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Barriers to organizational adoption of EMR systems in family physician practices: A mixed-methods study in Canada

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ABSTRACT

Background: EMR system can provide three main types of benefits: it can solve the logistical organization problems associated with paper systems; it can improve the quality of professionals' clinical decisions; and it can improve physicians' return on their practices by reducing the cost of managing clinical information. According to the 2012 Commonwealth Fund International Health Policy Survey, Canada ranked 10th out of 11 countries in terms of family physicians' adoption of EMR systems. Our main purpose is to investigate the reasons why so many primary care medical practices in this country have not decided to invest in these systems yet.

Methods: To achieve our main objective, a mixed-methods study was performed. We first conducted a Delphi study with a panel of 21 experts made up of general practitioners with extensive professional experience and a very good understanding of the issues surrounding the introduction of health IT in private medical practices. As a second step, we collected and analyzed data from a large questionnaire survey of family physicians working in medical practices without EMR systems ($n = 431$).

Results: The Delphi study reveals that private medical practices are hindered by four types of barriers when faced with the initial decision to invest in an EMR system, namely, behavioral, cognitive or knowledge-based, economic, and technological. Survey findings then indicate that the key challenges preventing private medical practices from investing in an EMR system are mainly related to economic and knowledge barriers. Surprisingly, we also found a cluster of medical practices which, although they have not invested in an EMR system, perceive no such barriers to adoption.

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Conclusions: A thorough understanding of the barriers faced by family physician practices in adopting an EMR system would help governments and other key stakeholders target policies and measures in support of medical practices. The "one size fits all" approach to such policies and measures is clearly inappropriate, given this study's findings that many medical practices face practically no barriers to EMR adoption, and that others differ markedly as to the type of barriers faced, be they mostly "soft" such as knowledge barriers or "hard" such as economic barriers.

1. Introduction

The adoption of information technologies (IT) in the healthcare sector offers great potential, as reflected by the proliferation of health IT applications aimed at improving the quality and continuity of services [1,2] and the efficiency and effectiveness of healthcare professionals [3–5], as well as reducing organizational costs [6]. In recent years, IT innovations have become critical for achieving healthcare reform priorities, including home care, primary care, and integrated care networks [7–9]. In this study we are concerned with one type of health IT and one type of healthcare setting, that is, electronic medical record (EMR) systems adoption among primary care physician practices. EMR systems are designed to support the activities of physicians and other authorized professionals in medical practices. The main functionalities associated with this type of system include, among others, medical consultation notes, lists of problems, allergies, vaccinations, vital signs, new prescriptions and renewals, automated alerts, automated reminders and medical appointments.

According to the extant literature, an EMR system can provide three main types of benefits that add value compared to traditional paper-based patient records: (a) it can solve the logistical organization problems associated with paper systems; (b) it can improve the quality of professionals' clinical decisions through automated logical or mathematical operations, by identifying clinical events that require attention and by fostering the dissemination of best practices; and (c) it can improve physicians' return on their practices by reducing the cost of managing clinical information [10,11]. The purpose of an EMR system is to improve the workflows of traditional, paper-based systems by eliminating lost requests and the ambiguities that result from handwriting, by automatically generating prescription requests, by preventing duplications of requests and by reducing the time spent on administrative tasks [12,13]. Hence, it becomes simpler and easier to consult data because it is more readable and the system sends automated notifications of laboratory results. The information may be presented in different forms, statistically analyzed or edited to produce various documents, such as discharge notes [14]. An EMR system can also be accessed remotely, which allows faster prescription updates, since the physical presence of the physician is no longer required [15]. Furthermore, quick access to electronic information, such as laboratory analyses and medical imaging results, may reduce the number of redundant diagnostic investigations and therefore lower the costs of health services and improve quality of care. Real-time assistance in decision making represents another benefit frequently mentioned in the literature [11]. An EMR system that provides alerts and automated suggestions can improve adherence to prevention protocols [16], thereby reducing medical errors [10].

Family physician practices play an essential role in the delivery of healthcare services but are least likely to adopt complex innovations such as EMR systems, particularly small practices [17,18]. According to the Commonwealth Fund International Health Policy Survey of Primary Care Physicians, Canada ranked 10th out of 11 countries in terms of physicians' use of EMR systems in their practice in 2012 [19]. Whereas the actual number of EMR users has increased in recent years, this growth still represents only 56% of all physicians in this country [20].

The adoption of innovations by organizations is a complex process comprising two phases that are carried out sequentially, namely, initiation and implementation [21]. During this process, medical practices face different barriers that must be overcome to fully realize the potential of EMR systems. The initiation phase begins with a variety of information collection, design, and planning activities that support adoption of the EMR system. It is directed at identifying and prioritizing the organizational problems that form the basis of the need to acquire an innovation. During the initiation phase, project proponents are also concerned with the fit between organizational needs and the attributes of the innovation itself. At the conclusion of this phase, the medical practice decides whether or not to adopt an EMR system [21]. In the event that the required investment is approved, the second phase of the process, implementation, begins. This phase includes all actions and decisions related to the innovation's deployment, customization, and integration within the organization [21]. It is only during this second phase that the EMR system is made available to physicians for their personal usage. Hence, the social and human aspects of the implementation are crucial during this phase, since it is through daily interactions and exchanges with their peers that physicians develop a common understanding of the new technology.

As shown later, prior research has mostly investigated implementation challenges associated with physicians' resistance to EMRs and has largely overlooked initiation barriers. The present study attempts to fill this gap. More precisely, our main purpose is to investigate the reasons why so many primary care medical practices in Canada have not made the decision to invest in EMR systems yet. To achieve our goal, we first conducted a ranking-Delphi study with a panel of

Table 1 – Initial categorization of EMR adoption barriers.

Categories	EMR adoption barriers	Initiation phase	Implementation phase
Financial	High start-up costs	√	
	High ongoing costs	√	
	Uncertainty about return on investment	√	
	Lack of financial resources	√	
Technical	Lack of computer skills of the physicians and staff	√	
	Lack of technical training and support		√
	Complexity of the EMR systems on the market	√	
	Limitations of the EMR systems on the market (lack of customizability, of reliability; of interoperability)	√	
	Lack of computers/hardware in the medical practice	√	
Time	Time to select, purchase and implement an EMR system	√	
	Time to learn the system		√
	Time to enter data into EMR system		√
	More time per patient		√
	Time to convert the records	√	
Psychological	Lack of beliefs in EMR systems		√
	Need for control		√
Social	Uncertainty about the vendor	√	
	Lack of support from external parties	√	
	Interference with doctor–patient relationship		√
	Lack of support from other colleagues		√
	Lack of support from the management team		√
Legal	Privacy or security concerns		√
Organizational	Organizational size		√
	Organizational type		√
Change process	Lack of support from organizational culture	√	
	Lack of incentives		√
	Lack of participation		√
	Lack of leadership	√	

Adapted from Boonstra and Broekhuis [28].

experts followed by a survey of physicians working in medical practices without EMR systems. From a practical standpoint, we believe a better understanding of these barriers may help policy makers design effective interventions to assist family physician practices to adopt EMR systems. The remaining of this article is structured as follows. In the next section we present a review of the literature on the adoption of EMR systems in the particular context of medical practices. Next, we describe our research design and methods and then present our findings. We conclude with a discussion of the implications for both research and practice.

2. Background

We searched several databases including Medline, ABI/Inform, EMBASE, and Web of Science looking for empirical studies on barriers to EMR system adoption in family physician practices. While we found several studies and reviews on EMR implementation barriers, i.e. physicians' acceptance and usage [e.g., 22–27], we observed that barriers facing medical practices during the initiation phase have not received much attention so far. While no single review specifically dealt with initiation barriers, we identified a highly cited review that was informative. Boonstra and Broekhuis [28], who surveyed the literature published between 1998 and 2009 concerning barriers to physicians' adoption of EMR systems, identified 22 empirical studies. All in all, they extracted eight categories of barriers but did not distinguish between initiation and implementation barriers. As mentioned earlier, we believe that it is important to separate these two types since they refer to different challenges. As shown in Table 1, half of the barriers found in this review represent reasons why medical practices hesitate to invest in EMR systems (initiation phase) while the other half consists of factors associated with physicians' acceptance of EMR adoption and usage (implementation phase). While we recognize that some of these factors might overlap in initiation and implementation, we categorized them based on the phase in which they were predominant. For instance, while issues such as "interference with the doctor–patient relationship" and "time required to learn the system" might influence the decision of a medical practice to invest or not in an EMR system, they were categorized as implementation barriers given that they have

long been considered as major causes of physician resistance. Similarly, while barriers such as "lack of support from organizational culture" and "uncertainty about the vendor" might represent difficulties to achieve successful EMR implementation, they are predominantly considered as key obstacles to EMR adoption in the extant literature.

Clearly medical practices face a wide range of barriers when they consider investing in EMR systems during the initiation stage. Financial barriers, which refer to purchasing, upgrading, maintaining, and governance costs, were among the most frequently mentioned barriers according to Boonstra and Broekhuis [28]. Barriers related to the complexity and limitations of EMR systems as well as the technical capabilities of the physicians and clerical staff to use these systems are also frequently cited in previous studies. Time represents another major barrier during the initiation stage. Consistent with this, previous research has shown that physicians opt not to invest time in EMR system selection and procurement as they think they should spend their time and efforts on patients. The decision-making process is also influenced by external parties, such as the transience of EMR vendors and the lack of consulting support from professional associations, governmental agencies, and private consulting firms. Lastly, the complexity of the change process associated with deploying an EMR system represents another barrier to its adoption by medical practices. The present study aims to broaden and strengthen our understanding of these barriers by focusing on the *initiation stage* of the innovation process.

3. Methods

To achieve our research objective, we focused on the Canadian province with the lowest EMR adoption rate. While the province of Quebec is Canada's second most populous province, with its 7.9 million inhabitants, it ranked 10th out of 10 provinces in terms of physician adoption of EMR systems in 2012, with a low adoption rate of 38% [20]. It is worth mentioning here that salaries of family physicians in Quebec (and elsewhere in Canada) are insulated from issues related to EMR adoption unlike other countries such as the United States. Physicians are reimbursed by the Quebec Health Insurance Plan strictly for the services they provide to patients. The province's Medicare fee for service system does not provide incentives for EMR system use nor does it impose financial penalties on physicians for lack of adoption.

From a methodological standpoint, we first conducted in early 2013 a Delphi study with a panel of experts made up of general practitioners (GPs) with extensive professional experience and a very good understanding of the issues surrounding the introduction of health IT in private medical practices. The list of physicians who were asked to participate in this study was established in collaboration with the Quebec Federation of General Practitioners (called FMOQ in French) which acted as a sponsoring organization. Of the 31 physicians who were initially contacted by email, 21 agreed to participate in the study (68% participation rate). Participants were mostly men (79%) aged between 50 and 59 years (74%). At the time, they averaged 27 years of experience in the medical profession and they had been using EMR systems for six years. All of them led the adoption and implementation of the EMR system in their own medical practice.

Following the methodological guidelines set forth by Schmidt [29] and Paré et al. [30], our Delphi study was divided into three interrelated phases. First, a brainstorming round was conducted to elicit as many barriers as possible from the panel of experts. Two of the authors worked jointly, collating the responses. In the second phase, the combined list of barriers was circulated to all panelists for validation. We also sought to narrow the initial list of barriers so that experts could rank them in phase 3. The panelists were asked to identify the 10 most important barriers in the consolidated list. Only those barriers that had been selected by at least 30% of the respondents were kept for the following phase. In phase 3, the experts ranked the top barriers in order of priority. Following Schmidt [29], we measured the degree of consensus among the panelists using the Kendall rank correlation coefficient (W). The three phases of the Delphi study were conducted over an approximate 3-month period.

Next, we conducted a large-scale survey of Quebec family physicians practising in primary care medical clinics. This survey was carried out in close collaboration with the Quebec's federation of general practitioners (called the *Fédération des Médecins Omnipraticiens du Québec-FMOQ* – in French). The questionnaire, which was developed in both English and French, was first pre-tested with four family physicians and three medical students. Some minor adjustments were made to the questionnaire following this step. The final version of the instrument and a description of the research design were submitted to HEC Montréal's research ethics committee, which reviewed the file and noted that the data collection for this study satisfied ethical research standards with human beings. The committee issued a notice of compliance on April 17, 2013. On April 24, an invitation to participate in the study was sent electronically to 4845 members of the FMOQ who had an email address and who were practising in primary care. The invitation letter contained a hyperlink directing the respondent to a secure Web site that gave them access to the online questionnaire. The online survey platform *Qualtrics* was used to develop the online questionnaire. A reminder letter was emailed to all the intended respondents on May 2, 2013. No incentives were used to maximize response rate.

While the survey targeted two different types of physicians, those working in medical practices with and without EMR systems ($n = 780$), only responses from those without EMR systems ($n = 431$) were of interest in the present study.[1] Using the final list of barriers obtained from the Delphi study, we asked respondents to check all the barriers that explained why their medical practice had not adopted an EMR system. Various statistical analyses (e.g., cluster analysis, ANOVA, Chi-square

[1] While the survey's 16% response rate was quite satisfactory, the possibility of a response bias was ascertained by comparing the 156 "late" respondents (i.e. those who answered after receiving a reminder one week after the initial invitation to participate) with the 624 initial respondents. As there was no statistically significant difference between these two sets of respondents on all attributes, response bias was deemed unlikely [39].

Table 2 – Final categorization of EMR system adoption barriers (initiation stage).

Categories		EMR adoption barriers	Literature review
Intrinsic	Behavioral	Shared feeling that the status quo (paper charts) is satisfying	
		The high proportion of physicians near retirement fosters a certain organizational inertia (a culture that does not support change)	√
		Lack of interest of physicians towards computers in general	√
		Resistance of clerical staff towards EMR systems	√
		The majority of physicians in the practice are opposed to EMRs	√
	Knowledge	Lack of expertise to manage the deployment of EMR systems	
		Lack of time and knowledge to select the best EMR system	√
		Lack of computer skills of physicians in the practice	√
		Lack of consulting support from the Quebec GP Federation	√
		Lack of technical support from EMR vendors	√
Extrinsic	Economic	High start-up costs (scanning of paper records, hardware, software, etc.)	√
		Costs are seen as being greater than potential benefits	√
		Transience of EMR software vendors	√
	Technological	Lack of interoperability of EMR systems available on the market	√
		Poor quality of EMR systems on the market (usability, security, etc.)	√
		EMR systems on the market do not meet the needs of physicians in the practice	√

analysis) were conducted to characterize medical practices according to the perceived barriers to EMR system adoption.

4. Results

4.1. *Delphi study*

In the first phase, the number of barriers presented by each expert ranged between 6 and 15, out of which many overlapped or referred to the same factor. Approximately 10% of the responses represented implementation barriers. Examples of such barriers include: “interference with doctor–patient relationship”, “lack of support from other colleagues to help me with effective usage”, “time required to learn the system”, and “more time spent with each patient due to EMR system usage”. As a result, we did not retain these responses since they correspond to barriers to physicians’ acceptance of EMR systems, not those associated with the initiation phase. Two of the authors eliminated duplicated responses and grouped similar items under a single barrier. Following these steps, we developed a consolidated list of 31 barriers (not shown here).

In the second phase of the Delphi study, the 21 experts validated the list of barriers. To avoid any ambiguity, a brief description accompanied each barrier. Participants noted that the consolidated list was a good representation of their ideas. We also sought to narrow the initial list of barriers so that they could be ranked by the experts. As mentioned earlier, each expert was asked to select at least 10 barriers that he or she considered as most important. In order to narrow down our list of factors to 20 or less, as recommended by Schmidt [29], only those barriers that had been identified by at least 30% of the panelists were included in the following phase. In the end, 16 barriers (52%) were included in the final list.

In the third and final phase, the experts ranked all the selected barriers in order of priority. We provided panelists with clear instructions on how to proceed. As a first step, they were asked to identify the top five barriers from the list and rank them from 1 to 5 where 1 represents the most important factor of all. Panelists were then instructed to repeat this exercise with another group of five factors, ranking them from 6 to 10. This process repeated itself one more time with the final six barriers.

Rankings from all participants were then computed to generate mean ranks for each barrier. As mentioned earlier, we also measured the degree of consensus among the experts using the Kendall rank correlation coefficient. The rounds of ranking usually stop when the correlation coefficient indicates a strong consensus ($W > 0.70$). The first attempt to arrange the top 16 barriers in order of priority provided inconclusive results, with a very low Kendall rank coefficient ($W = 0.11$). We informed our participants that the first round had not produced a high-level agreement on the relative rankings and, hence, we had to pursue the research efforts with a second round of ranking. In order to facilitate the development of a consensus, the revised list was ordered according to the mean ranks obtained in the first round. The second round produced a Kendall coefficient of 0.30, which represents at best a low–moderate level of agreement [29]. While this result does not invalidate our final list of top barriers, it signals a rather low level of agreement among our panel of experts with regard to the ranking of barriers. Table 2 presents the final categorization of the barriers identified by our panel of experts.

Findings from the Delphi study reveal that medical practices are hindered by two overarching types of barriers, namely, intrinsic and extrinsic, when faced with the initial decision to invest (or not) in an EMR system. Intrinsic barriers mainly refer to behavioral and cognitive impediments while extrinsic factors are related to economic and technological obstacles. The behavioral category mainly concerns physicians’ and clerical personnel’s resistance towards EMR systems and computers in general. Knowledge barriers refer to the inherent familiarity and skills necessary to evaluate, select, implement, and effectively use EMR systems. For their part, economic barriers include those related to the monetary issues involved in adopting and deploying EMR systems in medical practices. Last, technological barriers refer to the

Table 3 – Relative importance of EMR adoption barriers during the initiation phase.

EMR adoption barriers	Category	%
High start-up costs (scanning of paper records, hardware, software, etc.)	Economic	51%
Lack of expertise to manage the deployment of EMR systems	Knowledge	50%
Lack of time and knowledge to select the best EMR system	Knowledge	42%
EMR costs are seen as being greater than potential benefits	Economic	32%
Lack of computer skills of physicians in the practice	Knowledge	30%
Shared feeling that the status quo (paper charts) is satisfying	Behavioral	28%
The high proportion of physicians near retirement fosters inertia	Behavioral	26%
Lack of interoperability of EMR systems on the market	Technological	22%
Lack of interest of physicians towards computers in general	Behavioral	21%
Poor quality of EMR systems on the market (usability, security, etc.)	Technological	17%
Lack of support from the Quebec GP Federation	Knowledge	14%
EMR systems on the market do not meet the needs of the practice	Technological	13%
Transience of EMR software vendors	Economic	12%
Resistance of clerical staff towards EMR systems	Behavioral	10%
Lack of technical support from EMR vendors	Knowledge	8%
The majority of physicians in the practice are opposed to EMRs	Behavioral	5%

technical issues or problems with EMR systems. Interestingly, the views of our panel of experts are highly consistent with the extant literature given that 14 barriers out of 16 had also been identified in Boonstra and Broekhuis [28]. Further, two barriers were added to previous lists, namely, a collective feeling that paper charts (the status quo) are satisfying and the lack of local expertise to successfully manage the implementation of the EMR system in the practice.

4.2. *Large-scale survey*

As mentioned earlier, we first asked our 431 respondents to tell us why their medical practice had not yet adopted an EMR system. The questionnaire contained a list of barriers obtained from the Delphi study and respondents could check as many items as they saw fit. As shown in Table 3, our findings reveal that the main barriers to EMR adoption in Quebec family physician practices are related to economic and knowledge issues and challenges. From a financial perspective, the high starting costs, which include all the expenditures needed to get an EMR system working (e.g., purchase of hardware and software, scanning of paper charts), represent a high barrier to medical practices. It also appears that while EMR vendors often claim that the benefits outweigh the costs, physicians remain to be convinced as prior research has shown [e.g., 31–33]. From a knowledge standpoint, EMR systems are viewed as a type of complex technologies that impose a substantial burden on decision makers in terms of knowledge needed to select and deploy them successfully as well as on would-be users in terms of how to use these systems effectively. For this reason, it is no surprise to see that three out of four knowledge barriers in our list found their way in the top-tier group.

Barriers in the second-tier group mainly consist of behavioral issues. To a large extent, these factors refer to the type of organizational context or culture which prevents EMR system adoption. Doctors are well-known to be reluctant to use computer-based information systems, and several studies have produced evidence of computer resistance among physicians [e.g., 34 and 35]. Therefore, it should be recognized that physicians strongly influence EMR adoption decisions, particularly when one takes into account the high level of responsibility and autonomy enjoyed by these professionals in their practices [28]. This group of barriers is also composed of one technical limitation of most EMR systems available in Quebec, namely, system interoperability. In essence, the format of data varies among the different systems, in large part due to the lack of consistent data standards within the industry.

The third and last group of adoption barriers refers to a mix of behavioral (e.g., resistance of clerical staff towards EMR systems), technological (e.g., EMR systems does not meet local needs or requirements), knowledge (e.g., lack of support from external entities) and economic (e.g., transience of EMR vendors) issues. All the issues in this group had been identified in one or several studies in the past, as shown in Boonstra and Broekhuis [28]. In the following paragraphs, we investigate the profile of medical practices according to the perceived barriers to EMR adoption.

Common wisdom says that the presence of barriers prevents medical practices from deciding to invest in EMR systems, and that these barriers must be overcome. However, results of a cluster analysis,[2] shown in Table 4, reveal that many of the sampled practices perceive in fact no such barriers. Drawing upon the notion of organizational readiness or predisposition for innovation in healthcare [36], this first group of 159 medical practices was labeled as “EMR-predisposed” as they were found to perceive less than one barrier on average,

[2] This taxonomical approach aims to group the surveyed medical practices into clusters such that each cluster’s membership is homogeneous with respect to their perception of EMR adoption barriers and that each cluster differs from the others with respect to this same attribute [40]. The SPSS TwoStep clustering algorithm was chosen as it can handle a large number of cases and automatically determines the optimal number of clusters [41]. A two-cluster solution was found to be optimal in identifying groups of medical practices that could be clearly distinguished from one another, based on an interpretable and meaningful pattern of relationships among the four clustering variables, that is, among the EMR adoption barriers perceived for each barrier category. Moreover, as the clustering variables are operationalized though “index” (rather than “scale”) measures, they tend to follow more of a Poisson-type (rather than normal) distribution, that is, to be right-skewed if the mean is small [42].

Table 4 – Clustering medical practices by EMR adoption barriers during the initiation phase.

EMR adoption barrier categories	Medical practice groups		ANOVA F
	EMR-predisposed medical practices ($n = 159$)	EMR-indisposed medical practices ($n = 272$)	
	Average no. of barriers perceived		
Behavioral	0.2	1.3	131.3***
Knowledge	0.3	2.0	358.7***
Economic	0.2	1.5	334.6***
Technological	0.1	0.8	77.2***
Total number of barriers	0.8	5.6	703.2***

*** $p < .001$.

be it behavioral, knowledge-related, economic or technological. The other group, composed of 272 practices, was labeled as "EMR-indisposed" as medical practices in this group perceived more than five barriers, the knowledge barriers being most prevalent in this case with two such barriers perceived on average.

Interestingly, our findings also reveal that those medical practices who do perceive such barriers ($n = 272$) differ significantly in the types of barriers preventing them from adopting an EMR system. Results from a second cluster analysis, shown in Table 5, indicate that the EMR-indisposed practices can be further regrouped into three sub-groups. Referring to our final categorization of EMR adoption barriers (Table 2), medical practices in the first sub-group, labeled "extrinsically indisposed" ($n = 118$), perceive economic and technological barriers to be more present, that is, barriers that originate from outside the practice and over which they have no control. Conversely, practices in the second sub-group, labeled "intrinsically indisposed" ($n = 103$), acknowledge the presence of a greater number of behavioral and knowledge barriers on average, i.e. barriers internal to the practice and on which they have a potential hold. The third sub-group is composed of "systemically indisposed" medical practices ($n = 51$) who perceive almost twice as many barriers as the other two sub-groups (9 vs. 5 barriers on average). These medical practices clearly appear to be the most challenged with regard to adopting an EMR system, except for their perception of technological barriers which are comparable to the extrinsically indisposed practices.

Our survey also asked our 431 respondents to indicate whether or not their practice intended to implement an EMR system in the future. Twenty-seven percent of them said that their practice was actively engaged in an EMR selection process at the time of the survey. Another 22% indicated that their practice intended to adopt an EMR system in the next 12 months, but that no formal selection process had yet begun. One out of five respondents said that their practice may eventually decide to adopt an EMR system, without mentioning a time frame, and slightly more than one out of ten respondents reported that they were unaware of their clinic's intentions regarding the computerization of medical records. Lastly, 20% of respondents said that their medical practice did not intend to invest in an EMR system in the near, medium or long term.

Additional results on the future intentions of the surveyed medical practices ($n = 431$) with regard to adopting an EMR system, presented in Table 6, significantly differentiate the two groups previously identified, that is, the EMR-predisposed and EMR-indisposed practices. Medical practices in the latter group have "no intention to adopt an EMR" in greater proportion than in the former group (24% vs. 11%), are more "undecided on adopting an EMR" (25% vs. 11%), or "intend to adopt an EMR" in lesser proportion (18% vs. 28%). These results thus add predictive validity to our cluster analytical characterization of medical practices on the basis of the EMR adoption barriers faced by these organizations during the initiation phase.

Finally, the future intentions of the EMR-indisposed group of medical practices ($n = 272$) were broken down into

Table 5 – Cluster analysis of EMR-indisposed medical practices by barrier category.

EMR adoption barrier categories	EMR-indisposed medical practice sub-groups			ANOVA F
	Extrinsically indisposed ($n = 118$)	Intrinsically indisposed ($n = 103$)	Systemically indisposed ($n = 51$)	
	Average no. of barriers perceived			
Behavioral	0.5_a	1.6_b	2.8_c	116.6***
Knowledge	1.4_a	2.1_b	2.9_c	63.2***
Economic	1.8_b	0.9_a	2.4_c	102.0***
Technological	1.2_b	0.2_a	0.9_b	36.6***
Total number of barriers	4.9_a	4.8_a	9.0_b	155.5***

$_{a,b,c}$*Note*: Within rows, different subscripts indicate significant ($p < 0.05$) pair-wise differences between means on Tamhane's T2 (post hoc) test.
*** $p < 0.001$.

Table 6 – Breakdown of the EMR adoption intention by medical practice groups.

Intention of the medical practice	Medical practice groups				χ^2
	EMR-predisposed ($n=159$)		EMR-indisposed ($n=272$)		
	Freq.	(%)	Freq. (%)	(%)	
In the process of selecting an EMR	45	(28.3)	69	(25.4)	
Intend to adopt an EMR	44	(27.7)	49	(18.0)	
Undecided on adopting an EMR	17	(10.7)	69	(25.4)	40.6***
No intention to adopt an EMR	18	(11.3)	65	(23.9)	
Do not know	35	(22.0)	20	(7.4)	

*** $p<0.001$.

the extrinsically indisposed ($n=118$), intrinsically indisposed ($n=103$) and systemically indisposed ($n=51$) sub-groups. The results presented in Table 7 indicate that medical practices in the extrinsically indisposed sub-group "intend to adopt an EMR" in greater proportion (27% vs. 12% and 10%) than the other two groups. Further evidence is thus provided of the greater inhibiting power of the intrinsic barriers, and the knowledge barriers especially faced by medical practices as opposed to the extrinsic barriers, and the economic barriers especially deemed by common wisdom to prevent the organizational adoption of EMR systems in family physician practices.

5. Discussion

This article presents the results of a Delphi study with a panel of experts along with those of a large-scale survey of GPs in the province of Quebec, Canada. Both studies aimed to provide a deeper understanding of the reasons why Quebec is lagging behind other Canadian provinces (and other countries) with regard to organizational adoption of EMR systems.

Our Delphi study first reveals that medical practices are hindered by a myriad of intrinsic (behavioral and cognitive) and extrinsic (economic and technological) barriers when faced with the initial decision to invest in an EMR system. While the low–moderate level of agreement among our experts with regard to the ranking of these barriers does not invalidate our findings, it signals that if a myriad of EMR initiation barriers exist, there needs to be a myriad of solutions as well. For its part, our large scale survey indicate that the key challenges preventing private medical practices from investing in an EMR system are mainly related to economic and knowledge barriers. EMR systems are considered to be costly and the possible return on investment is often perceived as uncertain. Further, selecting, implementing, and upgrading an EMR system represents complex processes that impose a substantial burden on decision makers in terms of prerequisite knowledge. To alleviate these barriers and, thus, stimulate adoption of EMR systems in medical practices, the Quebec's Ministry of Health and Social Services has launched a financial incentive program on August 1, 2012. This agreement, called PQADME in French, sets certain conditions of practice and reimbursement terms (up to 70% of equipment and software costs) for physicians in practices. This initiative is intended to stimulate adoption and dissemination of EMR systems, while allowing medical practices to acquire certified software solutions that meet the requisite privacy, security and interoperability assessment criteria. In September 2013, the Quebec Federation of General Practitioners began a provincial information tour to stimulate extensive participation of physicians in the PQADME initiative. Furthermore, it has made a sustained effort to provide training sessions to its members, with a focus on disseminating the knowledge required for wider adoption and effective use of EMR systems. Given these measures, it comes as no surprise that half of the non-user physicians in our study reported that their practices were preparing to deploy an EMR system or had a firm intention to deploy one within the next year. This suggests that there is good reason to be optimistic about wider adoption of EMRs in Quebec's medical clinics in the coming years.

The preceding results may however be considered in light of the inherent limitations of survey studies. While the measurement of the EMR adoption barriers was shown to have

Table 7 – Breakdown of the EMR adoption intention by EMR-indisposed practice sub-groups.

Intention of the medical practice	EMR-indisposed medical practice sub-groups						χ^2
	Extrinsically indisposed ($n=118$)		Intrinsically indisposed ($n=103$)		Systemically indisposed ($n=51$)		
	Freq.	(%)	Freq.	(%)	Freq.	(%)	
In the process of selecting an EMR	31	(26.2)	29	(28.2)	9	(17.6)	
Intend to adopt an EMR	32	(27.1)	12	(11.7)	5	(9.8)	
Undecided on adopting an EMR	30	(25.4)	24	(23.3)	15	(29.4)	20.8**
No intention to adopt an EMR	17	(14.4)	30	(29.1)	18	(35.3)	
Do not know	8	(6.7)	8	(7.8)	4	(7.8)	

** $p<0.01$.

both content and predictive validity, there may yet exist survey biases linked to the perceptual (as opposed to factual) nature of the data. Relying on the perceptions of a single family physician as key informant to characterize the medical practice in this regard may also imply cognitive biases. Note that practical considerations (e.g., the unavailability of factual data) as well as a constructionist view of organizational reality (e.g. medical practices base their decisions on a "subjective" environment rather than on a non-existing "objective" environment) nonetheless support the choice of perceptual data in the present study [37].

Mindful of the contingencies of IT adoption that are specific to the healthcare sector, the contribution of this research from a theoretical standpoint lies in filling a knowledge gap in the health informatics domain, more precisely in a better conceptualization and comprehension of the reasons why family physician practices cannot or do not adopt EMR systems, notwithstanding the purported benefits of such systems for their organization and their patients. Of particular importance are the categorization of EMR adoption barriers (behavioral, knowledge, economic and technological barriers) and the taxonomy of medical practices with regard to these barriers (EMR-predisposed vs. EMR-indisposed practices) that emerged from this study. Common wisdom on the nature and presence of such barriers and accepted prescriptions on lowering these barriers were thus confronted to organizational reality. Furthermore, given the potential consequences of the presence of IT adoption barriers upon the subsequent assimilation of health IT [38], this categorization and taxonomy could be incorporated in future research on EMR adoption and implementation.

This research also provides a contribution to the healthcare sector from a practical standpoint. In fact, the results of this study should be of interest for governments, healthcare institutions and other stakeholders such as family physician associations in both developed and developing countries, as they must deal with continuously increasing healthcare costs combined with either an aging or a rising population. A thorough understanding of the barriers faced by primary healthcare organizations in adopting an EMR system would help target policies and measures in support of these organizations. The "one size fits all" approach to such policies and measures is clearly inappropriate, given this study's findings that many medical practices face practically no barriers to EMR adoption, and that others differ markedly as to the type of barriers faced, be they mostly "soft" such as knowledge barriers or "hard" such as economic barriers. Such analysis would also allow EMR suppliers or vendors to better define their product development and support strategies as well as their marketing and service strategies in order to meet the needs and requirements of their customers.

6. Conclusions

As governments continue to press for greater efficiency and effectiveness in primary healthcare, EMR systems will be increasingly required in order to enable and manage clinical and administrative processes in family physician practices, and without loss in the quality of care provided to patients.

Summary points

What was known on the topic:

- The adoption of electronic medical record (EMR) systems in primary care is a matter or priority in several countries.
- The potential benefits of using EMR systems in these settings are numerous, including better quality and continuity of care, greater effectiveness and productivity, and positive financial return on investment.
- Despite such benefits, Canada ranked 10th out of 11 developed countries in terms of family physicians' adoption of EMR systems in 2012.

What this study added to prior knowledge:

- Provides a better conceptualization and comprehension of the reasons why family physician practices, as organizations, cannot or do not intend to adopt EMR systems.
- Based on our taxonomy of adoption barriers, family physician practices without EMR systems can be categorized as either "EMR-predisposed" or "EMR-indisposed".
- Therefore, a "one size fits all" policy or measure in support of medical practices without EMR systems appears inappropriate. Instead, effective strategies will consider differences in terms of the intrinsic and extrinsic barriers that must be surmounted by medical practices during the initiation phase of the innovation process.

The basic premise of this study was that to fully realize the promise of EMR systems, an empirically valid conceptualization and deeper understanding of the barriers to adoption of these systems in private medical practices are needed. EMR adoption decisions can only be explained fully in light of fundamental differences in the environmental and organizational contexts that frame these decisions, that is, differences in terms of the intrinsic and extrinsic barriers that must be surmounted by family physician practices during the initiation phase of the innovation process.

Author contributions

Conception and design of study (all authors); data collection and analysis (GP, PP, AOG, LR), data interpretation (all authors), and drafting manuscript (GP, LR, AOG).

Conflict of interest

The authors have no potential conflicts of interest, including relevant financial interests, activities, relationships and affiliations (other than those affiliations listed on the title page of the manuscript) to disclose that are relevant to the subject of this study.

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