Are we on the right track to paperless hospitals?

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Abstract

Medical records management in São João Hospital Center (SJHC) is characterized by an hybrid context in which patient records are produced and stored both in electronic and paper format. Although SJHC has an Electronic Patient Record (EPR) application since 2004, SAM (*Sistema de Apoio ao Médico*), the fact that a patient medical record may be dispersed over various computer applications, not always connected with the hospitals' main EPR application SAM, and also in paper-based medical records, results in deficits and redundancies of information which cause delays or endanger the access to the patient record. In order to support the definition of a health information policy concerning the production of current medical records and the strategy to be applied to retrospective medical records, SJHC has conducted a medical information (re)use study. The fact that the main results of the study indicate that paper-based document typologies with higher access frequency are documents with textual medical records, which could alternatively have been produced in the EPR application, suggests that the co-existence of a paper-based medical record contributes to limit the use of the EPR. Conclusions of the study will support the Hospital's information management policy and the definition of the scanning strategy for current and retrospective paper-based records, which will be introduced as a temporary measure to maximize the use of the EPR, so that the institution fully benefits from the investment in information technology.

Keywords: medical information management; medical record; paper-based patient record.

Introduction

Medical information management decision making implies a wider perspective of the Healthcare system and a multidisciplinary approach, concerning different professionals involved in medical records production, storage and access. Considering that the objective of a medical information system is to support the needs of patients, healthcare professionals and healthcare institutions, most hospitals have successively adopted various departmental applications to respond to the specific needs of the different medical specialties and eventually introduced an Electronic Patient Record (ERP) application. As a result of the lack of an integrated information management strategy, the various computer applications used to produce and store medical records and the amount of current retrospective paper-based patient records stored in Clinical Archives place serious constraints that Portuguese hospitals face in the access to medical information. Since the paper-based medical record congregates printouts of the information electronically produced in various applications, not always integrated with the EPR, as well as the records originally produced in paper format, in some cases, it constitutes the sole information resource to have access to the complete patient record. Nevertheless, the fact that the paper-based record is a non-structured information resource and that the access is limited to the

physical format are disturbing factors for the daily healthcare activities. As Cruz-Correia, Wyatt, Ribeiro and Pereira (2010) stated, in a study concerning the use of clinical information in SJHC, despite major advances in information technology, the access to medical records is still inappropriate, resulting in duplication of effort, excessive costs, adverse circumstances, low efficiency and inability to take advantage of existing computer applications.

In this paper we describe the current medical information management model in SJHC, noticing the organizational, human and technological constraints that SJHC faces, which are common to most Portuguese hospitals. We present the results of the medical information (re)use study conducted in SJHC to support the current and retrospective medical records management strategy.

Current situation in SJHC

São João Hospital Center (SJHC), like most Portuguese hospitals, has an EPR (Electronic Patient Records) application, SAM (Sistema de Apoio ao Médico), implemented in 2004, which supports the production and access to patient records, allowing the integration of other medical information applications. Information management in a large hospital like SJHC, which has 1 100 beds and employs more than 5000 workers (more than 1 200 doctors and 1 800 nurses), is a highly demanding task. The diversity of applications used to support the specific needs of the 33 medical specialties that SJHC offers, not all connected with SAM, as well as the production and storage of current and retrospective paper-based records, pose serious challenges to the healthcare activities of the Hospital's professionals. Moreover, SJHC is a university hospital, hosting a Faculty of Medicine and several research institutes, what raises even more the medical information needs. The current situation negatively impacts the intense educational and research activity being carried on.

In order to understand the current medical information management model in SJHC, we made an attempt to uncover the evolution of perspectives adopted in SJHC concerning medical information management since its foundation in 1959. Considering organic and functional changes occurred in the Clinical Archives, Statistics, Medical Coding and Information Systems Services, we identified different perspectives which focused on the quantification of the hospital production, on the quality of the medical records and on the hospital's financing policy. The analysis of SJHC medical information management decisions since 1959, which reflect both the national policy and the hospital's perspective of its medical information patrimony, may be divided in four distinct phases:

1 - the creation of the Clinical Archive and Statistics Service in 1959, revealing particular interest with the quantification of the hospital's production;

2 - the initiative of creating the National Cancer Registry in 1977, focusing on the need to adopt statistical analysis considering medical records individually per patient, and the hospital's initiative concerning the standardization and the quality of the templates used to register medical information;

3 - the use of an application for inpatient encounters, designated SMIMAI, introduced in 1986, which requested a minimum set of medical and administrative information, allowed the systematic recording of information extracted from each inpatient encounter;

4 - the introduction of medical diagnosis codes, known in Portugal as GDH (homogeneous diagnostic group) in 1989, which are used for reporting and to support the hospital's financial policy, placed the focus on the quality of the medical records as well as on the need to convey information about all the healthcare activities to the patient record.

About the last ten years, it is important to refer the rise of hospitals' costs due to the growth of chronic pathologies, the increase in the consumption of medical drugs and the increase of life expectancy (Costa et al., 2008). These factors have contributed to the discussion of Hospitals' management models

and of the financial funding policy based on medical diagnosis codes. The dispersion of medical information concerning a specific patient encounter through paper and electronic supports, its storage in various formats, and the absence of a formal policy which ensures its long term preservation, are challenges that place constraints on the management of data concerning the hospital's production. To overcome these constraints, hospitals need to adopt a multidisciplinary strategy, combining the knowledge of various professionals, in order to develop and implement an internal information policy based on the institution's current information management model (functional processes and infrastructure).

Concerning SJHC current organic and functional structure, there are two non-clinical services responsible for medical information management, storage and access. The Documentary Processes Management Integrated Unit (DPMIU) is responsible for the hospital Clinical Archive and the access to medical information to internal and external users, and the Information Systems Service (ISS) is responsible for managing the hospital technological infrastructure that supports the production and storage of medical records in electronic environment. Although in SJHC these two services are cooperating in the Hospital's strategy for medical information management, this organizational model, which is common to most Portuguese hospitals, reflects the lack of an integrated information management strategy. Moreover, the gradual lack of investment in the modernization of Clinical Archives and the unsupervised growth in the adoption of new technologies in the Portuguese hospitals, have contributed to a fragmented vision of medical information management. The fact that the goal of a medical record is to accurately reflect the healthcare that the patient actually receives, implies that information management activities involved in the patient admission, treatment and discharge must be analyzed as transverse to the whole hospital. In this context, the development of information management strategies in SJHC and other hospitals may benefit from the adoption of a scientific perspective of medical records based on the systemic theory which approaches information as a phenomenon and a process, considering the Clinical Archive as an integrated part of the SJHC information system (Silva e Ribeiro, 2002) (Silva et al., 1998). In order to explore how the impact of the adoption of a modern perspective in medical information management may contribute to the introduction of changes in the information management functional processes, we present a brief characterization of the paper-based medical records in SJHC, as well as of the hospital technological applications that support the production, storage and access to medical records.

SJHC Clinical Archive stores more than 50 years of medical records in paper and microfilm format that support the healthcare and research activities of the Hospital's professionals (Table 1), which occupy an area of more than 1000 m2 in the Hospital building. The fact that managing enormous volumes of paper-based records is a physically demanding task, has contributed to the allocation of unskilled human resources dedicated to archiving tasks. Microfilm, which started in 1978 in SJHC, was the solution adopted by many hospitals to downsize the amount of paper-based records they had to preserve. As a result, the current access to retrospective records in microfilm format is excessive time consuming for medical professionals, since searches in the finding aids and the access to the information on microfilm forces users to go to the Clinical Archive. This is particularly disturbing in situations of access to retrospective records for healthcare purposes.

The fact that the SJHC does not have a single paper-based record per patient, keeping separated files for outpatient and inpatient encounters, the existence of isolated clinical archive solutions in paper and electronic format in some medical specialties and of various computer applications used to produce and store medical records, not all accessible to the whole medical community, are constraints that often result in redundancies and deficits of information. Moreover, the fact that there are records electronically produced in the EPR and in various applications which are printed and stored in the

patient paper-based record contributes to the growth of unstructured paper-based medical records. Due to the hospital's dimension and the lack of investment in a global strategic information management policy, it's up to medical staff to decide which records to print and integrate in the paper-based record. Although there is a general consensus among the medical community of the advantages of assessing, preserving and making retrospective paper-based records accessible in digital format, there are medical professionals who reveal discomfort towards the EPR application access policy and the uncertainty concerning long term preservation of records which are only recorded in electronic format.

TYPE OF PATIENT ENCOUNTER	YEARS	PRESERVATION FORMAT	FINDING AIDS
INPATIENT	1959-1992	microfilm	patients card files (inpatient and emergency encounters)
			microfilm books registry
INPATIENT	1993-2003	paper	patients identification system (SONHO)
INPATIENT	2004-2011	paper/electronic	patients identification system (SONHO)
OUTPATIENT	1959-1991	paper	patients card files (outpatient encounters)
OUTPATIENT	1992-2003	paper	patients identification system (SONHO)
OUTPATIENT	2004-2011	paper/ electronic	patients identification system (SONHO)
EMERGENCY	1964-1991	microfilm	patients card files (inpatient and emergency encounters)
			microfilm books registry
EMERGENCY	1992-2006(*)	paper	patients card files (inpatient and emergency encounters)
			patients identification system (SONHO)
EMERGENCY	2006-2011	electronic (**)	patients identification system (SONHO)

(*) 17 Nov. 2006
(**) In emergency encounters all records are produced electronically but we must consider paper-based records used in the emergency produced outside the hospital.

Table 1 - Identification of the preservation format and finding aids used in the SJHC Clinical Archive according to the type of hospital encounter and production date.

Concerning the medical records production in electronic format, the fact that since 2006 all information produced in emergency encounters in SJHC is produced and accessible in electronic format, integrated with SAM, ensures the access to these records 24h a day to the entire hospital medical community. As for information produced in outpatient and inpatient encounters, although the use of SAM to produce textual records has grown considerably in the last years, the percentage of use varies according to the medical specialty and the existence of departmental applications, as well as the availability of computers to register records in inpatient encounters. Figure 1 presents the main applications of SJHC which are used to produce and store medical records and shows that, besides the EPR application SAM, medical specialties use departmental applications that respond to specific needs. The representation was built considering four different levels for the information which is managed by the various applications: (1) identification, demographic and administrative; (2) exams and tests; (3)

medical history and medical encounters notes; (4) medical coding. Though the applications considered on fig. 1 are all integrated with the patients' identification system SONHO and the Hospital's EPR SAM, SJHC has other departmental applications which are not integrated with the Hospital's main applications and are accessible to the whole hospital medical community just in the paper-based records, which were considered in the (re)use study presented on the next section.

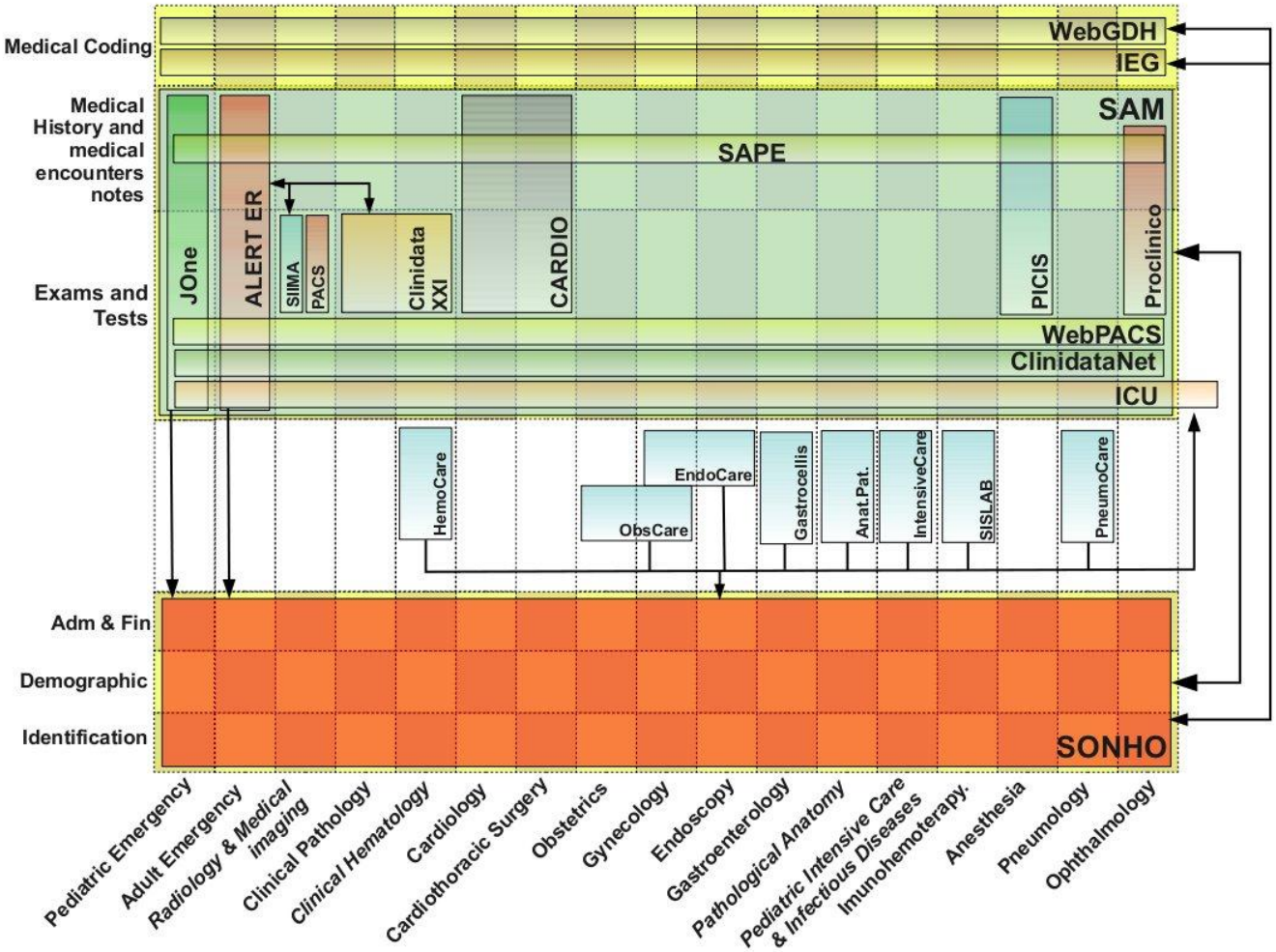

Figure 1: Graphic representation of the main medical information applications in SJHC integrated with SONHO and SAM. (Adapt. From Bastos, Março 2011)

In the attempt of preserving all retrospective records, according to the legal dispositions on Portaria 247/2000, which places the legal value of paper medical records on the original record or on the microfilm, Hospitals' budgets for Clinical Archives are limited to microfilm or paper storage outside the institution. These policies have never contributed to the implementation of assessment policies based on analysis of the content of the patient record considering the information substance and the information use, as proposed by Ribeiro and Silva (2004), contributing to the maintenance of unskillful human resources in Clinical Archives, and making the access to medical information more difficult. Although these arguments cause an impact in the Hospital community, the belief that the adoption of EPR applications will result in an effective modernization of the medical information services, has

been postponing the development of other approaches. Nevertheless, it is important to notice that the fact that most Hospitals do not have digital preservation plans constitutes a barrier in the adoption of paperless solutions, maintaining the paper-based record and the microfilm copy has a safety or disaster prevention measure.

The information management strategy for SJHC

Considering the current situation presented in the previous section, the main concerns in the information strategy for SJHC summarized on fig.2 focus on: (1) the diversity of templates and non-standard typologies for current and retrospective medical records; (2) the diversity of electronic formats and the growth of paper-based duplicated records; (3) the interoperability constraints of various computer applications used to register and store medical records and (4) the lack of updated procedures concerning the production and long term preservation of medical records.

Figure 2 - Main concerns in the information management strategy for SJHC.

To overcome these difficulties SJHC has defined an information management strategy which consists in the implementation of an EPR application, integrated with the existing departmental applications, which supports the hospital's functional processes and, simultaneously, in the integration of retrospective and current paper-based medical records in the EPR application. The fact that departmental computer applications are tailored for clinical practice of a medical specialty contributes to the production of data with appropriate level of detail, ensuring its quality and enhancing information retrieval, reinforces the need to focus on interoperability and use of structured patient information (Vedvik et al., 2009). This argument is sustained by a recent study conducted in Portugal in order to analyze interoperability problems in Portuguese Hospitals (Ribeiro et al., 2010). According to a survey conducted in hospitals in northern Portugal 66.6% of respondents confirm they have ongoing projects regarding the integration of computer applications and 88.9% defend the need to introduce legislation and certification of software to ensure interoperability. Although the study points to a 20.9 average number of computer applications per hospital, in large hospitals as SJHC, the number of computer applications is higher, since the number of applications is proportional to the size of hospital

(1100 beds and 33 medical specialties), which increases the problem of interoperability. Authors classify the internal interoperability inside Portuguese hospitals as weak, mentioning three possible causes regarding the poor computer application interoperability situation in Portuguese hospitals: (1) the fact that existing solutions are obsolete (66.7 %), (2) the trend of Medical Services to act as independent "islands" (61.1 %) and (3) the poor architecture definition of the solutions adopted.

In the belief that the Hospital will fully benefit from the use of the EPR only when the complete patient medical record is produced in electronic format, SJHC strategy consists in using the change from paper to electronic medical records in order to change work routines. The combination of the EPR development and the availability of retrospective and current paper-based patient records on digital format will promote the reduction of time and effort consuming tasks in the daily routine of medical professionals, and reduce paper storage and management costs, maximizing the benefits of the EPR implementation. Considering the costs and effort of the adoption of the scanning strategy of paper-based medical records, as well as the constraints on the use of handwritten information contained in scanned records, the scanning strategy, which will be introduced as a temporary measure to support the path towards the production of a complete electronic patient record, will be supported on the current use of paper-based records. The fact that scanned records present unstructured information, which is sometimes unreadable and not searchable, are arguments that were considered in the project development, as well as the analysis of the results of two scanning strategies implemented in two medical services in SJHC in the last years.

Scanning projects of retrospective medical records is not an innovation and there are some case studies in the literature that alert to the danger of investing in medical records scanning projects that have no impact on the Hospital community. The dematerialization of paper-based medical records project conducted in Norwegian Hospitals since 2001, which proposed to scan retrospective paper-based medical information to achieve a complete electronic patient record, was based on a study that revealed that a considerable number of the functionalities of the EPR were not used by medical doctors due to the coexistence of paper-based medical records (Laerum et al., 2001). After the implementation, although not using paper medical records was considered highly useful by Norwegian doctors, (Lium et al., 2008), the physical removal of the paper records allowed the introduction of organizational and functional changes, establishing working routines that maximized the benefit obtained with the EPR (Lium et al, 2008). It is important to notice that although recent show that Norwegian doctors prefer the EPR in which the scanned documents were integrated, instead of the co-existence of paper and electronic medical records, the health care professionals' culture in Norwegian hospitals was an important factor for the success of the paperless hospitals project. Moreover the national dematerialization strategy conducted in Norway was supported by legislation changes introduced in 1999 (Lium et al., 2009). Apart from the Norwegian project, an analysis of other case studies discussed in the literature (Ehsani et al., 2008) (Scott and Williams, 2009) and (Carrajo et al., 2008) show that eliminating the use of paper-based medical removes functional obstacles that cause constraints on the daily activities and promotes the use of EPR applications. However, scanning paper-based medical record is not an innovative solution and a EPR composed of scanned images limits its potential (Lium, Tjora and Faxvaag, 2006). Considering that the true potential of the EPR is reached when all medical records are produced electronically, hospitals must define an organizational medical information management strategy for paper-based patient records integrated in the hospital EPR.

Considering that SJHC has two medical services that have adopted scanning paper-based medical records strategies, we conducted an analysis of the methodologies followed in the implementation phase, as well as of the factors considered and the current impact in the service daily activities. Considering the analysis of the two scanning strategies that have been implemented in SJHC in 2003 (Service A) and 2004 (Service B) summarized on table 2, it is import to mention that these initiatives reveal the medical community concern about the access and preservation of medical records due to the

lack of an appropriate response of the Clinical Archive. Although both services have had success with the strategies implemented, considering the objectives traced, in terms of benefits obtained with the scanning strategy implementation it is important to stress the positive results on Service B. The fact that the scanning strategy was supported on internal assessment criteria concerning the content of the medical record to be scanned, as well as on the definition of rules on the production of medical records, restraining the paper-based records production, were key factors for the success of the project. It is also important to notice that the fact that on Service B there was an initial effort to scan a substantial volume of retrospective records and, simultaneously, to add current records to the digital archive on a daily basis, contributed to the medical community awareness of the benefits of using the digital archive application.

	Service A	Service B
Objective	(i) Reduce waiting time for the paper-based record; (ii) Ensure 24h a day access to the patient record; (iii) Support the research work of the service medical community; (iv) Control and limit the access to the patient medical record.	(i) Ensure 24h a day access to the patient record; (ii) Overcome safety rules against the poor physical structure of the room considering to the volume of paper-based records stored in the Service; (iii) Free the administrative staff from time consuming paper-based records management activities.
Methodology	(i) Complete scanning of the paper-based medical record into a .pdf file; (ii) Definition of forms to collect data from the patient medical record; (iii) Development of a digital archive internal application tailored to the service not integrated with the Hospitals patient identification system SONHO or with SAM.	(i) Assessment of the medical record content to be scanned according to medical criteria; (ii) Definition of rules concerning the paper-based forms that could be used to produce medical record; (iii) Mandatory use of SAM to produce textual medical records; (iv) Scanning of single documents into jpg files; (v) Removal of the access to paper-based records after scanning; (vi) Adoption of a digital archive commercial application integrated with the Hospital's patient identification system SONHO and with SAM; (vii) Invested in a 1 year contract of external services to scan a considerable volume of retrospective medical records; (viii) Promote the daily scanning of recent medical information to persuade the medical community to use the application.
Additional functionalities	(i) Definition of access levels; (ii) Use of forms to collect and extract data from the scanned medical records.	(i)Document typology classification; (ii) Metadata used: document typology, time and date of scanning; (iii) Keyword search in the document type structure.
Main current results	(i) Control and access to medical records is limited to the medical community of the service; (ii) Higher production of paper-based records when compared with other services; (iii) Reduced use of the hospitals' technological infrastructure to produce and store medical records; (iv) Production of electronic textual records not integrated with SAM; (v) Maintain the practice of printing retrospective scanned records; (vi) Delay in the scanning activities; (vii) Reduced use of the data collection forms in the digital archive application.	(i) All retrospective medical records have been scanned and are accessible to the all medical community; (ii) All textual medical records are produced in SAM; (iii) Patient retrospective information is all accessible in the EPR; (iv) Reduction of paper-based medical records in outpatient encounters (1 sheet per patient encounter); (v) Reorganization of information management activities in outpatient encounters (more patients and the same staff); (vi) All paper-based records currently produced are scanned and integrated in the digital archive application at the end of the day; (vii) Storage of all paper-based records according to legal imposition; (viii) Lack of updated procedures concerning the scanning of new paper-based forms common to the Hospital.

Table 2 - Analysis of the two scanning strategies of paper-based medical records that have been adopted in SJHC.

Considering the constraints as well as the costs and efforts necessary to put in practice the paper-based medical records scanning project, the Clinical Archives department conducted a (re)use study of the paper-based current and retrospective medical records in order to: (a) identify priorities considering time of production of the records and the medical specialty; (b) analyze the relevance of the different medical typologies which integrate the patient record for each medical specialty; (c) explore the best organization for the scanned records in order to support the access (Gonçalves, 2011). An analysis of a sample of patient records allowed an identification of the document typologies on the paper-based

records of different medical specialties, which was crossed with the identification of the existing applications used to produce and access each record (Table 3).

number of paper sheets	Document Typology	form nº	Production (Handw./ Elect)	Production Computer Application	Access Computer Application	Section
1	Obituary notice	213-A	handw.	n.a.		INPATIENT ENCOUNTER
1	Medical codes sheet	1267	handw.	n.a.	SONHO/ WebGDH/ IEG	INPATIENT ENCOUNTER
1	Admission and discharge form	1264	handw.	n.a.		INPATIENT ENCOUNTER
1	Care Plan	1078	handw.	n.a.		TREATMENT
6	Care Plan (IPO)	n.a.	handw.	n.a.		CORRESPONDENCE
1	Letter from external doctor	n.a.	handw.	n.a.		CORRESPONDENCE
2	Transthoracic echocardiogram (TTE)	n.a.	electr./ handw.	Cardio	SAM	EXAM RESULTS
4	Laboratory request form	n.a.	handw.	n.a.		EXAM RESULTS
4	Discharge report (Medical Service A/ B)	n.a.	electr.	SAM	SAM	INPATIENT ENCOUNTER
1	Ischemic evaluation study	951	electr./ handw.	internal electronic devices		EXAM RESULTS
4	Echocardiogram (ECG)	n.a.	electr./ handw.	internal electronic devices		EXAM RESULTS
1	Patient transfer forms (IPO)	n.a.	handw.	n.a.		CORRESPONDENCE
3	Lab. Results	n.a.	electr.	Clinidata XXI	SAM/ ICU	EXAM RESULTS
15	Nurses notes	1192	handw.	n.a.		NURSES NOTES
2	ABL report	n.a.	electr.	internal electronic devices		EXAM RESULTS
22	Progress notes	n.a.	handw.	n.a.		INPATIENT ENCOUNTER
1	Exam request form	301/06	handw.	n.a.		EXAM RESULTS
11	Medical imaging results	n.a.	electr.	SIIMA	SIIMA	EXAM RESULTS
6	Prescription	n.a.	handw.	n.a.	n.a.	THERAPEUTICS
5	Emergency encounter report	n.a.	electr./ handw.	ALERT	SAM/ ALERT ER	EMERGENCY ENCOUNTER
1	Patient analysis ticket	n.a.	electr.	internal electronic devices		EXAM RESULTS
1	Imunohemotherapy report	n.a.	electr.	Sislab	ICU	EXAM RESULTS

information only available in paper format	handw. – handwritten
n.a. - not applicable	imp. -electronic

Table 3 - Analysis of document typologies in an inpatient encounter.

The results of the analysis of the paper-based medical records content show that it is common to print and add to the paper-based record medical information which is produced and stored in electronic format, as well as locating in a paper-based inpatient encounter copies of information produced in previous encounters. This last situation is more common in inpatient encounters due to the fact there are no mobile devices that allow the access to the EPR. The analysis of the paper-based records management activities and of the patients' records content allowed the conduction of a survey among the hospital community which contributed to analyze the access to retrospective paper-based records in outpatient encounters and in the Clinical Archive for research and healthcare purposes. A statistical analysis of medical records access requests to the Clinical Archive, considering requests of internal and external users for healthcare and research, and the main results of the surveys conducted are presented in the next section.

(Re)use of paper-based medical records in SJHC

The Clinical Archive supports the access to paper-based medical records for healthcare, research or administrative and legal purposes to internal and external users. The access to medical records in outpatient encounters is the most time and effort consuming activity of the Clinical Archive, ensuring the daily access to an average of 1572 patient records, stored in three different stores of the hospital building, which must be retrieved, verified, registered and archived. Considering the fact that SAM was implemented in 2004 and that there are some medical specialties that have gradually stopped using the paper-based record, we analyzed the number of requests of paper-based medical records for outpatient encounters since 2005, not considering requests which do not correspond to a real access to the paper-base record (fig. 3).

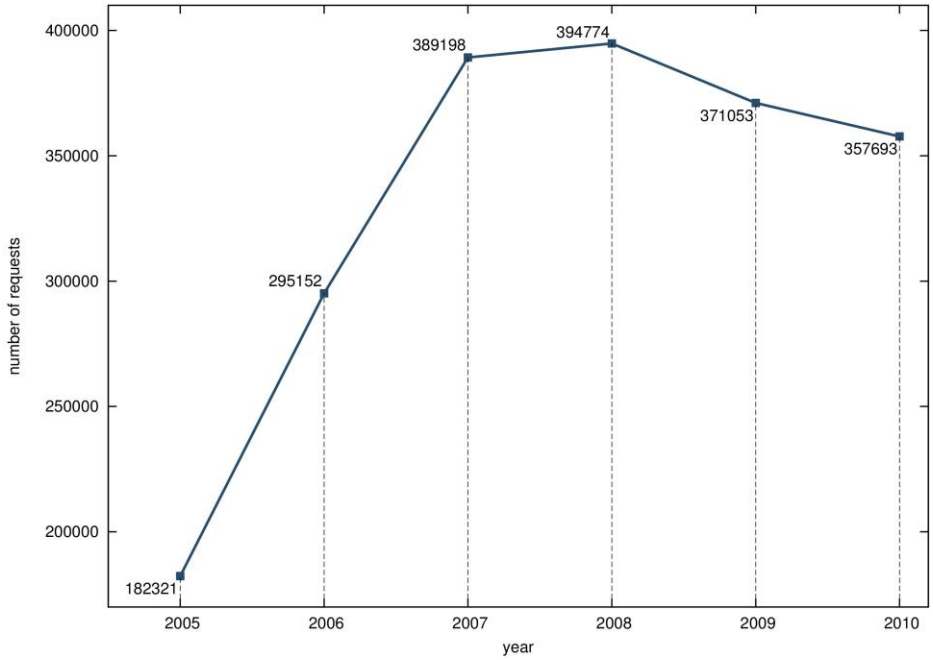

Figure 3: Requests of paper-based patient records for outpatient encounters in SJHC.

The fact that until 2008 medical doctors had to register their notes on the EPR application SAM and, simultaneously, fill in paper-based forms for referrals within the hospital or lab tests and exams, did not contribute to motivate medical professionals to use the EPR. The fact that since 2008 more applications and functions have been integrated in the EPR, may explain the decrease in paper-based medical records request after 2008. This indicates that when users perceive the benefit of using an EPR application in their daily activities, they are more willing to decide not to use the paper-based record. In the last two years, the fact that the Clinical Archive introduced some changes in the functional processes associated with the requests for outpatient encounters, downsizing the requests to situations in which medical doctors only use the paper-based record when the patient has external exams, reinforced the decrease of requests trend. Currently, Pediatrics and Surgery are the medical specialties with highest use of the paper-based medical record in outpatient encounters. This situation should be considered alarming since Pediatrics patients are the Hospitals' future patients and Surgery patients are most likely to have another patient encounter.

One of the most difficult aspects of analyzing the use of retrospective medical records is determining the time during which a specific medical information is clinically valid for healthcare, since use must be considered according to the patient's pathology and the various medical specialties (Cruz-Correia et al., 2010). In order to understand if there is a trend that may be observed concerning the access to retrospective medical records considering the year of the record, we used the requests data of inpatient encounters records from May 2011 to create a correlation between the number of requests and the year in which the record was produced. During the month of May 2011 the Clinical Archive registered 46 requests of paper-based records for healthcare purposes and 39 for research. These requests correspond to a total of 29 inpatient encounters records and 17 outpatient encounters accessed for healthcare purposes and 1333 inpatient encounters records and 450 outpatient encounters records accessed for research purposes. This data was used to build a cumulative probability function in order to analyze the percentage of accesses to information produced in previous years.

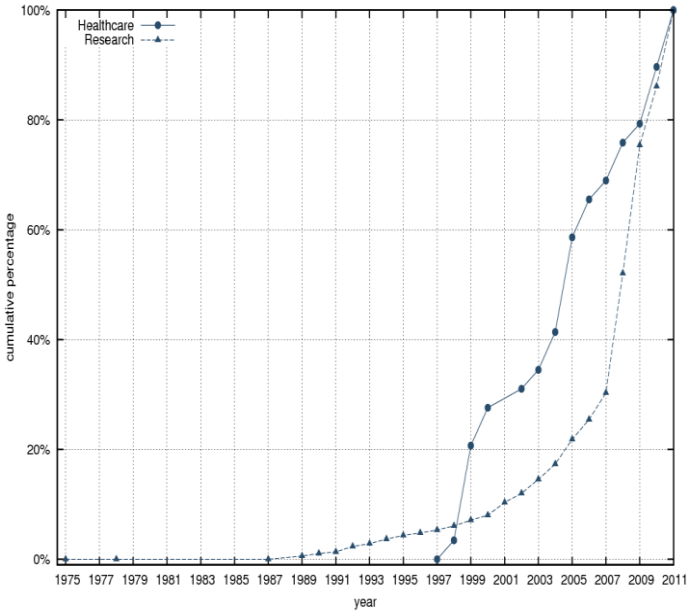

Figure 4: Cumulative function probability concerning the access to retrospective inpatient encounters paper-based records for healthcare and research purposes (based on requests registered in May 2011).

The interpretation of the data concerning the time interval between the production and the access to retrospective data is more accurate in access to inpatient encounters due to the fact that these records only contain information produced between the admission and discharge dates of the encounter. Concerning the access to retrospective records produced in inpatient encounters for healthcare purposes, 41% of the accesses registered were of records produced before 2004. The analysis of data concerning the access to inpatient encounters for research purposes also shows a descending curve as the time interval between the production and the access to the information increases. 75,3% of the accesses to inpatient encounters for research purposes were of records produced before 2009 and this percentage decays to 52% of records produced before 2008 and to 25,4% of records produced before 2006 (time interval of 5 years). The fact that medical codes only considers inpatient encounters produced after 1989 may explain the reduced access to inpatient encounters produced before this year.

The two surveys conducted in SJHC to users of the paper-based record in outpatient encounters and to users of the Clinical Archive allowed the collection of data concerning (i) the professional characterization of the respondents, (ii) the production and use habits of the EPR and of the paper-based record, (iii) the objective of the access, (iv) the type of encounter accessed and (iv) the content of the paper-based record they needed to access. The analysis of the data concerning items (i) to (iv) are systematized on table 4.

Clinical Archive users (102 respondents)	**Users in outpatient encounters** (142 respondents out of 600)

(i) professional characterization	• 91% medical doctors	• 87.3% medical doctors, 4.2% nurses and 4.95% nutritionists
	• 62.5% between 26 and 35 years old	• 34.5%between 26 and 35 years old, 29.5% between 36 and 45 years old.
	• 30 medical specialties	• 27 medical specialties and 33 outpatient specialties
(ii) production and use of EPR and paper-based record	• 47.3% use SAM, 17.5% use the paper-based record and 26.8% use both	• 78.5% use SAM, 4.1% use the paper-based record and 17.3% use both.
	• 52.5% assume they use the paper-based record on a daily basis	• 35.2% state they seldom use the paper-based record in outpatient encounters.
(iii) objective of the access to the paper-based record	• 46.9% research, 32.8%review a clinical situation, 13.6% healthcare, 6.8% produce medical reports, collect data, auditing and medical specialty meetings.	• 58.4% to have access to handwritten medical notes, 37.3% to have access to exams done outside the hospital, 27.4% when the patient has an outpatient encounter and 11.2% to have access to data not integrated with SAM.
(iv) type of encounter accessed	• 48.8% inpatient encounters, 34.8% outpatient encounters, 9.5% ambulatory surgery and 7% emergency encounters.	•100% outpatient encounters

Table 4 - Summary of main results of the surveys on (re)use of paper-based medical records conducted in SJHC.

The analysis of the habits concerning the production of medical records shows that there is a similar percentage of respondents that state they use SAM and the paper-based record to produce medical records. When we only consider respondents who only use SAM the percentage of those is higher for respondents in outpatient encounters (78.5%) than for respondents who are users of the Clinical Archive (47.3%). It is also important to notice that 52.5% of the respondents that are users of the Clinical Archive admit they use the paper-based record on a daily basis. Considering the objectives of the access to the paper-based record in outpatient encounters, the fact that 58.4% assume they access the paper-based record to have access to handwritten notes, suggests that an institution's information policy that stated the use of SAM as mandatory to produce textual notes in outpatient encounters could contribute to reduce the current production of textual notes on the paper-based record. The fact that there are 11.2% of the respondents that access the paper-based record to have access to data not integrated with SAM, reinforces the need to continue with the efforts of integrating departmental applications with SAM. The data gathered may help to define priorities since that, in this case, respondents were asked to identify the departmental applications. In outpatient encounters, the 27.4% of the respondents that state they always use the paper-based record in outpatient encounters are, probably, those that will not be willing to give up of the paper-based record.
In both surveys, respondents were asked to tick the document typologies that they accessed on the

paper-based record. This data was used to build a frequency matrix in order to analyze trends in the access to the various documents on the paper-based patient record (Fig 5 and 6).

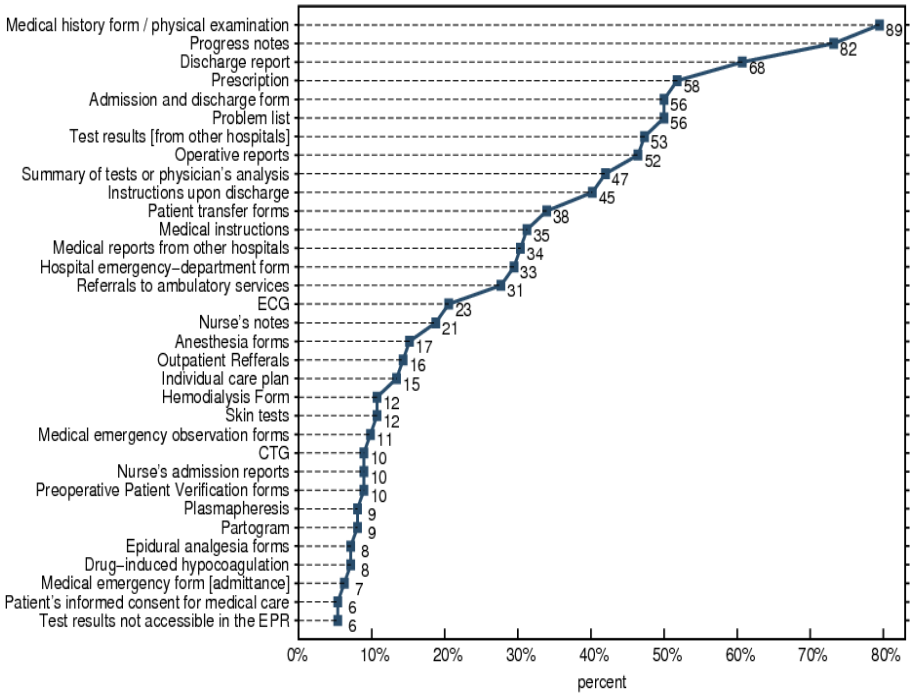

Figure 5: Frequency matrix concerning the access to medical forms on the paper-based medical records by users of the Clinical Archive.

Data considering the survey that the Clinical Archive users responded shows that the documents with higher access frequency are documents with medical textual notes (fig. 5). The fact that these document typologies could have been produced in SAM since 2004 indicates that SJHC is not fully benefiting from the EPR used. It is important to notice that the option not to produce notes on the EPR may be related to the fact that SAM does not have the possibility to limit the access to the patient doctor or allow the definition of access profiles, which is a controversy discussion among the medical community. This is an argument used by some medical professionals to maintain the production of paper-based records in parallel with the EPR. Nevertheless, the argument that another medical professional may need to have access to the full patient record in an emergency encounter is the main factor not to limit the access to the patient record within the medical community.

In the future, the 47.3% access registered to test results in other hospitals or exterior labs which are in the paper-based record, may no longer be necessary since these exams are stored on CDs and can easily be made available in the digital archive application. The document typologies with access frequency between 27% and 44% refer to documents with textual notes (transfer forms, medical instructions and nurses notes) as well as document typologies commonly used by all medical specialties which are only available on paper format (medical reports from other hospitals and referrals to ambulatory services). The document typologies with less than 26% access frequency refer to documents which are only available on paper or that are produced in an application not yet integrated with SAM and documents that are of specific use of a particular medical specialty. Data was used to build a correlation matrix, which allows the analysis of trends between two document typologies accessed by the same user. The correlation matrix shows high correlation values between typologies with medical records that

summarize the patient medical history (the medical history and the progress notes forms/ the admission and discharge form and the discharge report) and between documents which help to clarify the patient treatment in previous encounters (referrals to ambulatory services and the instructions upon discharge). The fact that the accesses to tests and exam results from other hospitals present high correlation values with referral to ambulatory services indicates that it would be useful to have access to this information in digital format integrated in the EPR, especially in outpatient encounters.
The same trends were observed on the frequency matrix concerning the survey for users in inpatient encounters. Documents with higher frequency are those that traditionally contain textual medical records. In outpatient encounters the exams in external hospitals or laboratories have an access percentage of 52.8%. It is also important to notice that respondents reveal a need to have access to retrospective outpatient encounters from other specialties and from the patient's medical doctor outside the hospital. The percentage of positive answers per document typology was standardized, considering the medical specialty of the respondents, in order to verify the distribution of the accesses per medical specialty. Data show for each document typology the number of accesses per medical specialty, revealing whether the access to each paper-based medical form is more common for some medical specialties or of global use (Fig.6).

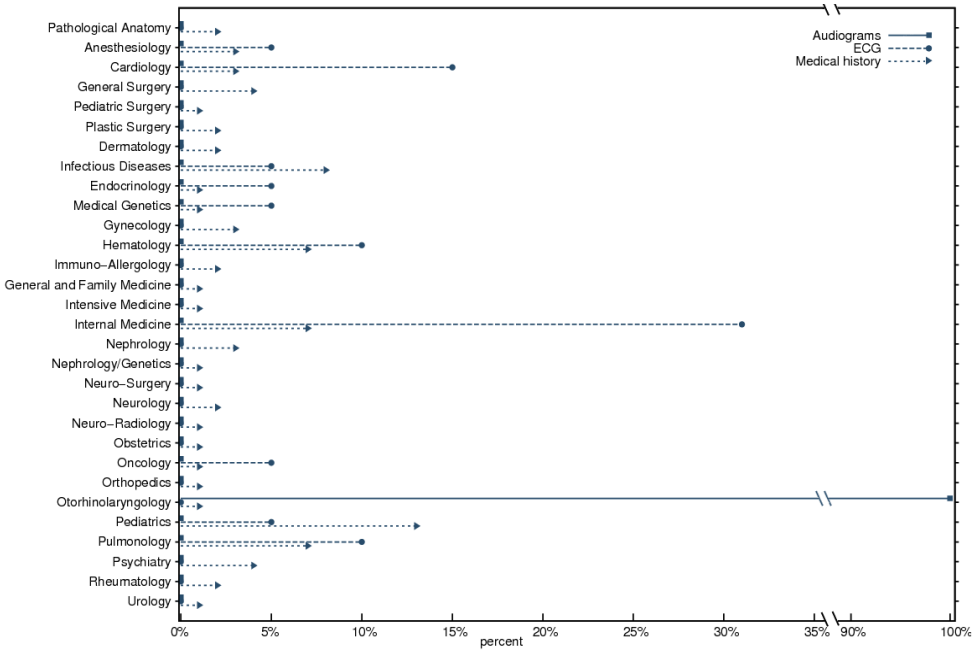

Figure 6: Example of percentage of accesses registered to three different paper-based records document typologies concerning the medical specialty of the Clinical Archive users.

According to the data analysis, current medical records produced outside the hospital, which are only available in the paper-based record, should be scanned and integrated in the EPR application. To use the digital archive to allow the access to recent data, which are brought from external institutions, will contribute to the users' understanding of the benefit of using the digital archive. The analysis of the frequency matrix allowed the distinction between document typologies in the paper-based records with medical information produced and used by all medical specialties and documents with information which tends to be used by a specific medical specialty. To formalize the scanning strategy, these records must be characterized according to its production, access and preservation potential, bearing in mind

that documents which are commonly used by all medical specialties have higher access frequency and, therefore, should have priority in the scanning strategy. The decision concerning documents used by specific medical specialties must consider the number of patients and the pathologies associated with each medical specialty, giving priority to patients from medical specialties with more hospital patients and more severe pathologies.

The fact that document typologies with higher access frequency for healthcare or research purposes are documents with textual medical records, which could alternatively have been produced on the EPR application, suggests that the adoption of EPR lacks an investment in the definition of an information policy in order to be successful. Bearing in mind that the results of the study show trends in the use of the document typologies, data from the reuse study is currently being analyzed and validated by the medical doctors responsible for the Hospital's various medical services. Results will support the definition of the scanning strategy for retrospective records. Moreover, the analysis and validation of the study will contribute to define procedures which will allow the introduction of changes in the daily information activities performed by the all community, e.g. which document typologies may still be produced on paper and which information electronically produced must be printed to the paper-based patient record. The fact that the retrospective information management policy is based on a reuse study, considering the information needs of the users, is a factor which contributes to ensure that the information policy will have a positive impact in the hospital's community.

Conclusions

Nowadays, Clinical Archives continue to invest in microfilm and in paper-storage services outside the hospital due to the lack of space to store paper-based records, in the expectation that the EPR will put an end to the paper-based medical records production. The fact that current legal requirements concerning the preservation of paper-based medical records maintain that medical records are of permanent preservation and must be stored in paper or in microfilm format in order to have legal value, contributes to dominate Clinical Archives by an empirical approach focused on floor space occupied by paper records, paper storage and microfilm costs. Moreover, the costs of allocating a percentage of the medical staff and nurses work time to the production and organization of paper-based patient records and, in some cases, the cost of total loss or inability to locate a paper-based patient record may be incalculable, resulting in poor human resources management and excessive costs repeating tests or exams and endangering the patient's health care. These current constraints are the proof that the current information assessment model adopted in the Public Administration does not meet Hospitals' information needs, doesn’t ensure the patient rights and that the adoption of technology by itself is not the solution to a paperless hospital. The current situation proves that the adoption of technology by itself is not the solution to a paperless hospital. The fact that digital preservation projects is a recent phenomenon in Portuguese public institutions indicates that hospitals may not be prepared to ensure long term preservation of medical records currently produced and stored in EPR applications.

The conduction of the (re)use study in SJHC allowed a thorough understanding of medical records production and access, emphasizing that any medical records management policy must be based on the use that medical records have in the pursuit of the Hospital's objectives. Information managers may play a key role in supporting the change from paper to electronic medical records, contributing to the development and implementation of paper-based medical records assessment policies based on (re)use studies and to the definition of digital preservation policies. In order to ensure that medical professionals and patients benefit from the investments in Information Technology (IT) to produce, store and retrieve medical records Hospitals need to involve the Hospital community in the development and implementation of information policies.

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