

Successful Computerization in Small Primary Care Practices: A Report on Three Years of Implementation Experience

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ABSTRACT

Electronic Medical Records (EMRs) are a relatively recent innovation in the charting and care of patients. As the technology of recording healthcare information using computers improves, more physicians are considering using them in their daily practice. Since EMRs represent a new way of charting and require new types of equipment in the office, we expect that their implementation will create some difficulties in the busy Family Practice clinic. This paper looks at how EMRs have been implemented in Family Practice settings across North America –what are the difficulties faced, how they are overcome and what constitutes a successful implementation. We conducted a systematic review of the literature to abstract best practices in EMR implementation with physicians as the group of interest. We also report on our experiences and results of implementation after three years of follow-up using those best practices.

In addition, we developed survey tools to measure medical office processes, including administrative and physician tasks pre- and post-EMR implementation. We included variables that were expected to improve with EMR implementation and those that were not expected to improve, as controls. We measured the same processes pre-EMR, at six months and 18 months post-EMR. Time required for most administrative tasks decreased within six months of EMR implementation. Staff time spent on charting increased with time, in keeping with our anecdotal observations that nurses were given more responsibility for charting in many offices. Physician time to chart increased initially by 50%, but went down to original levels by 18 months. However, this may be due to the drop out of those physicians who had a difficult time charting electronically.

The COMPETE study (Computerization of Medical Practices for the Enhancement of Therapeutic Effectiveness) is a pioneering community-based electronic health record project conducted by the Centre for Evaluation of Medicines, an academic research centre affiliated with McMaster University, Hamilton. After an extensive recruitment period, 33 family physicians and 75 of their staff in Hamilton and surrounding areas entered the study, which involved installation, training, use and evaluation of a full electronic health record (EHR) set up. COMPETE is the largest such research initiative in Canada.

INTRODUCTION

Computerization of physician practices is an on-going reality. With increasing fiscal restraint and a greater demand by all stakeholders for demonstrated value, it is important to measure the success of EMR implementations. Each stakeholder (physicians, patients, office staff, payors and administrators) has a different need for information and demonstration of value. We describe an evaluation of work flow and processes pre and post-computerization. This type of research is necessary to understand why computerization of medical practices succeed or fail, but is rarely reported in the medical literature.

BACKGROUND

The Centre for Evaluation of Medicines, an academic research institute affiliated with McMaster University, is conducting a study on the impact of computerizing community physicians in the Hamilton area. The research project is called the COMPETE study (Computerization of Medical Practices for the Enhancement of Therapeutic Effectiveness). COMPETE is a three year project to evaluate the impact of EMR on practice efficiency, quality of care and privacy concerns and to assess the effectiveness of computer generated educational interventions.

As EMR use is rare in mainstream family practice in Canada, considerable time and effort were applied to selection of EMR software and recruitment of family physicians.

Description of EMR System: We have recruited 32 family physicians in 18 practices in the Hamilton-Wentworth area of Ontario. Twelve physicians work in a Health Systems Organization model, meaning reimbursement through a capitation system, the rest are typical fee for service primary care physicians. Both reimbursement systems are managed by the province. Most physicians are community-based physicians practicing in urban settings; one clinic of six practitioners is located in a more rural setting. Computer skills vary widely amongst the physician participants. Each physician pays a nominal monthly fee to participate in the COMPETE project in exchange for a complete EMR system. The system includes a local area network (LAN) using Windows NT on the server and Windows 95 on the workstations. Each physician has a mean of 4 workstations – one for the receptionist and three for the exam rooms. The software used is Purkinje's Dossier of Clinical Information (DCI) version 1.4 which is commercially available internationally. Initial participants started with version 1.3, then were converted to version 1.4 when it became available in the summer of 1999. The system includes practice management software for billing and scheduling. This software is interfaced with Purkinje's DCI to allow access to a patient's EMR chart from the scheduler program. The DCI is a structured template-based EMR with integrated prescription module including real time drug interaction checks, diagnostics module for ordering and reporting, a cumulative patient profile and knowledge look-up resources. The server has mirrored hard-drives using a Raid 1 configuration. System back-ups are done nightly and the tape is taken home by a designated staff member at each site. Each site has a service contract with a systems integrator to ensure a 2-hour response time/4-hour fix for server problems and a 4-hour response/8-hour fix time for all other equipment. System downtime has been less than 2%.

All physicians and staff were trained in several sessions just prior to their system implementation. Study staff also provided onsite technical and software use support as needed. Data quality management was actively pursued by project data quality staff. Early management reports have noted that most, but not all, physicians enter patient data electronically. On average 65% of patients seen in participating clinics have encounter information beyond scheduling and billing entered in the EMR. A few physicians do not enter any notes on paper and chart all patient information into the computer. However, others use a mix of paper and electronic chart. Patients with multiple complaints and those who require counseling are more likely to have their records entered on paper as a structured EMR does not lend itself to rapid charting of psychosocial and counseling problems.^{1,2}

Due to ongoing restructuring amongst private laboratory companies in Ontario, only 11 of the 18 sites were able to receive lab results electronically. Other patient information from outside the office, including consult notes, x-ray reports and hospital discharge summaries come into the office on paper.

METHODS

Best practices in EMR implementation: A search of the English language articles in MEDLINE for the time period Jan 1, 1985 to May 1999; of the HealthStar database from Jan 1977 to June 1999; and of the EmBase database from Jan 1980 to May 1999, was carried out. The Medical Subject Heading key words used were: medical records systems, computerized; medical informatics; computerization; electronic medical records; primary health care; primary care; family practice; family practice; attitude to computers; attitude; implementation; systems integration; integration or introduction.

In addition, a search of MEDLINE using PubMed's 'related articles' option was conducted. An iterative process of searching by finding a relevant article and then finding 'related articles' was used. The bibliographies of relevant articles were combed. Published abstracts and presentations from computers in medicine meetings (American Medical Informatics Association Meeting; International Medical Informatics Association Congress; Health Information Management Systems Society Meeting; Towards an Electronic Patient Record Conference) were also examined. Personal communications with recognized leaders in the field were used to complete the search for relevant articles. Most articles from the search were retrieved. The search term, *attitude to computers*, proved unproductive in locating articles. Practitioners in the field tend to use the term *implementation* for the process of introducing EMRs into physician practices. In general, *integration* tends to be used for situations where there is a requirement for introducing new computers into existing computer systems, not for physician introduction.

Ten relevant articles were identified that appeared to meet our inclusion/exclusion criteria. If eligibility was unclear, the article was obtained and then excluded later, if necessary. Combing the bibliographies added one more article and an excellent book by Everett Rogers called *Diffusion of Innovations*³ which reviewed several decades' worth of research on the introduction of new ideas and products into social settings. Speaking to experts in the field turned up another article. PubMed's 'related articles' feature added nine more articles that had not previously been identified by MEDLINE searches. Finally, search of CD-ROMs from recent informatics meetings retrieved five more relevant articles.

Of the 25 articles identified as being possibly relevant to our topic, we were able to retrieve 24. Of the 24, most dealt with nursing implementations which did not include physicians as the group of interest. Those reports which did target physicians as important subjects of implementation were implementations in hospitals and very large clinic settings of 40 or more physicians. Most implementations have been conducted in hospital settings, as hospitals have been one of the first healthcare institutions to computerize. There are few descriptions of implementations in small family physician practices in the literature. This is to be expected since the economies required to computerize have only been affordable by relatively well-off institutions such as hospitals and health maintenance organizations (HMOs). Initially, we intended to exclude implementations in hospitals. However, this decreased the pool of articles to a very small number and also excluded potentially relevant articles that could be useful in answering our questions. Inclusion criteria included implementations in: primary care/Family Practice clinics/clinical practice, hospital implementations involving physicians, electronic medical records implementations, computerization, articles addressing physician, staff and/or patient attitudes, implementation difficulties, successes, overcoming resistance and change management, resistance to change. Exclusion criteria included: papers which were technical descriptions or specifications, nursing implementations, articles which were expert opinions and which did not describe a particular implementation. Eleven articles were included in the final review^{4,5,7,9,10,12,14,17,18,21,23}.

Each article was reviewed by two authors (KK and AN) and best practice themes relevant to EMR implementation were abstracted independently. Final themes were arrived at by consensus. Each

article was then reviewed by three reviewers (KK, AN and one of DT, ST or KL) and scored for the presence or absence of each of the themes. Each reviewer scored one point for each theme. **Table 1** shows the best practices and the score they each received.

Roger's book, though not included formally in the systematic review, was extremely helpful in providing a theoretical framework for diffusion of new ideas and a review of methods used to spread new ideas within social systems.

Workflow Distribution and Practice Management: In consultation with target physicians and a large practice management consulting group, we developed qualitative and quantitative measures of medical office work processes and front office efficiencies. We developed data collection tools to capture these measures pre and post-EMR implementation. We included variables that were hypothesized to improve with EMR implementation and those that were not expected to change to act as controls. We measured the same processes pre-EMR and six months post-EMR implementation.

Questionnaires sought self-reported estimates of the amount of time spent on all in-office and peri-office activities (e.g., completing charting at home). Separate questionnaires were administered individually to physicians and their staff. As well, each practice underwent periods of direct observation by practice management consultants to directly measure time-on-task and to comment on workflow issues. Each site participated in an interactive session just prior to EMR implementation to review their practice and discuss suggestions for EMR change management and improving efficiency. In the post-EMR stage, we also used electronic data from the scheduler, billing package and EMR to corroborate data collected through the surveys.

RESULTS

Best practices in EMR implementation: **Table 1** shows the results of a consensus review of the included papers for best practices in EMR implementation. Involving multiple stakeholders, providing training and having a stable and supportive governance body were seen by most implementers to be very important activities in successful computerization (27 points each, of a maximum 33). Most groups indicated that they tried to involve stakeholders early in the process –sometimes as early as the contemplation phase. Getting stakeholder buy-in is an important part of change management and empowering those who will be most affected by the change. It allows those who will be affected by change to prepare for the change and to learn as much as they can, have their questions answered and their fears allayed. Training was seen as an important element in getting physicians and staff oriented to the software and to help them visualize how they would do their work in the new system. Many authors mentioned that training should be an on-going activity and did not end with the initial implementation phase. Several of the more successful implementations also mentioned mobilization of 'super-users' to assist in training others. Super-users are those physicians who rapidly become expert users such that other physicians can call upon them for assistance. In many cases, these super-user physicians are superior to non-clinician trainers and have practical suggestions for difficult usage problems that may arise from time to time.

Having the support of senior management and having a stable source of funding were deemed to be critical in achieving success in EMR implementation. Most implementers felt that computerization of practices is only the first step in a long journey toward use of information technology in clinical practice. Without the support and encouragement of senior management, most authors felt that they would have not been able to convince physicians to participate or to allay the fear that computerization was just another way to control them.

Table 1

Best Practice	Score*
Process of Choosing Software	15
Involving Multiple stakeholders	27
Sell benefits/ Address obstacles	24
Develop early planning strategies	24
Provide implementation assistance	15
Workflow redesign	18
Training	27
Problem solving	24
Vendor support	21
Customizability of software	6
Project leadership	24
Governance support	27

*Maximum score 33

The next cluster of themes that seemed to appear in many authors' accounts of their implementations included the need to sell the benefits of computerization and to help lower barriers to uptake, the need to start planning early, the need to be prepared for and to pro-actively solve the problems that will inevitably arise during EMR implementation and to provide project leadership that has the authority and accountability for achieving results. Many implementers felt that it was important to document the potential benefits of introducing computers into physician practice and that it was important to get physician buy-in through addressing real and perceived threats. Ways of addressing obstacles included town hall meetings, one-on-one sessions with peers and frequently asked questions documents.

Starting the planning process early was deemed to be important –to plan and schedule the myriad tasks that go into putting computers into the physician workflow and to plan for the many problems, issues and pitfalls that arise during a complex project of this sort. The early planning sessions are also an important way of getting physician, staff and stakeholder buy-in early in the process of change.

Most implementers mentioned that special problem-solving teams, involving technical people, trainers, nurses and physicians were an important tool to help achieve course corrections when problems start arising after 'go live'. Problems were considered to be inevitable and having dedicated staff to help users resolve their problems and achieve productivity goals is an important tool for implementers as they computerize practices.

Competent project leadership was another important element in EMR implementation. Many of the issues that arise during EMR implementation span multiple disciplines and involve multiple stakeholders. Having one person with accountability for the project allows problems to be escalated and resolved quickly.

The final cluster of important themes involves workflow redesign, vendor support, providing implementation support and the process of choosing software. Surprisingly, being able to customize the software did not score as well as we had anticipated. Many authors neglected to mention whether their software was customizable, whether they did any customization work or whether they thought customization of EMR software was important to achieve success in their implementation. Workflow redesign, vendor support and providing implementation support in the early phase of implementation are all elements of good project management. It is likely that those authors who did not mention these best practices by name still used these to some extent in their implementations.

Some authors felt strongly that the process of choosing the software was an important element of their EMR implementation. There is no perfect EMR available, so the process of choosing the software is also an important time to learn about the strengths and weaknesses of the EMR, the vendor who is selling it and the type of support that is likely to be required for the EMR product. There was at least one report in the literature that describes an unsuccessful implementation where the process of choosing the software was quite cursory. The author ascribes the failure of their implementation, at least in part, to their failure to research the software carefully⁹.

Based on the best practices described in the literature, we developed a methodology to implement EMRs in small primary care physician practices. Our implementation process involved a highly structured, hectic 5-week cycle with 5 main activities: sales, practice assessment, hardware integration, software application and support, and practice management.

The process proceeds as follows:

1. The sales team ensures awareness and buy-in from all physicians and their office staff regarding the impending change. Change management training for the office starts at this time. Benefits are explained and obstacles addressed at this stage. Physicians sign a contract if they and their staff feel they would like to go ahead.
2. Office assessment to review hardware, network and security requirements and configuration. This includes a discussion with office personnel describing the plan, event dates and strategies to minimize disruption of the office during installation. Practice Management review of the office is necessary to assess workflows. Technical site review checks cabling setups and efficient computer placement.
3. Computer hardware is ordered well in advanced of the installation date. Extensive EMR classroom training for both physicians and staff is completed a short time before equipment installation. A “practice” computer with assigned “homework” is offered to all practices.
4. Each office is cabled, including exam rooms and high volume work areas.
5. The client-server network with extensive back-up and security and advanced EMR software are set up and tested on a single installation day. Once equipment is operating, back-up procedures are taught, help line use is encouraged and an installation sign-off is completed. This marks the official hand-over of the office to the support team, which includes ongoing EMR data quality improvement and management. Technical and clinical problem solving are provided in addition to usual vendor support.

Project management and clear lines of communication were important in ensuring confidence and commitment to the project during times of problems.

Workflow Distribution and Practice Management: As can be seen in **Table 2a**, there were significant gains made in computerizing the front office functions. Despite all recruited practices having used electronic billing systems before joining the COMPETE study, most sites still made significant gains in efficiency in the billing data entry and reconciliation process. Some of this is attributable to better software, but much of it is thought to be a result of training. The COMPETE project pays for any additional training that staff may require; something the physicians were reluctant to do on their own expense.

There were considerable reductions in the time required by administrative staff to pull charts for patient visits and for patient-related inquiries. Time spent on both activities decreased by over 50% (**Table 2a**). Staff time spent writing in the patient chart increased from an average of 33 minutes before EMR implementation to an average of 72 minutes 18 months post implementation. This figure supports a positive response to training and practice management suggestions of allowing staff, particularly nursing staff, to chart initial information for the patient encounter to free physician time for finishing with a previous patient.

Table 2a

ADMINISTRATIVE TASKS	Pre-EMR	6 Months Post	18 Months Post
Prepare Day Sheet (min)	9.1	4.8	1.2
Pull Charts for Day Visit (#)	29.2	27.4	22.2
Pull Charts for Day Visit (min)	46.4	37.1	16.5
Pull Charts for Inquiries (min)	43.5	38.4	20.6
Writing in Chart - Staff (min)	33.0	44.0	71.9
Billing Tasks (min/month)	441.7	341.9	389.8

For physician tasks, initial gains in electronic charting clarity and completeness were made at a price: 50% more time appears to be spent on charting functions in the first 6 months (**Table 2b**). Notably, the number of patients seen per day did not decrease.

Table 2b

PHYSICIAN TASKS	Pre-EMR	6 Months Post	18 Months Post
Writing in Chart - MD (min)	101.3	149.3	102.8
Percent paper use (%)	100.	52.6	39.0
Script writing and renewals (min)	16.2	14.2	21.3
Consult Reports Review (min)	14.9	14.6	23.4
Lab Report Review (min)	14.3	15.1	12.1
Number of Patients Seen/Day	20.9	21.8	21.8

If physicians take more time to chart initially, where is that time coming from? We asked physicians the questions listed in **Table 3a** and **3b**. Most physicians felt that they were working the same number of hours per day. Some felt they were working a longer day, but they were also seeing more patients (**Table 2b**). Most physicians felt they were spending more time charting than they did before the introduction of the EMR. Most agreed that the volume of work had not changed since the EMR was put into place. The vast majority felt they were saving sufficient time elsewhere to justify continuing with use of the EMR.

Table 3a

	LESS	SAME	MORE
Do you...			
Work a longer day?	0	12	6
Spend more time charting?	0	6	12
Have work left at day's end?	3	11	4

Table 3b

	NO	YES
Are you...		
Getting a better quality chart?	7	11
Saving time elsewhere during the day?	3	15

Gains were made in the filing of lab results and the handling of lab results. Most physicians whose lab results were sent electronically to their office felt that this made their practice more efficient (**Table 4**). This was despite a series of technical problems with lab result transmission requiring project team intervention early in the project.

Other areas where physicians felt they saved time were in the ability to print out referral notes to consultants, ability to record and print repeat prescriptions faster and ability to record follow-up visits faster.

Table 4

	Number of Replies
Where are you saving time?	
Reviewing E-Lab Results (N=11)	8
Referral Letters automatically done	4
Faster prescriptions/repeat scripts	3
Follow-up Notes are easier to do	1
Administrative tasks faster	2

DISCUSSION

Initial success of EMR implementation is largely dependent on managing the stress of the major change in the practice and hinges on a perception that sufficient value is gained from the change to justify the costs. As expected, we found that the success of implementation varied from site to site. Despite extensive training, professional practice management consultation and project case management providing EMR tips and encouragement, several physicians subsequently left the project. Eight physicians, six of them part-time, job-sharing physicians could not make the transition. In all cases, their staff were successfully using the EMR.

We noted a phenomenon of “cognitive dissonance” with physicians’ perceptions of time to chart a patient note. Most physicians felt that their charting time using the EMR had increased, yet they reported that they were able to see more patients or leave earlier at the end of the day. This variance may be related to the fact that the EMR consolidates many tasks and computerizes them (e.g., prescription writing, lab result review). As physicians spend time doing these other tasks on the computer, they may be all lumped under the category of ‘charting’, whereas previously they would have been considered separate tasks. Another explanation is that the additional time required for charting is at the expense of the patient –the physician spends more time charting during the encounter, leaving less time with the patient. The patients’ perceptions of their interactions with their physicians are being explored separately. Finally, although physicians might spend more time charting, this may actually lead to a higher quality chart and an opportunity for better patient care. Our evaluation of this point as related to prescribing is in progress.

Our study has several limitations. Self-reports based on recall are subject to error and bias. Similarly, participants were obviously not blinded to their allocation (pre-EMR or post-EMR) and their individual interest in or enthusiasm for EMRs could have influenced their reports.

In conclusion, there is little doubt that the implementation of electronic record systems requires considerable change engineering. We provide one of the first systematic evaluations of the effect of EMR implementation on workflow and practice efficiency in primary care. This type of research is essential to understand reasons for success, barriers to success and methods to increase success in EMR implementation.

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