

## A Conceptual Framework for Analyzing How Canadian Physicians are Using Electronic Medical Records in Clinical Care

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### Abstract

*Our electronic medical record (EMR) case study research pursued a set of questions to provide Canadian physicians with practical information on best practices and lessons learned regarding implementation and use of EMRs in ambulatory clinical care. The study's conceptual framework included an EMR System and Use Assessment Survey, interview guide, transcription codes, observation guide and case study report template. The common message that emerged was that no clinic would return to paper-based charts after experiencing the benefits of EMR. In seeking to corroborate our findings with success factors in an EMR implementation meta-framework, we further investigated the role of information incentives as a key factor in sustainable EMR implementations. The sections of our conceptual framework that best enabled us to capture information incentives were the 12 survey questions about information quality, EMR adoption questions in the interview guide and a subset of 26 items from our transcription coding scheme that were linked to physicians quotations about knowing more about the patient when using the EMR than when using paper.*

### Keywords:

Electronic medical records, Case studies, Motivation, Knowledge transfer, Boundary objects

### Introduction

In our EMR study, clinics were invited to participate in case study research being conducted by researchers from across Canada. Participating clinics were selected on the basis of using their EMR as the sole clinical record, that is, as the computerized legal record of patient encounters. The study was sponsored by the Canadian Medical Association and was financially supported by Canada Health Infoway, a not-for-profit organization whose mandate is to accelerate the imple-

mentation of electronic health records across the country. These case studies represent the first time in Canada that a structured approach has been taken to examine the benefits of EMRs to primary care delivery.

The EHR Impact Study showed that an easy to operationalize concept of an electronic health record (EHR) system did not exist and a conceptual framework was needed to ensure comparability between different impact measures [1]. An EHR extends the concept of an EMR to include data sharing.

A conceptual framework was the common point of reference for the nine members of the research team who represented the different perspectives of clinician and health informatician. Content analysis in case study research requires methods and procedures that will increase the credibility and transferability of the knowledge that rises from using the conceptual framework. The framework served as a boundary object for building greater shared understanding. Boundary objects are artifacts that enable a common point of reference that can be shared by individuals with different perspectives (i.e. clinicians and health informaticians) [2].

When attempting to corroborate research results, one must reshape the data in ways that make it fit all the frameworks involved. According to an EMR implementation meta-framework analysis [3], the success-failure odds ratio for information incentives properly executed is 69.75 [4]. In seeking to corroborate our findings with this odds ratio, we start with our conceptual framework and determine which dimensions capture the information incentives that come "from the ability to know more about the patient when using the EMR than when using paper" [4, p.113].

### Methods

The aim of this research study was to provide physicians with practical information on best practices and lessons learned regarding implementation and use of EMRs in ambulatory

clinical practices. To do this, we developed three primary research questions:

1. How are EMRs implemented?
2. How are EMRs used in clinical practice?
3. How can EMR adoption be increased and sustained?

The research consisted of two stages: the EMR System and Use Survey, which was used to tailor the subsequent interview; and a site visit comprising a one-hour interview with the lead physician and a series of one-hour observations of how the physician, nurse and office staff interacted with their EMR.

### Conceptual Framework

The conceptual framework for the study included an EMR System and Use Assessment Survey, interview guide, transcription codes, observation guide and case study report template.

The 7-page EMR System and Use Assessment Survey posed 30 questions asking about overall user satisfaction: 8 questions asking about system quality; 12 questions asking about information quality; 7 questions asking about service quality; 6 questions that were population health specific; 9 questions asking about system usage; open-ended questions regarding EMR systems; and, 3 questions for demographic information.

The interview guide was designed to prompt for responses on implementation, managerial and organizational impact, EMR capabilities and use, EMR and patient care, EMR adoption, practice culture, patient feedback/experience, EMR cost/benefit and other comments. The consent form for the face-to-face interview sought permission for audio recording. The transcription of interview audio recordings was undertaken by an external transcription company. Interviews were conducted in English and French, and the French transcripts were sent to an external service for translation to English.

The 89-item transcription coding scheme was developed based on the research questions and the data. Each transcript was analyzed by two researchers: one was the interviewer; the second was another member of the research team. We used Atlas.ti, a qualitative analysis software program, to code transcribed data to concept categories. The two codings of each interview were done independently. Then the interviewer compared the two analyses and incorporated both perspectives to achieve the final coded interview [5].

The observation guide was used by the researcher to focus on the interactions with the EMR when shadowing the different members of the clinic staff. A set of questions were to be kept in mind: Who is using the EMR? When is the EMR used? What functions of the EMR are being used? Where is the EMR? How is the physician interacting with the patient while using the EMR? What are the strengths and weaknesses?

The researcher who completed the interview wrote up the case study report according to the case study report template. This template contained the following sections: executive summary, introduction, methodology, limitations and challenges of research, EMR capabilities and use, workflow and process changes, organizational impact (with subsections on workflow

and clinical practice), key success factors, lessons learned, future plans, and, discussion and conclusions. Each case study report included a clinic sketch to show the physical configuration for encounters that involved patient, physician and computer screen [6].

### Data Collection

The unit of analysis for these case studies was the clinical practice setting, rather than individuals, organizations, or the EMR system. Data was gathered from 20 clinics using pre-visit surveys, key informant interviews and observations.

### Thematic Analysis

Using qualitative methods, we undertook a thematic analysis of data gathered from the site visits to answer our three research questions [7].

### Filtering Conceptual Framework for Knowledge Transfer

We sought to corroborate specific findings from the EMR implementation meta-framework analysis [3,4] with our study as a means for knowledge transfer around the third question: How can EMR adoption be increased and sustained? The specific success factor chosen for a more in depth analysis was information incentives. This was chosen because the common message that emerged from our research was that no clinic would return to paper-based charts after experiencing the benefits of EMR.

The sections of our conceptual framework that best enabled us to capture information incentives were the 12 questions posed in the survey about information quality, questions in the interview guide on EMR adoption and a subset of 26 items from our 89-item transcription coding scheme that were linked to quotations that expressed how physicians were able to know more about the patient when using the EMR than when using paper

## Results

Our nine member research team represented the different perspectives of clinician and health informatician. From a boundary object perspective, the conceptual framework provided a meeting ground among perspectives held by different participants in collaborative research. The only change to the conceptual framework after the research was underway was the addition of the concept of time to the transcription coding scheme.

Transcript coding analysis revealed variation in the application of the codes but convergence was achieved for common messages. Each interview was analyzed by two researchers to code transcribed data to a coding scheme based on 89 concept categories. Codes were developed based on the research questions and the data, and agreed upon by the research team. In total, researchers coded 3749 quotations from physician interviews for 20 EMR case studies.

The thematic analysis generated 20 themes loosely based on those pre-identified in the interview and observation guides [5]. These themes are listed in Table 1.

Table 1 – Themes across case studies

Theme	Theme
Clinic culture and leadership	Patient safety
Motivation	Key success factors and lessons learned
EMR capabilities and use	Barriers to EMR adoption
Technical issues	Benefits of EMR
Scanning	Facilitators of EMR adoption
Workflow and process change; Organization impact	Quality of care
Implementation strategy	Costs versus benefits
Productivity	Efficiency
Impact on patients	Lessons learned
Patient perspectives	Future plans

### Success Factors

Clinics believed that their perceived time savings and improved patient record-keeping had improved the quality of care and patient safety by providing more complete information. These clinics used an integrated suite that contains clinical data as well as administrative data, rather than having separate business (back office) and clinical systems. This integration of clinical and administrative workflow is considered to be a key success factor.

Additional success factor topics in our study were categorized as: personal leadership and commitment to EMR; funding; change management and ability to re-engineer; payment model; and collaborative culture [5].

### Classifications Across Two Conceptual Frameworks

We know from boundary object theory that classifications have their consequences [8]. When comparing our success factors with other literature we recognized a need to filter our conceptual framework to identify common concepts.

Keshavjee [4] used a different classification scheme to capture success factors in EMR implementation. These were expressed as governance; project leadership; involve stakeholders; choose software; sell benefits; pre-load/integration; tech usability; early planning; workflow redesign; implementation assistance; training; privacy & confidentiality; feedback and dialogue; support; user groups; incentives; and business continuity.

Our conceptual framework had to be adapted to enable us to corroborate what we revealed as success factors against Keshavjee's categories. The success-failure odds ratio is a metric that measures the importance of a factor in sustainable EMR implementations. As an example, incentives, which were primarily information incentives, had a success-failure odds ratio of 69.75.

We selected the concept of information incentives as a common concept worthy of further study. The definition of information incentives is the ability to know more about the patient using the EMR system than by using a paper-based system [4].

This concept can be conveyed in multiple ways. We explored how it was conveyed in the different components of our conceptual framework.

There were 14 items in the EMR System and Use Assessment Survey that explicitly addressed information quality. Improvement in information quality was reported in all clinics (12 strongly agree, 8 moderately agree). Most clinics felt that their EMR enabled the capture/recording of information that is accurate, consistent, complete, reliable, and with low risk of error to the patient. There was some disagreement on the completeness of the information recorded; this reflects the lack of interoperability with other systems. All clinics were content with the way in which their EMR presented information [5].

Of the 89 concept categories, we consider 26 as useful for capturing data on the information incentives, and give the number of quotations associated with the code in parentheses (Table 2). A review of associated quotes for the three most frequently used codes revealed the following ratios of positive to negative quotes: access to data 102:27; quality of care 94:4; interoperability 32:66.

Table 2 – Codes associated with information incentives

Item	Item
access to data (129)	patient education (55)
chronic disease management (62)	patient safety (33)
communicating patient information (63)	population health (33)
data mining (8)	practice management (39)
decision making (51)	productivity (41)
EHR (19)	professional development (28)
Email (8)	quality of care (98)
information flow (56)	recalls (21)
information resources (28)	referrals (27)
internal communication (33)	remote access (37)
interoperability (96)	requests for information (3)
motivation (60)	secondary analysis (4)
organization of data (41)	stewardship of data (14)

### Information Incentives as a Success Factor

Respondents cited a set of benefits that outweighed the costs of EMRs. These included efficiency gains associated with EMR prescribing features; the ability to generate referrals; confidence in information and data; lab results; and accuracy. Those with electronic receipt of lab data believe that this feature in itself immediately improves patient care. Other improvements in quality of care arise from the simple fact that the chart is now legible, and the information can be used in

terms of proactive and preventative care. The EMR empowers physicians to provide quality care, because information is more easily available and the information is correct.

The following illustrative quotes came from physicians.

*“Clinical notes that are legible, prescriptions that are integrated, alerts for drug interactions, renewal made easier, electronic receiving of labs that is very quick, in the minutes following its production, whereas before it could take up to two days to have access, when it was on paper, it's easier when a colleague is on maternity leave or sick leave, it's easier to communicate with other colleagues. When I have a note and I want to advise him, I send it in the internal messaging system and he receives the note in his inbox. That's what it's made easier, yes.”*

*“Clinics feel comfortable with their information — that it is always there, never lost, and most of all, always legible.”*

*“You can be confident in the information you're seeing. Not only is the note legible, another thing that improves care is that the notes — when you dictate notes, or when you're doing the notes firsthand, when you're right there with a patient — you put little nuances and implications into your notes that actually improve the care. Because you understand what you were thinking before, or you can understand what the other physician was thinking.”*

*“I believe it gives better patient care... I definitely think it's the way to practice. It's organized, it's neat, it's legible, and it facilitates communication with your office staff.”*

*“We use the Drug Interaction module. There's Clinical Support Decision Tools like Chronic Disease Management Guidelines and things like that.”*

### Information Incentives and Potential for Improvement

A few EMR functions were dependent on interoperability with external systems in hospitals, labs and other health providers. Insufficient interoperability was shown to be a significant roadblock to successful implementation. Policy makers would be wise to address interoperability issues in order to increase EMR adoption and sustainability.

*“The lack of integration. The lack of big-picture vision of what electronic records are going to look like in ..., and move systematically toward a big-picture integrated, functional system that it should be, given the day and age of IT.”*

*“One of the biggest issues right now is the continuing frustration that because of regulatory issues and readiness I can't just push out a prescription to the pharmacist. I have to print it and give it to the patient. I can't just message outside of my system very well.”*

*“It's an EMR practice in a paper-based system.”*

The usability of EMR functions also impacts information incentives as a success factor.

*“The main advantage of having an EMR is precisely that it integrates the clinical with the administrative. Because if you buy two different systems, I don't think it's necessarily a very bad decision, but you lose the advantages linked to integrating things together. But there are suites that have modules that are not as good — like the system we currently have, the scheduling, it's not as good as the one I had before. I gained on other things, I lost on some others”.*

Many of the clinics have staff exclusively scanning paper documents received from other health care providers. This distracts from much of the potential cost savings predicted by many EMR vendors.

*“I would say that we may even have more staff than we would if we weren't electronic just because we receive so much in paper copy and we're trying to get it into electronic form.”*

### Discussion

A conceptual framework was required for a diverse team of researchers to collaborate on case study research. The Canadian EMR Case Studies conceptual framework ensured that the research was conducted in a way that enabled the team to observe a number of commonalities across case studies.

The coding system designed for a particular set of research questions worked well for cross-case analysis, but required some pooling of concepts for comparison of research findings with another EMR implementation analysis study based on a different conceptual framework.

Complex behaviour change interventions, such as EMR implementation, require the use of consistent terminology to support meta-analyses and dissemination of scientific results [9]. The commonalities across the 20 case studies in our research identified the following success factors: personal leadership and commitment to EMR; funding; change management and ability to re-engineer; payment model; and collaborative culture [5]. Keshavjee's factors for EMR implementation success in his meta-analysis were: governance; project leadership; involve stakeholders; choose software; sell benefits; pre-load/integration; technology usability; early planning; workflow redesign; implementation assistance; training; privacy and confidentiality; feedback and dialogue; support; user groups; incentives; and business continuity [4].

The investigation into one specific success factor, information incentives, illustrated how issues around data organization and indexing need to be addressed to improve knowledge transfer. One resource that could help inform methods for head-to-head comparison of frameworks is the Rx for Change Interventions Database. It organizes its information according to the intervention classification scheme of the Effective Practice and Organisation of Care (EPOC) Review Group in the Cochrane Collaboration [10].

## Conclusion

The common message that emerged from the research into how Canadian physicians are using EMRs in primary care delivery was that no clinic would return to paper-based charts after experiencing the benefits of EMR [5]. The attainment of a common message illustrates that the perspectives of the two decision-making cultures in EMR implementation—the clinician and the health informatician—converged. The conceptual framework served as a boundary object and enabled the research team to achieve a shared ground.

The vocabulary used to express success factors varied across studies and illustrated difficulties that could arise in pooling data across research studies. Further work is required to make commensurable the different ways that success factors are categorized in different studies.

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