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Streamlining Electronic Health Records and Health Care Information System Implementation for General Practices: One Clinic’s Experience

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ABSTRACT
The small medical offices around the world can benefit from the implementation of a paperless EHR system in many ways. This paper is about the small practice gaining interest in the benefits of implementing a system that not only benefits the patient but the practice itself as well. In this paper we go over the pre-implementation procedures and processes that are needed for a small organization to be successful, followed by the steps recommended to be the smoothest way to implement an electronic health record (EHR) system.

Keywords
Electronic health record (EHR) system, health care information system (HCIS), small practice, system implementation

INTRODUCTION
The Health Information Technology for Economic and Clinical Health (HITECH) Act enacted as part of American Recovery and Reinvestment Act of 2009 was signed into law on February 17, 2009 to promote the adoption and meaningful use of health information technology with the focus on Electronic Health Records (EHR). EHR is defined in the Subtitle D of HITECH Act as “the electronic record of health-related information on an individual that is created, gathered, managed, and consulted by authorized health care clinicians and staff.” (HITECH Act, 2009).

The capabilities and features of an Electronic Health Record system can create an extremely efficient and result-driven practice that can focus less on technology and protocols and more on the service of its patients. Acquiring a measurable improvement over the paper-based system however requires careful planning and sound execution of the system, which is the most difficult part of the process and can cause drastic and obvious issues down the road, such as negative returns and reverse efficacy. The small medical offices around the world can benefit from the implementation of a paperless EHR system in many ways. We first examine a case of an early EHR developed in Atlanta, seeing the benefits and problems associated with its system and then discuss the phases in the EHR implementation process as prior researches suggested (e.g., Jaén, 2011; Lorenzi, Kouroubali, Detme and Bloomrosen, 2009). Lessons learned from the case and recommendations about implementation of EHR system in small medical offices are then presented.

THE ATLANTA BARIATRIC MEDICINE CENTER (ABMC) EHR SYSTEM
Back in the days when computer based systems were either in a cutting edge university or a hospital, most private practices maintained their own private paper records that were kept in massive and heavy cabinets in a room indexed by colors, letters, and numbers. In those days, it was too expensive to implement a network; a terminal and mainframe system was needed to have an EHR system. Paper records were sensitive to flooding, fire, misplacement, and theft. Then around the 1980s, some homegrown EHRs started to become prevalent, such as in 1986, the Atlanta Bariatric Medicine Center (ABMC), a private physician’s office, developed its own EHR, which became to be called ABCare. At the time, it made sense to create a system that was computerized to make use of the speed, redundancy, and efficiency that electronic records are famously known for today. So a programmer was commissioned to create the system based on several basic requirements: being able to track patient data for routine visits, track billing information, be able to send information to a printer for submission to insurance companies, and many other proprietary functions that allowed the day to day work of the office to run smoothly. It has essentially stayed the same for over 20 years, evolving over time as requirements needed to be met for the growing practice. Figure 1 shows the original DOS based plan and displays the data flow of the system from 1988-2009.

ABCare was developed for ABMC, and is still used today as a basic DOS program morphed into a Windows application. The system then was designed to be run at a single office, and since then ABMC has grown to 4 locations throughout the Atlanta area, and now the current system has to be accessed from an offsite location via a secure virtual connection from a local machine, making Internet outages extremely inconvenient for the practice. Today the challenges facing ABCare is the maintenance of connections across multiple sites to a single offsite server, the ability to print locally from an offsite
computer, and difficulty with integrating newer devices such as Apple’s iPad and iPhone. ABCare Context diagram is a simplified version of the overall interaction of the system with the roles in place as it is today (Figure 2).

Figure 1. Data Flow Diagram of Original ABCare System from 1988-2009

Figure 2. Context Diagram of Current ABCare System with the Roles

Such growing pains are typical amongst early adopters of technology. The most obvious problem in ABMC’s EHR system was their selection and development of a system that failed to have modularity and scaling capabilities that could be considered adaptable for future technologies. Thus the system had to be continuously developed over time to keep pace. Even today it is still an ongoing project that requires time and effort. It was also designed from the ground up with a narrow set of requirements, meant to only benefit the practice of ABMC and not be of use to anyone else, which essentially means it will not integrate with external providers or systems, an example being an Electronic Rx system. There are many other newer systems that have developed since the inception of ABCare. The incentive to transfer from the old paper record system to paperless systems has become enormous. The ABCare system was selected as the subject for this paper due to its
availability and convenience. However, this system represents the small medical practices in terms of the difficulties and challenges of EHR implementation. For small practices, the biggest challenge they are facing is migrating from paper-based systems to EHR and practice management systems. Lack of funding, lack of standardized implementation process, and small skilled workforce are the major difficulties for them. Such difficulties experienced can be alleviated with planning and deliberate execution of its implementation.

**PHASES OF EHR IMPLEMENTATION**

Proper EHR implementation is a process. It involves research, information gathering, identifying workflows, understanding budgeting issues and constraints, analyzing benefits and barriers, preparing and training staff, making planned and effective transitions, and continuously evaluating the process and making changes, if warranted. When it comes to the planning of implementation, serious consideration and thought needs to be done, even though it may appear to be obvious to most professionals.

Lorenzi et al. (2009) in their debate in the BMC Medical Informatics and Decision Making article, *How to successfully select and implement electronic health records (EHR) in small ambulatory practice settings*, succinctly describe five distinct phases: decision phase, selection phase, pre-implementation phase, implementation phase, and post-implementation phase (Lorenzi et al., 2009). Below is a table that lists each phase and the responsibilities and processes usually associated with each phase, as described by Lorenzi et al.:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Responsibilities / Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Decision Phase</td>
<td>Focuses on identifying champions, gaining &quot;buy-in&quot;, collecting information, assessing workflows, understanding financial issues, and analyzing benefits.</td>
</tr>
<tr>
<td>II. Selection Phase</td>
<td>Focuses on information gathering. It is important to spend the time required to understand both the needs of the practice and the capabilities of the EMR systems on the market that can meet those needs.</td>
</tr>
<tr>
<td>III. Pre-Implementation Phase</td>
<td>After a decision is made to move forward with implementing an EMR, the following steps are involved in Pre-implementation: communicating and involving people-staff and patients; redesigning workflows; establishing a project plan; getting help; timely training; and having fun.</td>
</tr>
<tr>
<td>IV. Implementation Phase</td>
<td>This phase assumes that realistic expectations were developed. The following concepts must be addressed during the implementation process: engaging the patient; making changes and managing change; implementing rapidly and supporting extensively; and encouraging the practice.</td>
</tr>
<tr>
<td>V. Post-Implementation Phase</td>
<td>This phase involves continuous updating, training, evaluation, and again, celebration.</td>
</tr>
</tbody>
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Table 1. Phases of EHR Selection and Implementation in Small Ambulatory Practice Settings

*Information compiled from (Lorenzi et al., 2009)*

Above phases are presented along the timeline of EHR implementation. It summarizes the responsibilities and both technical and managerial processes. The planning is the most important phase. There are several major categories in the planning phase of implementation: process assessment & analysis, goal & expectation assessment, cost assessment, usability evaluations, and risk analysis. There are many more categories, but these are the critical ones that in combination with well documented planning can make a successful EHR/HCIS implementation. In the next section, we discuss how issues need to be addressed in each category.

**Process Assessment & Analysis**

In Process Assessment & Analysis, the major goal is to fully understand the existing processes and structure within the organization. Any “quirks” or flow differentials should be identified and documented, an example being how a blood sample is taken and recorded. If there is something that has to be done that is essential to the practice, such as legal concerns or sign-offs, it will have to be considered when choosing the EHR to be implemented. EHR system can enhance efficiencies but effective workflow analysis should precede EHR implementation. Organizations are advised that analyzing workflow must be their first task in the process of successful adoption of health information technology. The implantation process in small
practice settings needs close attention to office workflow, or how tasks are organized and resources used to achieve outcomes (Lee, Cain, Young, Chockley and Burstin, 2005; Kushinka, 2011).

Workflow refers to “the interaction of process (made up of tasks) through which a clinic or hospital provides health care to patients” (Kushinka, 2011). Medication refill is an example of a process whereas checking that a prescription is current is an example of tasks within the process. Workflow analysis assesses inefficiencies in the current processes. Process redesign rearranges or reconstructs tasks to make the process more efficient by using the information gathered from the analysis and taking into account factors such as introduction of new technology systems.

One approach to analyze common clinic processes is to consider each of the clinical categories (such as processes of billing, medications, registration, referral, and scheduling protocols, to name a few). After the current workflows are analyzed, future state workflows occurred within the EHR is also need to be envisioned.

**Goal & Expectation Analysis**

Goal & Expectation Analysis is something that needs to be done prior to the selection of the EHR to be implemented; this is because without understanding what specific goals the EHR needs to achieve, it would be nearly impossible to adequately ensure the implementation will be a success. Analysis will consist of interviewing technicians, nurses, doctors, and other people who will have access to the system. If the system needs to be accessible to patients, then the patients will be privy to goal analysis as well. Feature requests are also to be done, where a subject will record the things they find most valuable in the previous system (be it paperless or not), and have those recommendations noted as expectations of the new system. This process is done so that there is consideration and representation for all types of users who will have access to the system, so that the biggest points are largely addressed.

As one of the goal & expectation analysis processes, organizations need to first make decisions about the capabilities their EHR should possesses from the eight core capabilities of an EHR system identified by US Institute of Medicine (IOM, 2003): health information and data, result management, order management, decision support, electronic communication and connectivity, patient support, administrative processes, and reporting. These capabilities are mainly addressed from the user and organizational point of views.

In the case of ABCare, capability was the major consideration in the decision making process when first starting the EHR project. From the technical point of view, modularity and interoperability should also have been addressed in the goal & expectation analysis. Modularity enables easy scaling of solutions with increased functionality and capability. In the context of healthcare information, interoperability supports (1) data transfer and sharing on more than one local clinic; (2) knowledge transfer and integration; (3) medical terminology transfer, mapping and integration, (4) image transfer, and (5) integration with clinical and non-clinical application (Open Clinical, 2005).

When considering interoperability, three levels of interoperability described by the US National Committee on Vital and Health Statistics can be taken into account (NCVHS, 2000, p. 22):

- **Basic interoperability**—allowing a message from one computer to be received by another but does not require the ability for the receiving computer to interpret the data.
- **Functional interoperability**—an intermediate level defining the format of messages. This ensures messages between computers can be interpreted at the level of the data fields, so that data can pass from a structured field in one system to a comparably structured field in another. Neither system, however, has understanding of the meaning of the data within the field(s).
- **Semantic interoperability**—provides common interpretability, i.e., information within the data fields can be used intelligently.

**Cost Assessment**

Cost assessment is a process that outlines the budget of implementation, considering all the odds and ends of the system will allow the organization to fully monitor and audit the situation to control it from becoming too costly. The cost for implementing EHR system (including hardware, software and networking), time to implement the system, as well as the support and maintenance over time should all be taken into consideration. This should be done so you do not have a “runaway” system that ended up being several times more costly than it should have been. Allowing for certain amounts of over expenditure is typical, however there should be a threshold placed so that those in charge of the project are responsible for the money that goes into the system’s implementation. Practice specific considerations such as time offline should be noted, as the amount of time required to implement the system is a cost in itself, so evaluating a time proper time and place to do the implementation is crucial as well.
Usability Evaluation

Usability is defined as “the effectiveness, efficiency and satisfaction with which specific users can achieve a specific set of tasks in a particular environment” (Schoeffel, 2003). Essentially a system is easy to use and effective. Usability evaluation is broader than the user satisfaction measurement. Usability metrics consist of measures of efficiency, effectiveness, cognitive load and ease of learning (HIMSS, 2009).

Usability is different from utility. Utility refers to “the existence (or absence) of feature or function necessary to carry out a specific task” (Schumacher and Lowry, 2010). Usability is how easy and effective those functions can be carried out.

Usability evaluations are where the clinicians and staff review the software first hand, so that there is a certain amount of hands on experience to everyone involved. Reviewing how the software interacts with the professionals is vitally important, as well as asking questions about it. Communication between the provider and organization in regards to the system will help smooth implementation because nothing will come as a surprise. As said by Haughom et al. (2011):

"By taking the time to listen to their concerns and discuss ways to incorporate their feedback into our EHR, we empowered our clinicians to help make improvements and adjustments that have a material impact on the care patients receive.”

Choosing the EHR that integrates and suits the organization the best will create familiarity and efficiency over time, so selection through usability evaluation is essential.

Risk Analysis

A final pre-implementation consideration is risk management, where one documents the faults of the current and new system, so that they can be addressed before, during or after implementation. If the risks that are identified are mission critical, such as the security of patient data over an unsecured connection, one will have to consider what will have to be done to maintain confidentiality across multiple mediums. Other forms of risk management include data storage and maintenance, where the data should be held and how often it should be backed up. Finally the last piece of risk management is considering what should be done if something does in fact go wrong with the system, addressing the steps that need to be done to continue the practice or postpone it until there is a fix. Creating documented procedures for things going wrong can only help in a situation where everything goes bad.

ISSUES DURING IMPLEMENTATION AND POST-IMPLEMENTATION

Now that pre-implementation has been analyzed with our case, we discuss the actual things that need to be done during implementation itself. For the majority of the process, it requires a swift yet deliberate hand over the process. The process can be handled first from the backend, where the hidden systems are installed and integrated into the office. Example being a typical Ethernet subsystem, installing the local machines and any other subsystems required by the EHR. Once all systems are in place, turning on and testing of the system should be relatively easy. All troubleshooting from the software and hardware aspect of the system should be done before full use of them system. Other suggestions in physical installation should be double checking of all components and verifying that all hardware is running as intended. From our personal experience, software and hardware installation can be done quickly but sloppily, so taking care is vital to having a hiccup free first day. Documentation of any bugs, issues, or problems should be kept and maintained, the more detailed they are, the better off post implementation fixing will be. As long as the system itself works as intended, and pre-implementation of the EHR was done, the EHR should maintain itself for the longevity of the practice.

For post-implementation, maintenance of the system should be done on off-peak times of the year, and documentation of such maintenance should be recorded and archived. Post implementation surveys should be distributed to acquire additional information about the big leap from paper to paperless. As bugs and issues crop up, as they always will in such a major change, you will have to proactively investigate and report such issues to your provider or your developer to receive support and fixes in the long term.

CONCLUSION

This paper examines a case of an early EHR developed in Atlanta. The problems identified with this early EHR system include selection and development of a system that failed to have modularity and scaling capabilities; a narrow set of requirements to start with to only benefit the single practice office but not be of use to anyone else, which essentially means it will not integrate with external providers or systems. Two of the most important lessons learned from this case are: (1) the implementation process especially the planning phase needs to be carefully conducted to anticipate and deal with the future
successfully; and (2) clear definition of goals and detailed analysis of workflow are a priori for the system selection and implementation.

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REFERENCES


