Adoption of an Ophthalmologic Electronic Record (Medisoft Ophthalmology) – Case Study and Success Factors

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Abstract

There is hardly any question that the future lies with electronic medical records. The implementation however requires investment, and in order for this investment to be cost-effective, it is important to identify the key success factors. Following the best practices described, it was possible to overcome the difficulties and reach the desired improvements: increased usability, paper-free records, error reduction, enabling audits and traceability without compromising patient privacy and efficiency. The deployment in a Portuguese Ophthalmologic Research Institute of a highly specialized Ophthalmology Electronic Medical Record, tailored to the Portuguese market, allowed the identification of these success factors. Their dissemination contributes to the overall increase in efficiency and the provision of better health care to patients.

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1. Introduction

The usage of Electronic Medical Records (EMR) is becoming widespread. However, there are obstacles to a successful adoption of electronic records [1] and to the transition from a paper-based paradigm. These
obstacles are not only technological, but often also related to the deployment procedures followed. Already in 1988 it was forecasted that Computer-Stored Medical Records [2] would play an important role in Medical Practice. Progress has not been so fast as predicted, though recently the adoption has gained a reinforced impetus [3].

Considering the investment required, the sustainability [4] and efficacy of the investment must be carefully considered, so that the process meets with the interests of the organization. A study in 2001 [5] compares 16 different solutions available at the time for an Ophthalmology context, but underlines that small percentage of ophthalmology practices have incorporated an EMR. Some limitations are identified in the same publication, such as the complexity to fully describe elements of the examination. Notwithstanding, the value of an EMR in a clinical setting has been upheld, in particular when clinical trials are carried out [6]. The adoption of Information Technology (IT) can enrich the clinical data [7] made available in comparison with paper medical records, which are time-consuming and error-prone to use. When clinical trials need to be run, the need for information further leverages the adoption of EMRs [8]. The issue of patient records privacy and computer phobic attitudes have also been studied and found not to be a barrier to EMR adoption [9].

2. From Paper to Electronic Medical Records

The common existing scenario is typically a paper based medical record system. In a Research Institute, the complexity is increased due to the fact that the Research Institute runs multiple clinical trials, which increase the documentation requirements. Paper-based medical records are vast and complete, but time-consuming to search, in particular when looking for possible candidates for a clinical trial. Relevant patient information may be spread over different records.

2.1. Objectives

The deployment of an Electronic Medical Record (EMR) proposes to achieve the following objectives:

- Quick and efficient identification of patients for Clinical Trials. Thus enabling increased competitiveness of the organization;
- Store Information on both Diagnostics and Clinical Findings. Clinical Findings are particularly relevant in a research context, and an important search criteria;
- Consolidate all information available; enable all researchers to access and search information from different on-going Clinical Trials
- Enable audit and traceability records, to clearly identify when each procedure was performed, by which professional and using which equipment.

2.2. What is an EMR solution

An EMR solution allows the collection of electronic health information about individual patients. It is capable of acquiring information from different sources, from interaction with users or directly from connected equipment.

The information stored may include a range of data, including demographics, medical history, medication and allergies, test results, images, or personal information. This information can be accessed by different users, with different profiles and access rights, and allows for the generation of reports.
3. Case Study Methodology

The research question at hand is “is it feasible to implement a completely paper free solution for a Research Institute?” In order to tackle this question, the case study herein presented will analyze the deployment and adaptation of a commercial EMR to a Ophthalmic Research Institute. In addition to the main question, the case study will also aim at clarifying: “Does a paper free practice have benefits such as increased efficiency over a paper based practice?”

The parameters to be evaluated are firstly the adoption of electronic records. In other words, the verification that paper records are in fact no longer required. Additionally the case study will also record whether additional advantages can be identified as the system is deployed. I.e. record if the deployment of the solution enables further improvements to the Research Institute activities.

The Research Institute participating in this case study is focused on Ophthalmology, conducting several simultaneous clinical trials. The choice of an EMR solution needed therefore to keep in mind the specific requirements to reach the appropriate solution.

3.1. About Medisoft Ophthalmology

Medisoft Ophthalmology is the most used Ophthalmology EMR system in the United Kingdom. It is currently in use at over 50 public hospitals, plus ISTCs and private hospitals. It has been developed by ophthalmologists, for ophthalmologists. The system features rapid data collection for all ophthalmic sub-specialities, Clinician Decision Support and detailed audit of clinical outcomes. The software interfaces with most ophthalmic diagnostic equipment and imaging systems. Medisoft is a highly specialized EMR for Ophthalmology, covering all the sub-specialties and allowing for the detailed recording of Ophthalmic procedures. Critical Health undertook the adaptation of this tool for Portuguese speaking countries, and extended the functionalities of the tool to answer specific needs mainly for the handling of clinical trials. These extensions were developed in partnership with Medisoft and later on incorporated in the original product. These extensions include the provision to record not only Diagnostics, but also Clinical Findings, and the generation of detailed reports. In this context, Diagnostics are understood as e.g. the identification of disease (such as Glaucoma), whereas Clinical Findings are observations (such as the recording of an abnormal intra-ocular pressure). The functionality of the existing EMR was complete for most clinical usage in hospitals and clinics, but in the case of Clinical Trials and R&D activities there are other specific requirements. E.g. the recording of Clinical Findings is very relevant, whereas the recording of diagnostics alone would not be sufficient. In Table 1 there are listed the reports that Medisoft Ophthalmology is able to export in the deployment described.

Table 1. On-demand reports that are produced by the EMR at any given moment.

<table>
<thead>
<tr>
<th>On.Demand Reports</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>Complete List of Patients</td>
</tr>
<tr>
<td>Consent</td>
<td>List of Patients of signed Consent forms</td>
</tr>
<tr>
<td>Clinical Trial</td>
<td>List of Patients per Clinical Trial</td>
</tr>
<tr>
<td>Findings</td>
<td>List of Patients per Clinical Finding</td>
</tr>
<tr>
<td>Exams</td>
<td>List of Exams performed per Technician</td>
</tr>
<tr>
<td>Exam List</td>
<td>List of Exams and Appointments</td>
</tr>
<tr>
<td>Exam Stats</td>
<td>Stats of Exams and Appointments</td>
</tr>
<tr>
<td>Ambulatory</td>
<td>List of exams in Ambulatory</td>
</tr>
<tr>
<td>Scheduling</td>
<td>List of appointments and scheduled exams</td>
</tr>
</tbody>
</table>
3.2. Data Protection, Traceability of Changes, and Audits

Patient data is protected for read and write actions in both application and database modules. Access to the database is restricted to specific users with permissions set and limited to the lowest possible settings in order to restrict data access and manipulation. These database credentials are set during the installation by authorized personnel and are never given to the users. At the application level, authentication and authorization layers are enforced by the User and Groups paradigm (similar to Active Directory) where a user is mapped to the respective group (e.g. secretaries or nurse) and has the edit/view functionalities limited to what the group(s) the user belongs to allows. This guarantees that only registered users are able to enter the system and only see and modify data if they have such access configured. In the scenario where, somehow, someone was to get access to the database server (which is installed in a password protected server) that person would still require to have the confidential (and internal only) username/password combination to access any kind of data.

The software also contains an audit layer for audit enabled fields. Changes made in the application to audit enabled fields are kept traced and logged in the database in specific audit tables. These audit tables keep a record of what was changed, when it was changed and by whom it was changed. A summary of these records changes is also visible in the 'admin tab' of each patient episode in the application for quick assessment of changes.

3.3. Localization & Translation of medical terms

Ophthalmology is performed similarly everywhere in the world. But nevertheless there are specificities that need to be tailored to the local market such as: drugs, visual acuity measurement scales and medical terms.

The original version of Medisoft Ophthalmology was available in English language only. In this project, a total of 40,000 expressions were translated to Portuguese, including 25,000 clinical expressions. This represents a significant effort, however once translated, the software can now be used in any Portuguese-speaking context (Portuguese language is natively spoken by more than 200 million people and the official language in 9 countries [10]). This is why Critical Health, Medisoft and the customer committed joint development efforts to achieve this.

Whilst medical doctors generally speak English proficiently, translation of medical terms is nonetheless mandatory. On one hand, several users will be making use of the software solution, including clinical secretaries, and other staff. Moreover, the software additionally needs to create outputs that are shared with the patients, such as letters and reports. Lastly, but not least important, very often clinical practices, including private ones, but research practices even more, need to interface with governmental entities. All these factors justify the investment in the translation effort.

4. Implementation Details

Implementing the Medisoft Ophthalmology EMR at the Ophthalmologic Research Institute allowed the identification of success factors. The objectives were a motivation for the project team involved, either bringing more knowledge or more productivity.
4.1. Generating Enthusiasm

Early involvement of users and stakeholders is paramount to the success. More important than training or users manuals, is the flexibility to involve the users in the customization of the workflow. This allows for a more efficient adaption, for a smaller burden with the change, and the generation of “champions” who are willing to uphold the configuration they choose and contributed to define.

4.2. Workflow definition

Each organization has their own workflows, and the EMR solutions assume also a given workflow. Transitioning from a paper based system to a digital one, involves more than just digitizing documents or typing in what was written to records. It implies the redefinition of workflows, and it is important to find agreements in the workflows that are acceptable to the users and possible for the software before deployment actually starts.

4.3. Hardware support

Since the EMR system was envisioned to take a fundamental role in the daily clinical practice, the aforementioned application was deployed over a two-node fail-over Microsoft cluster technology (based on Microsoft Windows Server 2008 and SQL Server 2008 products). The adoption of such a technology ensures a high level of reliability by providing fault-tolerance to hardware failures. At the same time it enables the possibility to undertake server maintenance tasks without disturbing users experience at any given time, even when the system is being used (no downtime occurs during maintenance).

With the increasing demand for prompt information, data security is a major concern, especially on systems where patients’ private information from patients becomes accessible and permanently stored. This aspect led to a tightened network and system access by implementing more restrictive security information practices. Data security was not only approached on the unauthorized access prevention but also on the consistency, traceability and storage safety features. While enabling transaction logging feature of SQL Server warrants data consistency and traceability, storage safety is achieved using Redundant Array of Independent Disks (RAID) volumes for production data storage as well for backup data.

5. Results Achieved

After the definition of all the workflows, training of the users, and interfacing with the different equipment, it is important to assess the results. The most relevant results must show whether the intended objectives were reached with the deployment.

5.1. Complete Adoption

This project managed to reach the complete adoption of an electronic medical record. 100% of the appointments are registered today without paper. In a period of 15 months from the start of the project, close to 4000 patients have been inserted in the system, and almost 15000 appointments have been recorded.

The project was adjudicated in September 2011, the base module was fully deployed in April 2012, and the remaining modules (Age-related Macular Degeneration, Diabetic Retinopathy and Glaucoma modules) until the end of the year (2012). The adoption numbers can be seen in detail in Table 2, and Figure 1 depicts the increased use of the EMR system.
Table 2. EMR Adoption Figures.

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>3819</td>
</tr>
<tr>
<td>Appointments</td>
<td>14988</td>
</tr>
<tr>
<td>- Medical</td>
<td>5641</td>
</tr>
<tr>
<td>- Nurse</td>
<td>1121</td>
</tr>
<tr>
<td>- Orthoptic</td>
<td>7289</td>
</tr>
<tr>
<td>Surgical procedures</td>
<td>2872 (in 853 patients)</td>
</tr>
<tr>
<td>Exams</td>
<td>15220</td>
</tr>
<tr>
<td>Equipment connected*</td>
<td>7</td>
</tr>
</tbody>
</table>

A total of 7 different types of devices where connected to the system, allowing for patient exams to automatically being stored within the patient electric record. These include Optical Coherence Tomography (OCT), Retinography (fundus images) and functional exams, from several different manufacturers such as TOPCON, ZEISS or HEIDELBERG.

Medisoft Ophthalmology also incorporates a number of different roles user can have (see Table 3). According to each role, a user can have access to different information, and permission to edit and complement patient record information in different ways. This variety of roles makes usage of the system simpler, since the risk of a user accidentally editing the wrong information is greatly reduced.

Table 3. EMR Users and Roles.

<table>
<thead>
<tr>
<th>Role</th>
<th>Number of Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Secretary</td>
<td>2</td>
</tr>
<tr>
<td>Clinical coordinator</td>
<td>7</td>
</tr>
<tr>
<td>IT technician</td>
<td>1</td>
</tr>
<tr>
<td>Orthoptist</td>
<td>6</td>
</tr>
<tr>
<td>Nurse</td>
<td>4</td>
</tr>
<tr>
<td>Ophthalmologist</td>
<td>15</td>
</tr>
<tr>
<td>Supervisor</td>
<td>4</td>
</tr>
</tbody>
</table>

The adoption curve in Figure 1 reflects the acceptance of the EMR system by the users. It becomes clear that as users start to notice the advantages of the system, the adoption also increases.
5.2. Quality of Clinical Data

Whilst paper records give a clinician a high flexibility to add data, the constraints of a EMR actually also bring the benefit of standardization. This means that patient data recorded by different clinicians becomes uniform, and more independent of the person collecting the data. This is an advantage to the organization and to the patients.

With a more uniform data collection, the quality of the data stored also increases, the patients records become more comparable and prompter to analyze. Ultimately this will bring more information, faster analysis, easier dissemination of best practices, leading to better patient care.

5.3. Additional advantages

As a result of the deployment, a number of additional advantages were identified. These are mainly related to the reduction of errors and quality of information as such software brings consistency to the filling out of Patient Records.

One error avoided was the repetition of exams, which previously happened for a number of reasons, from the non-availability of the results, to the misfiling of the results.

If errors such as repeated exams are mainly a cost and efficiency issue, others have even impact on patient safety, for example when defining the administration of drugs and treatments. Information such as allergies, always present in the Electronic Medical Record, is fundamental to have always available.

With the deployment of EMR solution, there have been found improvements in efficiency, patient safety, and in completeness of clinical data.
5.4. No more paper Records

Fig. 2. Example of patient information, where the different patient visits can be visualized, together with the clinical findings and exams at each visit.

The transition away from paper records leads to savings in operational costs and environmental costs. Both of these contribute to the certification requirements, for example. Moreover, the complete traceability and audit possibilities ensure that quality standards can be met.

6. Conclusions

The results described demonstrate that it is possible to implement a paper free medical record solution in an Ophthalmic Research Institute context. Furthermore, the deployment of an EMR in an Ophthalmology context can additional be very advantageous. There are gains to be achieved in efficiency, and in competitiveness. The Research Institute can on one hand provide better and more consistent care to the patients, and on the other hand reply more efficiently to the demand for clinical trials. At the same time, patient safety is also increased, with the reduction of errors. The quality of health care provided increases, with added traceability and audit possibilities.

The implementation is not straight forward, but relevant success factors have been identified and addressed. Users must be involved earlier on, and before deployment starts it is important to define and commit to
workflows and objectives. Adopting the strategies followed and described will lead to replicating the advantages in other deployments.

Finally, another important outcome is the adaption of a highly specialized Electronic Medical Record, with a proven track record, for Portuguese speaking markets. This software solution can now, after the development efforts, be easily adopted by any interested organizations, to profit from the mentioned advantages.

References