

# Implementation of electronic medical records

## Theory-informed qualitative study

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### Abstract

**Objective** To apply the diffusion-of-innovations theory to the examination of factors that are perceived by family physicians as influencing the implementation of electronic medical records (EMRs).

**Design** Qualitative study with 2 focus groups 18 months after EMR implementation; participants also took part in a concurrent quantitative study examining EMR implementation and preventive services.

**Setting** Toronto, Ont.

**Participants** Twelve community-based family physicians.

**Methods** We employed a semistructured interview guide. The interviews were audiotaped and transcribed verbatim; 2 researchers independently categorized and coded the transcripts and then met to compare and contrast their findings, category mapping, and interpretations. Findings were then mapped to an existing theoretical framework.

**Main findings** Multiple barriers to EMR implementation were described. These included lack of relative advantage for many processes, high complexity of the system, low compatibility with physician needs and past experiences, difficulty with adaptation of the EMR to the organization and adaptation of the organization to the EMR, and lack of organizational slack. Positive factors were the presence of a champion and relative advantages for some processes.

**Conclusion** Early EMR implementation experience is consistent with theoretical concepts associated with implementation of innovations. A problematic implementation process helps to explain, at least in part, the lack of improvement in preventive services in our quantitative results.

#### EDITOR'S KEY POINTS

- Diffusion of innovations theory can be used to describe the implementation of electronic medical records (EMRs).
- Barriers associated with EMR implementation included lack of relative advantage (not perceived as better than paper records), high complexity of the system, low compatibility with physician needs and past experiences, and lack of organizational slack, or additional resources, that could be devoted to adapting the EMR to the practice and adapting the practice to the EMR. The presence of an EMR champion was a facilitator.
- Findings in this study were mapped to several attributes negatively associated with implementation of an innovation.

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# Mise en œuvre des dossiers électroniques

## Étude qualitative à l'aide de la théorie de la diffusion des innovations

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### Résumé

**Objectif** Appliquer la théorie de la diffusion des innovations à l'examen des facteurs qui, selon les médecins de famille, influencent l'introduction des dossiers médicaux électroniques (DMÉ).

**Type d'étude** Étude qualitative à l'aide de 2 groupes de discussion, 18 mois après la mise en œuvre des DMÉ; les participants participaient en même temps à une étude quantitative sur les rapports entre l'introduction des DMÉ et les activités préventives.

**Lieu de l'étude** Toronto, Ontario.

**Participants** Douze médecins de famille de la communauté

**Méthodes** On a utilisé un guide d'entrevue semi-structurée. Les entrevues ont été enregistrées sur ruban magnétique et transcrites mot à mot; 2 chercheurs ont, chacun de leur côté, codé et classé par catégories les transcrits, pour ensuite comparer et confronter leurs observations, leur classement en catégories et leurs interprétations. Leurs observations ont été ensuite appliquées à un cadre théorique existant.

**Principales observations** On a décrit plusieurs obstacles à l'introduction des DMÉ, dont le manque d'avantages relatifs pour plusieurs processus, la grande complexité du système, le peu de compatibilité avec les besoins et les expériences antérieures des médecins, la difficulté d'adapter le DMR à l'organisation et d'adapter l'organisation aux DMÉ, et l'absence de flexibilité de l'organisation. Les facteurs positifs étaient la présence d'un champion et des avantages relatifs pour certains processus.

**Conclusion** Les premières données sur l'introduction des DMÉ sont compatibles avec les concepts théoriques associés à la mise en œuvre d'innovations. Un processus de mise en place problématique peut expliquer, au moins en partie, le peu d'amélioration des services préventifs qu'indiquent nos résultats quantitatifs.

#### POINTS DE REPÈRE DU RÉDACTEUR

- On peut utiliser la théorie de la diffusion des innovations pour décrire l'introduction des dossiers médicaux électroniques (DMÉ).
- Parmi les obstacles à l'instauration des DMÉ, mentionnons l'absence d'avantages relatifs (le DMÉ n'étant pas considéré meilleur que le dossier papier), la grande complexité du système, le peu de compatibilité avec les besoins des médecins et leurs expériences antérieures et le manque de flexibilité de l'organisation ou de ressources additionnelles qui pourraient adapter le DMÉ à la pratique et adapter la pratique au DMÉ. La présence d'un champion en DMÉ en facilitait l'implantation.
- Les résultats de cette étude ont été appliqués à plusieurs attributs négativement associés à l'introduction d'une innovation.

Cet article a fait l'objet d'une révision par des pairs.  
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Evidence that the presence of electronic medical records (EMRs) improves quality in primary care is equivocal.<sup>1-6</sup> We studied the first 2 years of EMR implementation (or putting the EMR into daily use)<sup>7</sup> in the practices of 18 community-based family physicians in Toronto, Ont. We measured the effect of EMR implementation on the provision of preventive services affected by a pay-for-performance program. We found no difference in the change-of-service provision between physicians implementing EMRs and a group who continued to use paper records.<sup>8</sup>

Quantitative results provide information about what happened, while qualitative findings help to explore and understand why it happened.<sup>9</sup> Research using theoretical frameworks to describe EMR implementation in primary health care practices is rare.<sup>10</sup>

We conducted a concurrent qualitative study in the same practices that were studied for our quantitative project.<sup>8</sup> To provide a theoretical framework for the possible changes occurring during EMR implementation in these practices, we identified concepts that described the implementation of innovations in health services organizations<sup>10</sup> and determinants of implementation applicable to small family practices. The determinants were based on an empirically validated model, Rogers' diffusion of innovations.<sup>7,10-14</sup> This model has been used to describe diffusion of health information technology.<sup>15-19</sup> Rogers' theory addresses a variety of factors that can affect the implementation of an innovation; these include attributes of the innovation, the process of implementation, individual characteristics of and interactions between the implementers, and organizational factors.<sup>7,10,17</sup> These attributes and characteristics are described in **Table 1**<sup>7,10,17</sup>; their expected effects on implementation<sup>7,10,20</sup> are shown in **Figure 1**.

The goal of this study was to determine what factors were perceived by physicians as influencing their EMR implementation.

## METHODS

To frame and explain our quantitative results, we used focus groups to explore the perceptions of study physicians about the implementation of their new EMR systems. Focus groups are particularly suited for collecting information on people's attitudes and experiences, "how they think and why they think that way," within a particular context.<sup>9</sup>

The focus groups were conducted in February 2008, 18 months after implementation, in parallel with the quantitative study.<sup>8</sup> Results from the quantitative study were not available at the time the focus groups were conducted. We invited all 17 eligible physicians in the EMR cohort to participate, excluding the principal investigator (M.G.) who was a study physician. To avoid

introducing bias, she did not conduct or participate in either focus group. Five physicians participated in the first focus group, and 7 participated in a second focus group.

The interviews were conducted by one of the researchers, (J.B.) who had experience in qualitative and focus group studies in primary care, along with the research coordinator. The focus groups lasted approximately 1 hour each. To maximize ease of participation, the sessions were held after office hours or at lunchtime in the office of one of the participating physicians. We used a semistructured guide developed from our previous study on physician perceptions of pay for performance,<sup>21</sup> which participants did not see in advance. We did not specifically ask about preventive care, as the focus group took place during the study, and we did not want to bias practice behaviour by introducing suggestions about preventive processes. The interviewer introduced the topic by stating that the discussion would explore participants' experiences with EMRs; the initial question was whether participants used only EMRs or a combination of paper and EMRs. The interviewer then encouraged participants to talk about both positive and negative experiences associated with EMR use.<sup>9,22</sup>

The focus groups were audiotaped and transcribed verbatim. Two members of the research team (J.B., M.G.) independently read and coded the transcripts. The

**Table 1. Factors selected from Rogers' diffusion-of-innovations theory<sup>7</sup> that can influence the implementation of innovations in health care settings**

ATTRIBUTE	DESCRIPTION
Relative advantage	Degree to which the innovation is perceived as being better than the previous state <sup>7</sup>
Compatibility	Degree to which the innovation fits with users' values, needs, and past experiences <sup>7</sup>
Complexity	Perception that the innovation is difficult to learn and use <sup>7,17</sup>
Observability	Ability of others to see the results of the innovation <sup>7</sup>
Reinvention	Extent to which the innovation can be modified to fit the organization and local context as it is implemented <sup>7,10</sup>
Organizational size	Number of staff and size of budget in the organization <sup>7</sup>
Organizational slack	Presence of resources beyond those required for the management of daily tasks <sup>7</sup>
Presence of champion	Opinion leader actively engaged in supporting implementation efforts <sup>7,10</sup>
Supportive leadership	Organizational leader positively inclined toward the innovation <sup>7</sup>

constant comparative method,<sup>23</sup> a method of checking and comparing data to identify categories,<sup>24</sup> was used to identify key words and themes describing the participants' opinions about and experiences with the EMR system. We also searched the data for alternative explanations contradicting the themes we were developing.<sup>25</sup> Key words and themes were provisionally classified into categories. The coders then met to compare and contrast findings, category mapping, and interpretations<sup>24</sup>; disagreement was resolved by discussion and consensus. We used theory-driven reflection<sup>20</sup> to map the findings of this study to our framework.

All physicians signed a consent form to permit the focus group recording, transcription, and analysis. The study was approved by the University of Toronto's Research Ethics Board.

## FINDINGS

**Table 2** shows physician characteristics. Participants in the focus groups agreed that they continued to use both paper records and EMRs, and were in effect running hybrid systems. Participants also indicated that they were not willing to go back to their previous paper-based records.

Several themes associated with the first 18 months of EMR implementation emerged from the focus groups and were categorized as barriers or facilitators and benefits of EMR implementation.

### Barriers

Participants viewed the EMR system as complex and inflexible, as well as not highly compatible with their current needs. Some of this was believed to be owing to software interface issues and perceived software immaturity. Participants recognized that these were not issues isolated to their settings.

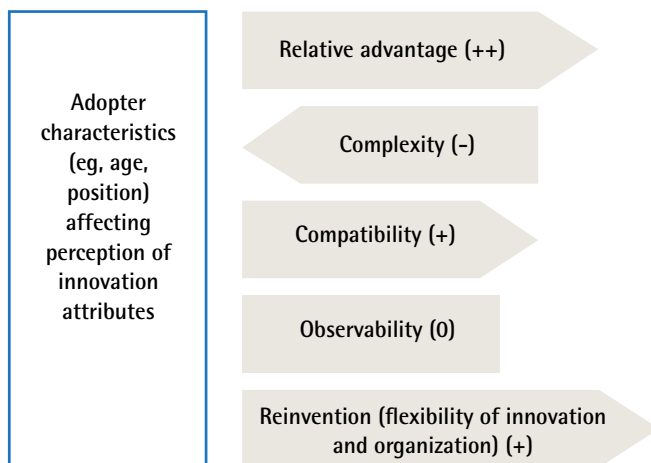
If you flip back in business and look at the programs 20 years ago, they didn't have Excel spreadsheets and this and that and the other, and I think we have to evolve. It has to be intuitive and have the flexibility, and that is just not in the existing [EMR] software. There won't be until they have the volume of people.

A common theme was the enormous amount of time required for data entry by physicians, clearly far more than they had expected. There was a long perceived time-lag between effort and reward, leading to disappointment.

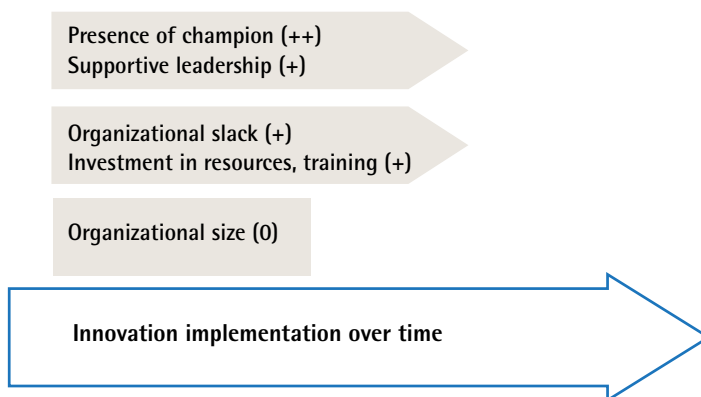
It is taking me longer when I am seeing [patients]. I am staying later. I am working weekends .... And that is the most discouraging thing to me, this workload thing. I didn't mind the data entry; I just thought suck it up for a year, you know; you will be here every night and every weekend. But now I am really not feeling very good about it.

**Figure 1. Theoretical factors affecting implementation of an innovation:** A) *Innovation attributes that positively (+), negatively (-), or inconclusively (0) affect implementation;* B) *Organizational attributes that positively (+) or inconclusively (0) affect implementation.*

### A) Innovation attributes



### B) Organizational attributes



**Table 2. Characteristics of the physicians participating in the focus groups\*: N = 12.**

VARIABLES	PARTICIPANT RESPONSES
Year of graduation, median (range)	1975 (1967 to 1983)
Men, n (%)	7 (58)
CCFP, n (%)	8 (67)
No. of medical doctors in practice, median (range)	2 (1 to 6)
No. of hours worked per week, median (range)	45 (35 to 60)
No. of patients per physician, median (range)	1363 (630 to 2200)

CCFP—Certification in Family Medicine.

\*Obtained from questionnaires administered at the onset of the quantitative study.

Participants believed that there were unexpected costs for the technology and for human resources required to implement the innovation.

I think [the incentive funding] is a little amount compared to the overall costs and the costs that we are now spending on IT [information technology] and how we had to change the office and hire a new staff person. So, these costs that we didn't foresee are now part of what we have.

The EMR appeared to have different effects for various staff members:

We are freeing up our front staff, but we are causing lots more work for our nurses because we find the nursing function is more labour intensive; but the front staff love it.

Several physicians mentioned the decrease in efficiency owing to technological barriers such as lack of system interoperability. All paper-based materials coming from specialists, hospitals, or diagnostic imaging facilities need to be scanned in; in effect, the practice-based EMR functioned as an "electronic island." "My secretary spends an hour or 2 every day scanning this stuff in, and then I have to look at what they scan."

Several participants mentioned IT structural failures (eg, hardware breakdown), lack of redundancy (eg, absence of a back-up Internet line when the primary line failed), and lack of technical support. Solving common IT problems was left to physicians, as offices initially lacked technical support, or to nonphysician personnel familiar with computer technology. There was no routine way to manage problems, so many issues escalated into larger problems.

We need an office manager who could handle the printer going down, the scanner problems that we

have been having, the connectivity issues, then it would be okay. But one of us is always running like a chicken with their head cut off crazily trying to put the finger in and nothing ever happens.

Several participants described a lack of knowledge about basic computer operations and common programs (IT skills), as well as a lack of keyboarding skills.

I am not very sophisticated in terms of computers in general, so for the newbie like myself everything has been an adventure. So learning about not just our software but just how [Microsoft] Office works or whatever application we are using. So we had to learn everything and that slowed us down immeasurably.

Training was offered before the EMR was implemented; however, there were no formal sessions scheduled later on. Participants recognized their need for ongoing training in EMR use.

I don't even know what I could learn. I know there are buttons there that I am not using efficiently, so it would be nice if you could follow me around for 2 or 3 patients to see how I am doing it and tell me probably how I can use it better.

### Facilitators and benefits

Physicians mentioned the availability of a champion as a strong facilitator. The champion provided support, helped solve some problems, and was perceived as facilitating and maintaining enthusiasm for the transition. "She [the EMR champion] makes sure that you understand the value of [the EMR], and she is so enthusiastic."

Participants found that since they had learned the system, some aspects of the EMR made them more efficient. Prescription refills and consultation letters in particular were much quicker. This occurred after an initial decrease in efficiency, once some data entry was completed. Physicians thought that their administrative personnel were more efficient.

I find that prescription renewals are great, especially if you have someone on 10 medications and you have to start writing it out.

It saves huge amounts of time for the staff. They don't have to pull [the charts] and refile them. Prescriptions don't have to be pulled; labs don't have to be filed, so there is a lot of time saved there for our staff.

Participants believed that starting an EMR system was becoming a necessity; however, they thought that the benefits were greater for younger physicians.



I don't think there is any future for paper charts. Ten years from now it will not be considered standard care. For anybody going into practice now who didn't start with EMRs [it] would be a total mess.

Although physicians worried about their patients' perceptions of the new technology, they thought that patient reaction ranged from neutral to positive. Patients sometimes even encouraged their physicians. "I think patients are pleased. You know, 'Oh, finally you are in the modern age, I see. Good for you.'"

However, some physicians thought that the EMR interfered with their interactions with patients. Some of the difficulties were related to data entry problems, such as being unable to type:

It interferes between my relationship with my patients. I find that I want to look at them and they want to look at me; they don't want to see the back of my head or back, and unfortunately I cannot talk to them and make notes at the same time. I talk to them, I do everything, and then I walk out of the room and then I put my notes in.

Physicians believed that the EMR implementation had improved the quality of their records: charts were better organized, and they were able to find data quickly. Legibility had improved as well.

It is nice to be able to find reports. If somebody comes in and says they had a mammogram and I don't remember, I just look back and see the results. If they have seen a specialist it is so much easier than trying to leaf through a chart.

Overall, participants expressed ambivalence about the EMR; while some of the promised benefits were starting to be realized, there was a definite perception that the implementation was much more difficult than anticipated.

We reflected on these findings and mapped them to the theoretical framework presented earlier. Physicians noted a low relative advantage during EMR implementation compared with the paper records previously used. Physicians thought that the relative advantage was greater for younger physicians and, depending on their roles in the practice, for some staff members; for example, EMRs might have been a greater advantage for office staff at the front desk.

There were, however, some perceived relative advantages to the EMR during implementation. Physicians described some gains in efficiency after an initial decrease. Also, there was an increase in efficiency for several administrative processes managed by the front staff. There was a perception that relative advantage would improve over time.

There was limited compatibility, as implementers described a poor fit with most of their needs and past experiences. Implementation of the EMR involved a large number of simultaneous changes. However, there was some compatibility with values: physicians thought that the quality of charting was improved. Physician perceptions of patient reactions were mixed.

Observability was not mentioned during the focus groups. There was a high degree of perceived complexity during implementation. Initial expectations of usability were not met during this implementation.

Physicians thought they did not have the knowledge, training, or assistance they needed to successfully reinvent the EMR or their practices.

Although physicians described the presence of a champion, there was a perceived lack of leadership and support at the system level to assist with implementation activities. They also described a lack of help with integration with other IT systems. At the practice organizational level, physicians did not think that they had sufficient capacity (or organizational slack) to enable them to learn and test the new skills needed to effectively use the technology.

## DISCUSSION

Our qualitative findings map to multiple theoretical factors associated with implementation difficulties. These are consistent with findings for small primary care practices in other studies. Terry and colleagues<sup>26</sup> used qualitative methods to study small primary care offices implementing EMRs in southwestern Ontario. Participants found that the time required for implementation was far greater than expected; prior expectations of usability were not met; training was an important factor; and the presence of a champion helped with implementation.<sup>26</sup> A qualitative study of innovators and early adopters of EMRs in small community practices in California<sup>27</sup> found that initial costs were higher than expected, with benefits not always being realized; physicians thought that the EMR led to increased quality of care; the distribution of benefits was uneven, with superusers benefiting the most; and the presence of a champion was critical to implementation.<sup>27</sup> Another study<sup>28</sup> found that several barriers to EMR implementation in community practices were present: high initial costs, additional time requirements and immaturity of the technology, difficulties with the ability to customize and adapt the EMR, inadequate interoperability with external data sources, and differing physician attitudes toward the EMR.<sup>28</sup> A recent review of studies on barriers to EMR implementation<sup>29</sup> found that these could be broadly categorized as concerns about costs, technical issues (including lack of interconnectivity, high

complexity, and lack of customizability), lack of time, psychological factors such as lack of belief in EMRs, social factors such as a lack of support from colleagues, legal issues such as concerns over privacy and security, differing organizational size and type (hospital vs community practice), and difficulties with change management.<sup>29</sup> It is possible that EMR implementation will be perceived as less problematic over time, as more primary care groups use these systems and implementation experience is gained. Procedures, training, and support for implementation activities might improve; technological barriers might decrease if the systems mature and interconnectivity increases.

Theory-informed interventional studies could address some of the barriers and facilitators to EMR implementation and could measure the effect of interventions on the implementation of various aspects of the EMR and on the quality of care provided to patients.

### Limitations

Some theoretical factors associated with Rogers' theory were not addressed here. These include perceptions, degree of control, and influences of nonphysician practice team members; and perceptions of attributes over time and correlation with specific stages of implementation (the focus groups were conducted at a single point in time, 18 months into implementation). There are a number of theories addressing the implementation of information technology<sup>10,30-33</sup>; however, not all theories are applicable to health care settings or small family practices.

### Conclusion

Physicians thought that EMR implementation was problematic. Factors influencing EMR implementation were a lack of relative advantage, high complexity, and low compatibility. These small offices did not have the organizational slack to adapt the system to their practices and to reinvent their workflows to take advantage of the EMR during implementation. The difficulties with implementation help to frame and explain the lack of improvement in the provision of 4 preventive services that we observed in our quantitative study (ie, Papanicolaou tests, screening mammograms, fecal occult blood testing, and influenza vaccinations)<sup>8</sup>—an IT system that is not adequately implemented is unlikely to lead to positive changes.

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#### Contributors

All authors contributed to the concept and design of the study. **Drs Greiver and Barnsley** contributed to the data gathering. All authors contributed to the analysis, interpretation, and preparation of the manuscript.

#### Competing interests

None declared

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