Measuring the Success of Electronic Medical Record Implementation Using Electronic and Survey Data

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ABSTRACT

Computerization of physician practices is increasing. Stakeholders are demanding demonstrated value for their Electronic Medical Record (EMR) implementations.

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.

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.

Although there are several reports of EMR implementation with physicians as the change recipients [1,2,3,4,5,6,7,8,9,10,11,12,13,14,15], few of them describe implementation in small clinics. Most reports are of implementations in hospitals or large ambulatory clinics associated with hospitals.

Since the process of computerizing a physician practice is complex and risky[7], it is important to be able to monitor the progress of an EMR implementation. We sought to measure processes in the physician practice that could be an early indicator of progress, stalling or failure of an implementation.

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 practice 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.

Due to ongoing restructuring amongst private laboratory companies in Ontario, only 11 of the 18 sites are able to receive lab results electronically. Other patient information from outside the office, including consult notes, x-ray reports, come into the office on paper since virtually none of the specialist groups are computerized. A few offices scan these reports into the EMR.

METHODS

In consultation with target physicians and the four leading medical practice management consulting groups, we developed measure of medical office work processes and front office efficiencies. Most of the EMR implementation literature we reviewed reports figures for workflow and clinical processes that are relevant to a hospital setting. For example, typical measures might be: number of unsigned verbal orders, number of transcription lines dictated and number of procedures ordered through the physician order entry system.

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.

Staff related administrative measures included: time taken for chart pulls – for day visits and for filing lab results and consult notes, time spent in doing billing, and time spent writing in the chart.

Physicians related clinical measures included: time spent writing in the chart, time spent reviewing lab results, time spent writing prescriptions, time to review consult notes. Physicians were also asked whether they felt they worked a longer day, felt they were spending more time charting, had more work to do during the day and whether they felt they had a better quality chart.

Questionnaires sought self-reported estimates of the amount of time spent on all in-office and peri-office (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

Table 1a shows the measurements for the front office (administrative) 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 likely to be a result of training. The COMPETE project paid for any additional training that staff required; something the physicians were reluctant to do on their own expense. The overlap in many of the 95% confidence intervals is likely a result of the small sample size in this study.

There was a trend to seeing 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 1a). 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 1a **ADMINISTRATIVE TASKS**	**Pre-EMR**	**6 Mos Post**	**18 Mos Post**
Prepare Day Sheet (min.)	9.1	4.8	1.2
(95%CI)	(3.7)	(0.36)	(0.11)
Pull Charts for Day Visit (#)	29.2	27.4	22.2
(95%CI)	(4.1)	(4.5)	(6.9)
Pull Charts for Day Visit (min.)	46.4	37.1	16.5
(95%CI)	(11.9)	(11.1)	(6.8)
Pull Charts for Inquiries (min.)	43.5	38.4	20.6
(95%CI)	(11.8)	(10.3)	(15.1)
Writing in Chart - Staff (min.)	33.0	44.0	71.9
(95%CI)	(12.3)	(21.4)	(31.6)
Billing Tasks (min./month)	441.7	341.9	389.8
(95%CI)	(174)	(150)	(103)

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 1b). Notably, the number of patients seen per day did not decrease.

Table 1b **PHYSICIAN TASKS**	**Pre-EMR**	**6 Mos Post**	**18 Mos Post**
Writing in Chart - MD (min)	101.3	149.3	102.8
(95%CI)	(24.7)	(50.1)	(18.3)
Percent paper use (%)	100.	52.6	39.0
Script writing and renewals (min)	16.2	14.2	21.3
(95%CI)	(2.5)	(3.0)	(5.8)
Consult Reports Review (min)	14.9	14.6	23.4
(95%CI)	(3.4)	(2.9)	(6.8)
Lab Report Review (min)	14.3	15.1	12.1
(95%CI)	(2.47)	(2.7)	(2.3)
Number of Patients Seen/Day	34	---	33.4
(95%CI)	(4.31)		(3.84)

If physicians take more time to chart initially, where is that time coming from? We asked physicians the questions listed in Table 2a and 2b. 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 1b). 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 2a	**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 2b	**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 3). 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 3	Number of Replies
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 subsequent-ly left the project. Eight physicians, six of them part-time, job-sharing physicians could not make the transition. In all cases, their staff was 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.

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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