	Between 2 and 3 hours	Between 3 and 4 hours	More than 4 hours
What is the average amount of time you spend each time you use the system?						

How do you use electronic records?	<input type="checkbox"/> only research	<input type="checkbox"/> research and entry	<input type="checkbox"/> only entry
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What is your level of agreement with the following statements on electronic records	Completely disagree	Disagree	Indifferent	Agree	Completely agree	Do not know or does not apply
Are they easy to use?						
Does the order of information presented on the screen agree with your needs?						
Is the information divided in a consistent manner?						
The speed of the system is good						
The system facilitates patient care						
It facilitates hospital billing						
It facilitates the analysis of hospital bills						
It reduces the occurrence of frauds						
It facilitates the nursing work of checking medications						
It facilitates the prescribing of patient medications						
It facilitates the medical evaluation of patients						
It facilitates the nursing work in the evaluation of patients						
It facilitates the verification of the materials and medications used in the surgical center						
It allows medications to be requested directly from the pharmacy						
It provides greater control over the consumption of medications						
It facilitates the work in the sector of guidelines and authorizations						
It facilitates auditing in the processes of authorization and release of procedures						
It facilitates the implementation of internal						

What is your level of agreement with the following statements on electronic records	Completely disagree	Disagree	Indifferent	Agree	Completely agree	Do not know or does not apply
The system presents a good level of integration with the units responsible for the Auxiliary Services for Diagnosis and Therapy (ASDT)						
The system works well						
The system provides clear information						
The system provides reliable information						
The system provides useful information						
The system provides complete information						
They system has few interruptions						
The system has enough screens for its activity						
The screens of the system present good organization (with the adequate use of tables, figures, graphics, and text)						
The format of the screens is pleasant (Zen,?)						
It is easy to insert information into the electronic records (Zen, 2008)						
The screens of the system facilitate research of the information						
The system has enough records for its activity						
The records of the system present an appropriate format						
The records of the system are well organized (with the adequate use of tables, figures, graphics, and text)						
The generation of records is fast						
The records are reliable						
The records are useful						
The records have updated information						
The records improve the reliability of the decision-making process						
The records facilitate the decision-making						
The records facilitate the coordination of tasks						
The records facilitate the need for control, surveillance, and conferencing						
The records increase the level of control over the operations						
The records are easily configured						

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