

Adopting electronic medical records

Are they just electronic paper records?

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Abstract

Objective To understand the key challenges to adoption of advanced features of electronic medical records (EMRs) in office practice, and to better understand these challenges in a Canadian context.

Design Mixed-methods study.

Setting Manitoba.

Participants Health care providers and staff in 5 primary care offices.

Methods Level of EMR adoption was assessed, and field notes from interviews and discussion groups were qualitatively analyzed for common challenges and themes across all sites.

Main findings Fifty-seven interviews and 4 discussion groups were conducted from November 2011 to January 2012. Electronic medical record adoption scores ranged from 2.3 to 3.0 (out of a theoretical maximum of 5). Practices often scored lower than expected on use of decision support, providing patients with access to their own data, and use of practice-reporting tools. Qualitative analysis showed there were ceiling effects to EMR adoption owing to how the EMR was implemented, the supporting eHealth infrastructure, lack of awareness or availability of EMR functionality, and poor EMR data quality.

Conclusion Many practitioners used their EMRs as “electronic paper records” and were not using advanced features of their EMRs that could further enhance practice. Data-quality issues within the EMRs could affect future attempts at using these features. Education and quality improvement activities to support data quality and EMR optimization are likely needed to support practices in maximizing their use of EMRs.

EDITOR'S KEY POINTS

- The potential benefit of using information communication technology in health care (eg, electronic medical records [EMRs]) is large. Benefits include a positive financial return on investment, efficiency of communication, care coordination within a practice, and diabetes care process outcomes.
- Electronic medical record users consistently scored lower in 3 categories: decision support, patient support, and practice reporting.
- The findings revealed 3 themes that were challenges to the adoption of EMRs: a general ceiling effect of current technology, lack of awareness of EMR capability, and poor EMR data quality.

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Adoption du dossier médical électronique

Ne serait-il qu'un dossier papier en version électronique?

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Résumé

Objectif Comprendre les défis principaux que pose l'adoption des caractéristiques avancées du dossier médical électronique (DMÉ) au bureau et mieux définir ces défis dans le contexte canadien.

Type d'étude Étude utilisant diverses méthodes.

Contexte Le Manitoba.

Participants Les soignants et les autres membres du personnel de 5 établissements de soins primaires.

Méthodes On a établi le degré d'adoption du DMÉ et analysé les notes prises durant les entrevues et les discussions afin d'établir les défis et les thèmes communs à tous les sites.

Principales observations On a tenu 57 entrevues et 4 groupes de discussion entre novembre 2011 et janvier 2012. Les scores pour l'adoption variaient de 2,3 à 3,0 (sur un maximum théorique de 5). Les établissements avaient souvent des scores plus bas que prévu quant au suivi des décisions, à l'accès du patient à ses données personnelles et à l'utilisation des outils pour les rapports de pratique. L'analyse qualitative a indiqué certains effets de plafonnement relativement à l'adoption du DMÉ, liés la façon dont le DMÉ a été instauré, à l'infrastructure de cybersanté existante, au manque de connaissance ou de disponibilité des fonctionnalités du DMÉ et de la faible qualité des données du DMÉ.

Conclusion Plusieurs médecins utilisaient le DMÉ comme « version électronique du dossier papier » sans se servir des caractéristiques avancées du DMÉ, lesquelles auraient pu améliorer davantage leur pratique. Certains problèmes de qualité des données dans le DMÉ pourraient aussi nuire aux tentatives futures pour utiliser ces données. Des activités de formation et d'amélioration de la qualité des données seront probablement nécessaires pour que les établissements maximisent l'utilisation du DMÉ.

POINTS DE REPÈRE DU RÉDACTEUR

- Dans le domaine de la santé, il y a énormément d'avantages à utiliser la technologie de partage de l'information (c.-à-d. le dossier médical électronique [DMÉ]). Parmi ces avantages, mentionnons un retour intéressant sur l'investissement, une communication efficace, une bonne coordination des soins à l'intérieur d'une clinique et certaines conséquences pour le traitement du diabète.
- Les utilisateurs du dossier médical électronique avaient des résultats régulièrement plus bas dans 3 catégories : le suivi des décisions, le soutien aux patients et l'utilisation des rapports de pratique.
- Nos observations ont révélé 3 thèmes qui constituaient des défis pour l'adoption du DMÉ : un certain effet de plafonnement de la technologie actuelle, une connaissance insuffisante des fonctionnalités du DMÉ et une faible qualité des données du DMÉ.

Cet article a fait l'objet d'une révision par des pairs.
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The adoption of electronic medical record (EMR) systems is a matter of priority in Canada. Several provinces have invested in EMR deployment and support programs, and Canada Health Infoway has invested \$380 million toward acceleration of EMR implementation.¹ The Canadian National Physician Survey reported increased EMR use from 10% in 2007 to 16% in 2010, as well as an increase in physicians using a combination of EMRs and paper charts (25% to 34% during the same time).²

The potential benefit of using information communication technology in health care (eg, EMRs) is large.³ Benefits include a positive financial return on investment,⁴ efficiency of communication,⁵ care coordination within a practice,⁶ and diabetes care process outcomes.⁷

However, there is a gap between the potential benefits and the actual research.^{8,9} There is less evidence on EMR benefits specific to primary care, and that evidence is mixed. A recent systematic review found a limited positive EMR effect in the physician office.¹⁰ Common reasons for this limited effect include not having the following: robust EMR features that support clinical use; a good fit between the EMR and clinical work flows; demonstrable value to clinicians; and patients engaged in the process of EMR adoption.

Electronic medical record systems in primary care settings are complex. There are recognized methodologic issues associated with the study of such complex interventions.¹¹ A recent review identified 48 distinct factors that influenced EMR success.¹⁰ There is increasing recognition of the multifactorial and complex set of system and implementation factors that affect the adoption of health information systems such as EMRs. These include user interface–design quality, usability, feature functionality, data quality, and broader integration to external systems.^{12–14} Other studies have looked at implementation factors in primary care in Canada.¹⁵

The EMR adoption framework described below provides a way of assessing use of EMRs across 10 functional areas.¹⁶ This paper adds to our current knowledge by examining postimplementation adoption of EMRs through a mixed-methods analysis based on feedback from EMR users—health care providers and staff in primary care offices. The objectives of this study are to examine challenges related to lower adoption rates of advanced EMR functionality and to better understand these issues in a Canadian context. By understanding the use of EMRs in this context, we hope to support future optimization of EMR use.

METHODS

This mixed-methods study assessed EMR adoption in office-based practices and provided formative feedback based on the findings at the clinic level. It used the EMR

adoption–assessment interview tool¹⁶ to conduct semi-structured interviews and reflective discussion groups.

Conceptual framework

The EMR adoption framework consists of 10 EMR functional categories (**Figure 1**) in which clinician activities are scored from 0 (paper chart) to 5 (theoretical maximum score for an integrated electronic record). These scores are summarized to single scores for each clinician and an overall score for each clinic. Electronic medical record adoption is supported (or limited) by EMR capability (ie, functionality) and the eHealth infrastructure (the technology and policies that support EMR use, connectivity, etc). These 2 components will create a ceiling effect for the possible score. For example, a clinician cannot score 5 in the medication management section without the eHealth infrastructure to support electronic prescribing. In Canada today, one would expect a user who has fully adopted an EMR to score close to 4, based on this ceiling effect. The Manitoba eHealth EMR requirements¹⁷ were reviewed to provide guidance as to what was possible in the approved EMRs.

Recruitment of participants

Clinics were recruited by Manitoba eHealth to participate in an EMR adoption–assessment project. Clinic participation was voluntary. Clinics were eligible if they were actively using EMRs in practice and had been doing so as a clinic for at least 6 months. Individual clinicians and staff members at each clinic could then choose whether to participate in the study. Recruitment occurred before the site visit and again during the site visit, with a face-to-face introduction session early in the first morning. Participation in the interviews was kept anonymous. Clinics were recruited to represent urban and rural clinics, early and recent EMR adopters, and fee-for-service and alternate payment models.

Study team

The study team comprised the principal investigator (PI), clinical analysts (physicians and nurses), and nonclinical analysts who traveled to each clinic to complete a 1- to 2-day field assessment of its current EMR adoption level. We engaged the clinics in an action-oriented research approach, in which we also gave feedback for improving adoption.

Data collection

There were 3 parts to each field assessment: an introduction session, one-on-one semistructured interviews, and a reflective discussion group. This was consistent with our previous work.¹⁶

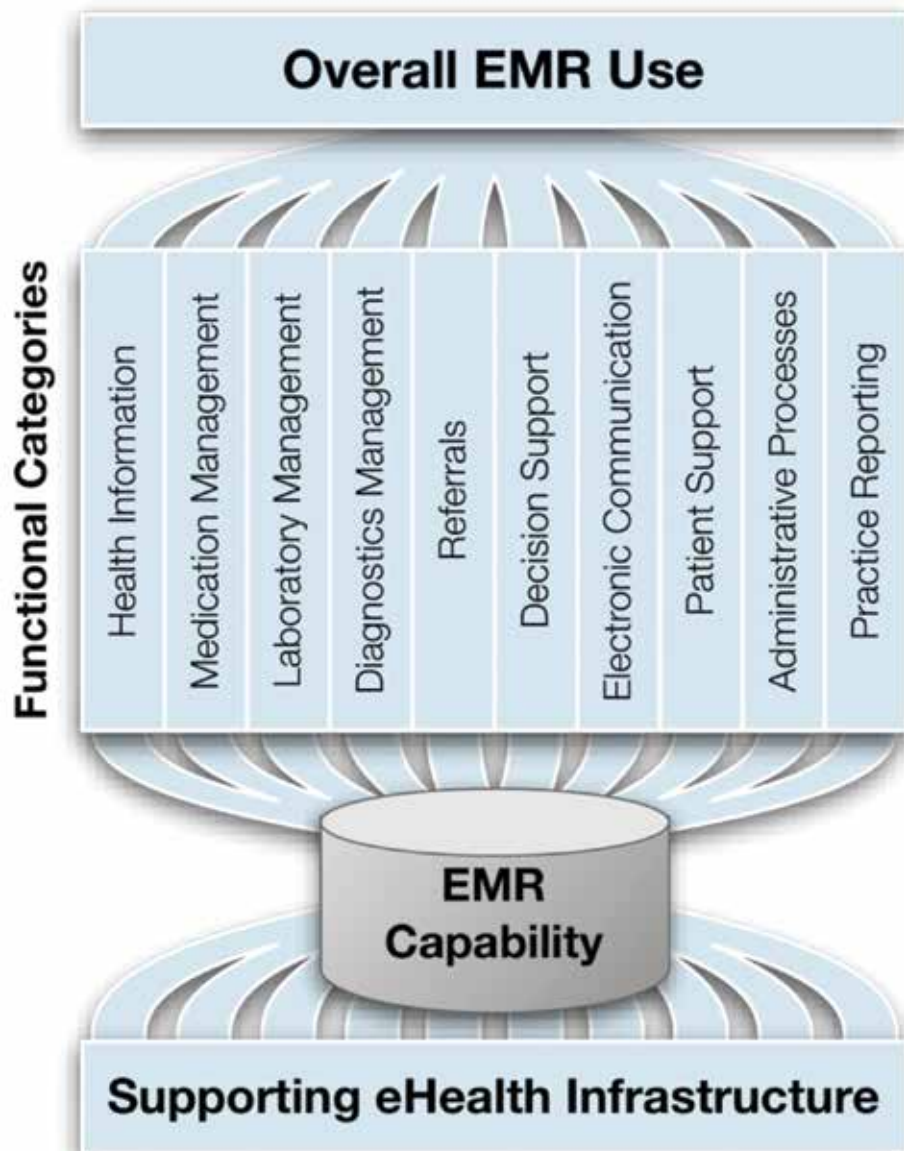
After a 30-minute introduction, semistructured interviews were conducted with clinicians and staff at each clinic. Each user's EMR adoption level was individually

assessed across 10 functional categories using the interview format from the EMR Evaluation Toolkit, version 3.0, from the eHealth Observatory (<http://ehealth.uvic.ca>). While scoring current use of EMR features (Figure 1),¹⁶ the interviewers also recorded field notes, capturing participants' comments on how the EMR was used, challenges they faced, and perceived benefits of the EMR. In some cases, interviewees used test patients in

their EMR systems to demonstrate aspects of their EMR practices. Interviews were not recorded.

A discussion group was held at the end of the 2-day assessment to review the summative EMR adoption levels across the 10 functional categories. The study team sought clarification on unclear processes and discussed challenges and potential improvements. The study team encouraged clinics to consider 1 or 2 key areas of

Figure 1. Electronic medical record adoption framework



EMR—electronic medical record.
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improvement for actionable change that were high priority, feasible, and within the clinics' control.

Quantitative data analysis

Quantitative analysis followed the protocol set out by Price and Lau.¹⁶ To ensure consistency of scoring, analysts reviewed individual interview scores with the PI.

Qualitative data analysis

Figure 2 describes the qualitative analysis. After each interview, there was a debriefing with the PI and qualitative findings were discussed under each functional category. Items were captured in a set of common field notes for each clinic.

The study team collectively discussed findings for each clinic, reviewing field notes. A list of challenges and suggestions was developed during the discussion. This list was captured in a slide presentation for feedback in the discussion group. The analysis was then validated through the discussion group with the clinic.

The study team completed a further review of the summarized field notes after all clinic assessments were completed. Common challenges of EMR adoption across clinics were extracted as themes.

Ethics approval was received from the University of Victoria, the University of British Columbia, the University of Manitoba, and the Winnipeg Regional Health Authority before the site visits.

FINDINGS

Site visits occurred from November 2011 to January 2012. A total of 57 clinicians and staff members across 5 different clinics were interviewed (**Table 1**). Office staff members were invited to participate to supplement gaps when physicians were not available (eg, if they were away during the site visits). Four discussion groups that engaged 10 additional participants (who had not been interviewed) were also conducted. For the convenience of the participants, the feedback sessions for 2 jointly operated clinics were merged.

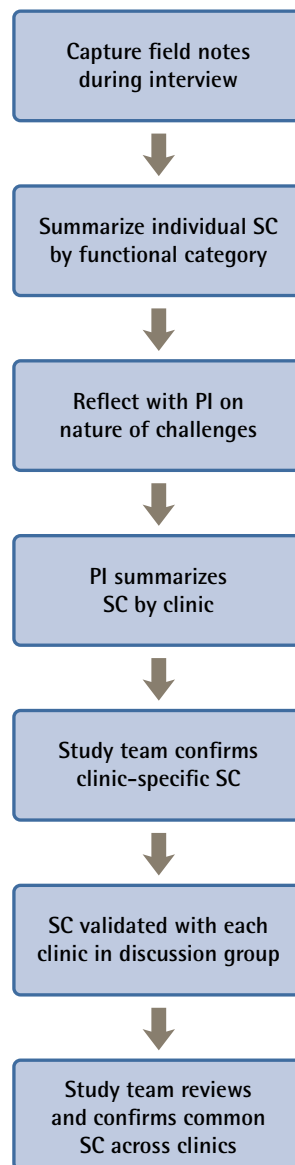
Clinics varied in time since EMR implementation from 9 months to 12 years. Participants had been using

Table 1. Interview participants: A total of 57 interviews were conducted.

| TOTAL CLINICIANS AND STAFF | INTERVIEW PARTICIPANTS, N (%) |
|--|-------------------------------|
| Family physicians and nurse practitioners (N = 38) | 32 (84) |
| Other specialists (N = 6) | 3 (50) |
| Nurses (N = 18) | 8 (44) |
| Office staff (N = 14) | 14 (100) |

EMRs from 3 months to more than 12 years. Clinics had chosen 1 of 2 main EMR products available in Manitoba. Both vendors were approved by the Manitoba eHealth EMR adoption program and so they were expected to have features available such as structured documentation for problems, allergies, and immunizations; a prescription module with drug interaction checking; and practice-reporting tools as per the published Manitoba EMR requirements.¹⁷

Figure 2. Approach to qualitative data analysis



PI—principal investigator, SC—strengths and challenges.

Adoption scores

Overall EMR adoption scores among clinics ranged from 2.3 to 3.0, and scores among individual participants ranged from 2.1 to 3.3. Clinics used many features of their EMRs. Use was not consistent across all 10 categories (**Figure 3**). Time since implementation did not seem to affect adoption score. The one clinic to score 3.0 was an early EMR adopter, but it was also involved in a structured quality initiative.

Electronic medical record users consistently scored lower in 3 categories (ie, below 3 and below what would be expected based on the published Manitoba eHealth EMR capabilities): decision support, patient support, and practice reporting. Qualitative challenges for these categories are described below.

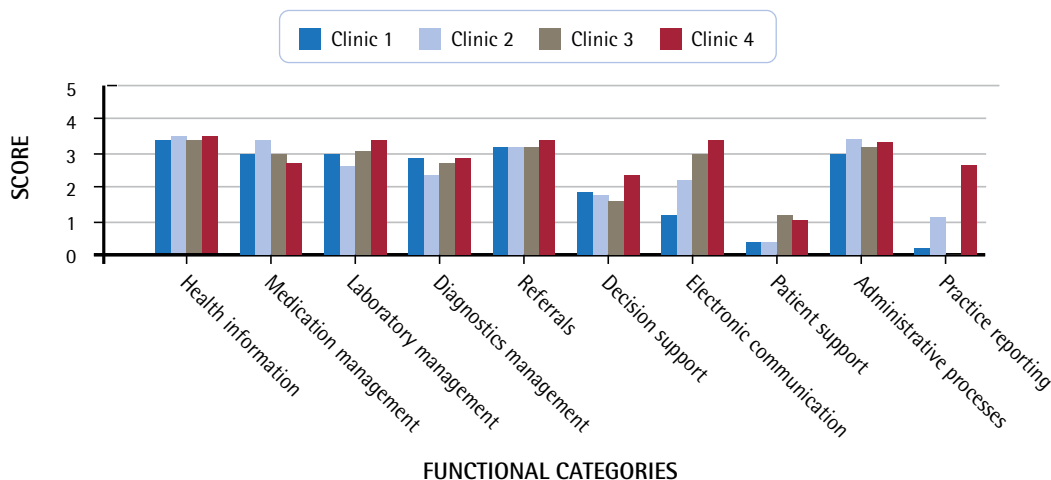
Decision support. Decision support includes use of alerts and reminder functions in the EMR. Overall, point-of-care decision support within the EMR was used rarely. Participants were often not aware that an EMR could provide decision support such as rule-based reminders and alerts. No clinic in our assessment was using a built-in drug interaction program. (In the EMR adoption framework, drug interaction checking—a form of decision support—is captured in the medication management category; however, we included it here for our analysis.) Several participants used smartphones and external websites for drug interaction checking. Often, clinical data were not being properly captured in a structured format, so they could not be acted upon later by the EMR. Examples included immunizations being recorded in free text; free-text lists of problems; laboratory results recorded as a scanned paper; and free-text documenting of medications and allergies. Each

of these hampers use of automated clinical decision support now and in the future.

Patient support. The patient-support functional category assesses use of knowledge bases (eg, paper or electronic educational handouts) for patients, as well as patients' access to their own data. We found participants were often not aware that EMRs could provide these features or found the features limited. Some users were aware of the features in their EMRs but as providers were responsible for developing and maintaining their own content (ie, handouts), which they found to be unsustainable. Providers then relied on Web search engines to find handouts or used paper copies. These were not linked to the patient record. No clinics provided patients with electronic access to their EMR data (eg, patient portal or personal health record). Some were considering online self-appointment booking in the near future.

Practice reporting. Practice reporting is the process of internally reviewing one's own practice (ie, across patient populations) to better understand the nature and needs of the practice and then implementing quality improvement activities. Electronic medical records can be used to develop patient recall lists, report on practice-performance metrics, monitor chronic diseases, and ensure adherence to guidelines. Two common reasons were found for not using EMR practice-reporting tools: lack of awareness and lack of time. One exception was in a clinic involved in the Physician Integrated Network quality improvement program.¹⁸ The participants at that clinic commented on the considerable effort required to improve their EMR data quality to get

Figure 3. Electronic medical record adoption scores, by clinic



* Data from the 2 jointly operated clinics were merged.

meaningful EMR reports. The importance of data quality was not something they had considered when they began entering data into their EMR. They had to spend considerable time cleaning the data so that their EMR could be used to generate the appropriate reports that reflected their actual practice.

DISCUSSION

Several studies have examined implementation of EMRs in Canada and found a range of barriers.^{12,15,19} We add to this body of knowledge by looking further at longer-term adoption and optimization trends. Reflection on our findings revealed 3 themes that were challenges to the adoption of EMRs: a general ceiling effect of current technology, lack of awareness of EMR capability, and poor EMR data quality. These are discussed below.

General ceiling effect of current technology

There was a ceiling effect to the EMR adoption scores owing to EMR capability, eHealth infrastructure, and the integration of the 2. In our scoring system, a score of 4 represents use of advanced internal EMR functionalities. Some features were not available (eg, drug interaction-checking modules were not purchased). A score of 5 represents EMR use that is integrated with a regional health system. These high scores were often impossible to achieve. For example, in Manitoba at the time of this study, the infrastructure to send electronic prescriptions did not exist.

Patient support in particular scored low owing to limited features in the implemented EMRs. This is not unique to Manitoba or to the EMR vendors used in this study; similar limitations exist in other provinces. At the time of this study, Alberta was the only province in Canada actively developing a provincial personal health portal.²⁰ Manitoba eHealth plans to provide this type of infrastructure in the future.

Lack of awareness or usability of EMR capability

For many participants, lack of awareness of EMR capabilities was an issue that limited EMR adoption. For some participants, training had occurred when the EMR was implemented, which was several years ago in some cases, and they had attended little or no subsequent training or user-group sessions. For others, they joined the clinic after EMR implementation and there were no ongoing training programs: they learned from peers or trial and error. In complex systems like EMRs, this has been shown to lead to unintended consequences—in particular, poor data quality. Some clinics held regular EMR meetings in which practice improvement techniques were shared, and this correlated with higher adoption scores. Participants highlighted the lack of

usability of their EMRs. If users found features were difficult to use or disruptive to patient care work flow, those features were often not used or not used consistently.

Three areas of decision support were examined: prescribing support, point-of-care decision support, and practice reporting. These areas had scores that were consistently lower than expected based on what was described as possible in the Manitoba EMR requirements. This was owing to lack of awareness, cost, usability, and time to learn to use the tools.

Quality of data

Poor quality of EMR data was not something that was explicitly highlighted as a concern by many participants. However, it was apparent by participants' descriptions of their EMR use that poor data quality was an issue for most users. This would likely limit use of advanced EMR functions that rely on data to support care. It might have unintended consequences, such as when users expect the EMR to perform certain functions but it is unable to owing to poor data quality (eg, drug alerting).²¹ Participants described documentation practices in which they recorded in their EMRs as much as they did on paper (eg, writing immunizations or medications in free text). Many users were surprised that their typical EMR practices would limit use of important functions such as automated reminders, recalls, and reporting.

Some advanced users and those involved in the Physician Integrated Network program were aware of the challenges of poor data quality. They had gone through the painstaking data cleanup in order to have the EMR generate meaningful reports. This is not atypical. In another ongoing (unpublished) study on EMR data quality, we are seeing low rates of usable structured data in EMRs in Canada. Other studies have shown variable data quality internationally.¹⁴ This will be a hindrance to effective advanced EMR use, such as decision support for prescribing.²² Data quality will also affect interoperability for electronic referrals. Even as EMR products conform to national data standards such as those being developed by the Canadian Institute for Health Information,²³ users are likely not conforming.

We realize that good EMR data quality is not a sufficient motivator for changing work flow in a busy clinic. Instead, the users need feedback and near-term benefits from maintaining good data. This includes leveraging the data to support the practice through efficiencies gained by using the data (eg, rapid prescription renewals); quality gains through practice reflection and point-of-care decision support; and even remuneration through more accurate billing.

Limitations

This was a mixed-methods study that relied on self-reported information (interviews and discussion groups)

from a limited number of providers in a single jurisdiction. Although these findings were consistent with our previous EMR adoption work, an expanded number of clinics across jurisdictions would have provided more generalizable findings. Also, additional methods could be used to validate the findings, such as assessments of EMR data quality, EMR functionality (eg, usability testing, work flow observations), or EMR audit logs.

Conclusion

Throughout this study, we found participants often thought of and used the EMRs as “electronic paper records.” Participants often expected the EMRs to be much like their old paper charts, only more legible. Many of the EMR adoption challenges we saw were related to this common conceptualization. If one thinks of an EMR as a paper record, data quality suffers, advanced EMR capabilities are not used, and there is a low demand for highly usable advanced features and infrastructure. Indeed, several of the authors are EMR-using physicians who struggle with balancing practice responsibilities and trying to achieve optimal EMR data quality. If we are to achieve more of the expected benefits of EMRs, we need to change our mindset and practices so that EMRs support productivity and high-quality care. Ongoing education on and engagement with EMRs (eg, through quality improvement programs) to optimize practices appear to be important requirements. Our study identifies the need for a further coordinated understanding of the factors that affect EMR optimization as the effort to move Canadian family practice into the information age continues.

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Contributors

All authors contributed to the concept and design of the study; data gathering, analysis, and interpretation; and preparing the manuscript for submission.

Competing interests

None declared.

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