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A Blended Model of Electronic Medical Record System Adoption in Canadian Medical Practices

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Abstract:

In this paper, we develop and validate a comprehensive theoretical model of electronic medical record (EMR) system adoption in Canadian medical practices. Canada lags other developed countries in the adoption of information technology (IT) in healthcare, and medical practice adoption of EMRs is particularly low. Most Canadian medical practices have the distinct feature of blending characteristics of both individual physicians and small clinics in private practice. We built a theoretical model combining individual-type and organizational-type perceptions (from one point of view) and opportunities and barriers (from another point of view) and tested it with 119 physicians from across Canada. Results show a reasonably valid model explaining 55.3 percent of the physicians' intent to adopt EMRs in their clinics. We found that physicians would adopt EMRs if they saw these systems as first being easy to use and second as being useful. Physicians' innovativeness regarding the use of new IT was an additional favoring factor. Conversely, physicians would choose not to adopt EMRs if they feared such systems would not perform as expected, would involve possible legal and privacy risks, would affect clinics' productivity, and would not be a justified adoption altogether. Overall, we found that physicians saw more opportunities than obstacles in using EMRs in their practices.

Keywords: Electronic Medical Record, Technology Adoption, Canada, Medical Practice.

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1 Introduction

An electronic medical record (EMR) system is a standalone repository of data in computer-processable form that general practitioners use to record and access clinical information about their patients. Research has reported that Canada lags behind many other developed countries and ranks last among industrialized nations in terms of EMR systems use in the mid-2000s (Davis, Doty, Shea, & Stremiks, 2009). With that said, Canadian EMR adoption rates have steadily continued to strengthen: the most recent National Physician Survey in 2013 (NPS, 2013) indicates that 62 percent of physicians were using EMRs. One can attribute much of this growth to the subsidies and other motivation schemes that six of the 10 provinces in Canada offer. These provinces have provided these schemes under the condition that physicians adopt provincially certified EMRs and, thus, support standards that will help these systems interoperate with other government-funded health information systems.

Because of the increasing complexity of providing healthcare today, medical practitioners who don't use EMR systems or those who use incompatible EMR systems may also lead to inappropriate and ineffective patient care and negative consequences for the healthcare system in general and for that in Canada (Kazemi, Fors, Tofighi, Tessma, & Ellenius, 2010; Wright et al., 2009). Since the early 2000s, the Canadian Government has created a major campaign to increase the general practitioner adoption rate of EMR systems to much higher levels in Canada and help such systems interoperate with other sources of patient records, such as hospitals, labs, and so on. However, this approach attacks the problem without knowing its root determinants, particularly in the context of the complex interrelationships that have determined the relatively low rate of adoption thus far (Bhattacharjee & Hikmet, 2007). Research has established that perceptions are an important determinant in successfully deploying any technology (Venkatesh, Speier, & Morris, 2002). Therefore, before making significant investments to increase EMR use in Canada, we need to understand what physicians consider in accepting or rejecting the implementation of electronic record systems in their clinics.

Several studies on the adoption of EMR systems in Canada and elsewhere have been published so far, but most of these studies have addressed a few relevant opportunities for, or barriers to, adoption in isolation (Chang, Hwang, Hung, Kuo, & Yen, 2009; Davidson and Chiasson, 2005; Jensen & Aanestad, 2007; Klein, 2007). In addition, many previous studies have investigated EMR adoption and use for large organization such as hospitals or the perceptions of health information systems at an individual user level (Reardon & Davidson, 2007), and one cannot easily apply their findings to small organizations. Scholars also recognize that little research has conducted theory-grounded investigations into small medical practices' adopting EMR systems because of the diversity of issues that these organizations face (Boonstra, Boddy, & Bell, 2008; Reardon & Davidson, 2007).

To further complicate the picture, literature available to date has not studied a separate category of small medical practices such as those in Canada. Canadian medical practices are characteristically mostly small private businesses that blend features of individual users and of organizational users of information technology (IT). Although, for example, both Canadian and American medical practices are essentially private businesses, the two countries have several differences in their related financial practices. First, in Canada, each province provides healthcare to all of its citizens and permanent residents except for the military and the native population, who the federal government supports. Support for more than 70 percent of healthcare support flows from the health authority in the province in which physicians reside (Canadian Institute for Health Information, 2010), with the remainder coming from private insurance or individual payers. In contrast, general medical coverage is not the norm in the US. Second, expenditures needed to recover provider costs from payers in the US are four times as high as they are in Canada because (at least partially) their payments come from multiple payers (Morra et al., 2011). Third, in the US, some patient cases may not receive care because of its cost (Schoen et al., 2012), but Canadians have the right to receive medical care in almost all situations except when it attracts extremely high costs and/or unusual treatments. Fourth, physicians in the US receive significantly more money for medical services than Canadian physicians (Laugesen & Glied, 2011). Finally, acute care facilities in Canada, where many physician specialists work and, at the same time, maintain their own private practices, are virtually all publicly owned, but, in the US, these major facilities may be either publicly or privately owned and operated (e.g., private health maintenance organizations), and many employ specialists full-time. These financial aspects of medical care can lead to differences between what physicians from the two countries focus on in their business practices and can create differing views on EMR use.

Studying Canadian practices' EMR adoption is interesting and important in clarifying EMR adoption research in medical practices for a wider audience. Incomplete research on EMR adoption may obviously result in healthcare policies that encourage implementation for the wrong reasons (e.g., use for shallow purposes such as office work) and, thus, leave physicians with partial answers and with problems rather than benefits (Chang et al., 2009). As a result, practices may abandon their systems at a financial loss, or they may not optimally use the systems' advanced information support for themselves and their patients. This issue is important since research has not always shown that EMR system use corresponds with significant positive outcomes for physician offices. For instance, in a systematic review, Lau et al. (2012) examined the impact of EMRs on physician offices in six areas: support prescription, disease management, clinical documentation, work practice, preventive care, and patient-physician interaction. They found that physician offices that have used EMR systems have gained limited positive benefits. Accordingly, the authors suggest that research should pay more attention to EMR features that help clinics use such systems and redesign their work practices. Furthermore, the authors stress that EMR adoption should demonstrate value for money, that physicians need to have realistic expectations of EMR implementation, and that patients should be involved in the adoption and implementation process. However, the authors do not address the additional value that may arise from being able to link electronically to health information systems in other practices, hospitals, labs, and so on.

We propose and test a comprehensive blended model that simultaneously considers the most important of many factors that may encourage physicians to or deter them from adopting EMR systems from their viewpoint. Our model considers physicians as both individuals and as members of their practices. As a result, we help develop a fuller understanding of the adoption issue for Canadian medical practices and in similar healthcare systems elsewhere. To validate the model, we surveyed 119 Canadian physicians that we recruited from across Canada in medical practices that were using EMRs and who had decision making responsibilities in their practices. Our model helps identify the issues that are the most important for EMR adoption, which, in turn, allows one to focus attention on reinforcing favorable factors and mitigating adoption reluctance through changes in EMR deployment strategies and/or through improved implementation and operational practices associated with these systems.

This paper proceeds as follows. In Section 2, we present the theoretical background. In Section 3, we present our research model and associated hypotheses. In Sections 4 and 5, we present our experimental methodology and results, respectively. In Section 6, we discuss our findings and offer recommendations for future research.

2 Theoretical Background

Many scholars have investigated the adoption of innovative IT applications in healthcare due to the social sensitivity and the dynamics of providing IT-supported services in this sector (Chau & Hu, 2002; Sun, Wang, Guo, & Peng, 2013). Examining the use of IT solutions that target individual professionals has been an opportunity to determine the applicability of popular adoption models from information systems (IS) research to the healthcare sector (Chau & Hu, 2001; Ford, Menachemi, & Phillips, 2006; Yi, Jackson, Park, & Probst, 2006). Findings to date have not clearly indicated what factors contribute to skilled professionals' accepting IT support and, therefore, have not led to a widely accepted theoretical model.

Furthermore, few papers discuss comprehensive models of IT user adoption in medical practices. Findings from studies of IS adoption in larger healthcare institutions are unlikely to be generalizable to medical practices because they have various fundamental differences (Davidson & Chiasson, 2005; Thong, 1999), the key one being the contrast between the organizational and the individual contexts. For example, unlike larger institutions, most Canadian medical practices are similar to small businesses and tend to have highly centralized structures. Further, in these medical practices, individual physicians make most of the critical decisions. In contrast, in larger organizations such as hospitals, administrators make most decisions. The central role that physicians play indicates that their individual characteristics are critical to EMR adoption decisions in most Canadian medical practices.

As Mantzana, Themistocleous, Irani, and Morabito (2007, p. 92) posit, "IS adoption in healthcare affects and is affected by human and organisational actors". Since Canadian medical practices have characteristics of both individuals and organizations, one could consider these practices to represent both types of actors at the same time. Therefore, one can reasonably assume that a comprehensive IT adoption model should combine factors from models and theories of both individual decision making and user behavior related to technology in an organizational context. This bi-faceted view requires the support

of a common theory-grounded foundation that would justify using certain salient factors for the adoption equation.

Due to the healthcare sector's social sensitivity, research suggests that medical practices gradually adopt EMRs and that this adoption should gravitate around physicians. Rogers' (2003) diffusion of innovation research supports the theory that most individuals assess an innovation not on the basis of scientific evidence as reported in the literature but through subjective evaluations as reported by peers who have already adopted that novelty (e.g., see the Canadian EMR (2014) report).

An important body of research in information systems discusses factors of technology adoption in an individual context. This research generally assesses the variability in individual users' behavioral intentions to adopt an information technology under the influence of beliefs developed in association with using that IT (Jensen & Aanestad, 2007). One of the most popular theoretical models used in this research stream is the technology acceptance model (TAM) (Davis, 1989), which draws on the theory of reasoned action (TRA) (Fishbein & Ajzen, 1975) and the theory of planned behavior (TPB) (Ajzen, 1985).

Studies of technology adoption in an organizational context investigate user perceptions and behavioral reactions to technology use from a social and organizational perspective (Jensen & Aanestad, 2007). While individual climate in an organization is determined by the interpretive perceptions of individuals in it, the organizational climate, although an outcome of aggregating individual perceptions, results in being more objective and at a higher level (Gibson & Birkinshaw, 2004; Klein & Koslowski, 2000). Scholars have frequently used TAM2—TAM's organizational version—for capturing perceptions regarding the implementation of a new information technology in a social and organizational context (Venkatesh & Davis, 2000). Researchers have widely used the unified theory of acceptance and use of technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003) since its introduction both in individual and organizational environments. However, relatively recent research tends to associate it primarily to an organizational context. Moreover, Venkatesh, Thong, & Xu (2012) propose an evolved UTAUT2 suitable to a consumer (and, hence, individual) context.

None of the above-mentioned theories and models directly apply to an investigation of Canadian medical practices' adoption of EMR systems since this environment intersects the individual and the organizational contexts and because favoring and disfavoring factors influence it. Therefore, we rely on more fundamental theoretical support. Out of the prominent competing theories or models of technology diffusion or adoption reviewed in the comparative study of Venkatesh et al. (2003), the decomposed theory of planned behavior (DTPB) seems a suitable choice for the present research on EMR adoption in small clinics.

DTPB posits that human intent to act in a direction (e.g., adopting and using a new IT) is determined by several factors that fall into three major categories of belief components: attitude, subjective norm, and perceived behavioral control. Previous research has validated several factors belonging to each category of belief components (Brown & Venkatesh, 2005; Tan & Teo, 2000; Teo & Pok, 2003). Thus, attitude captures cognitive-type beliefs by showing a person's feelings (positive or negative) about the intended behavior (Fishbein & Ajzen, 1975). Accordingly, attitude has antecedents such as the perceptions of relative advantage or usefulness and ease of use, all of these developed with respect to an IT artifact or its compatibility with a person's values or needs. Attitude may be also influenced by negative factors such as the risk perception associated with using new IT. Subjective norm captures the social influences of significant other people (such as peers or superiors) on behavior (Fishbein & Ajzen, 1975), such as that regarding using a technology. Perceived behavioral control refers to factors that ease or constrain behavior (Ajzen, 1991), such as self-efficacy and resource and technology facilitators.

Therefore, DTPB builds on the theory of planned behavior (TPB) by having the same major belief components as determinants of behavioral intention, but DTPB is more granular and has better explanatory power because it decomposes the belief components into several constructs (Chau & Hu, 2001; Taylor & Todd, 1995a, 1995b). DTPB's simple and stable belief component structure makes it easier to operationalize; thus, it suits many contexts (Teo & Pok, 2003), including those that feature complex factors associated with IT adoption (Benbasat & Zmud, 1999). Furthermore, because DTPB decomposes belief components into basic constructs, the theory provides a magnifying lens for investigating the various influences on behavioral intentions in complex models (Macredie & Mijinyawa, 2011); as such, it can explain more meaningful managerial implications (Teo & Pok, 2003).

In addition, as we explain in Section 1, because of the comparatively low rate of EMR penetration in small practices in Canada, we can expect that negative user perceptions play a significant role in the adoption

equation. DTPB offers a good framework for capturing practitioners' possible negative views by integrating them through the attitudinal belief component. All these reasons make DTPB suitable as a foundation for a comprehensive theoretical adoption model (and more complex than, for instance, TAM or UTAUT) that merges beliefs expressing the use of IT in both an individual and an organizational context from one perspective and favoring and disfavoring factors from another perspective.

The most popular IS theories that model adoption, including DTPB, examine factors that would generally favor user intention to adopt and use IT in voluntary settings (Klaus & Blanton, 2010; Venkatesh et al., 2003). To have a more complete view of the adoption issue, one should also analyze negative influences since low EMR adoption rates in medical practices clearly indicate that the latter category of factors plays an important role. Disfavoring, or barrier, factors have been gaining increased popularity in IS research on IT adoption and are generally encompassed under the concept of perceived risk (Cocosila, Archer, & Yuan, 2009; Featherman & Pavlou, 2003) or resistance to adoption (Lapointe & Rivard, 2005; Lapointe & Rivard, 2006). They capture negative perceptions associated with the real or virtual disadvantages connected to implementing a new IT application (e.g., it is too costly, demands too much time, etc.).

The success or failure of an organization's efforts to adopt new technology often rests less with that technology's quality and more with the quality of the organization's leadership (Still & St. Amant, 2006). A strong leader champions the productive changes that technology can bring. In the context of this study, participating medical practitioners and decision makers are likely to have views similar to the chief executive officers (CEOs) of small firms since the risks they perceive are similar to risks to their own wellbeing. The normal risk assessments that large firms use to evaluate projects are not appropriate since these assessments do not directly involve operations management.

Decision makers in medical practices, as in small businesses in general, would tend to relate perceived business risks (such as risk of overspending on IT) to themselves, and, as users of EMR systems, they would also perceive risks as consumers (hence, in an individual context of the adoption picture). Therefore, the IT adoption literature is relevant to our research. To complete the picture of innovation adoption, we added perceived risks adapted from consumer behavior to the positive factors, similar to previous research (Featherman & Fuller, 2003; Wu & Wang, 2005). The risk perceptions in this study, although related to organizational risks, are similar to those that consumers interested in adopting innovations for personal use apply in evaluating the risk those innovations have. Further, studies in conjunction with TAM have often used such risk perceptions (Featherman & Fuller, 2003; Wu & Wang, 2005). Consequently, we extend previous studies of EMR acceptance to include measures of negative utility that decision makers may attribute to perceived risks associated with adopting this technology. Our approach builds on Featherman and Pavlou (2003) who identified specific risk facets and tested them empirically in TAM in relation to e-services adoption.

Consequently, we consider that favorable and unfavorable individual-type and organizational-type elements influence the adoption and use of EMRs in Canadian medical practices, and we offer a model to explain this process. Accordingly, we address the following research question:

RQ: What are the key positive factors and the most important negative factors that influence the adoption of EMRs in Canadian medical practices?

3 Model and Hypotheses Development

Based on the reasons expressed in the theoretical discussion above, we propose a model that combines both factors that are favorable to and unfavorable to the adoption of EMRs in medical practices in Canada. We use a healthcare-IS perspective (Chiasson & Davidson, 2004; Klein, 2007) by inserting constructs previously validated in IS research (in an individual or organizational context) in the general framework that DTPB provides. Following the rationale we present above, this research also incorporates IS constructs originating in marketing but validated in IS research to capture resistance or perceived risk associated with new IT use. We now present the main constructs and the relevant hypotheses.

3.1 Behavioral Intention to Adopt

Behavioral intention to adopt is a key outcome that studies of technology adoption have used extensively both in an individual context (Davis, 1989) and an organizational context (Venkatesh & Davis, 2000; Venkatesh et al., 2003). This construct reflects user intentions to adopt and to use the system being investigated and is a common proxy for actual user behavior (Agarwal & Prasad, 1998) as the

endogenous construct of various adoption models and theories, including DTPB. Therefore, behavioral intention is the endogenous construct of the entire adoption model we build. All the other constructs in the model are direct or indirect antecedents used to explain adoption intention.

3.2 Performance Expectancy

Performance expectancy incorporates people's tendency to use a technology based on their perception of how technology might help them perform their jobs (Venkatesh et al., 2003). It arises from the attitudinal belief structures of DTPB (Taylor & Todd, 1995a) and is an expression of the relative advantage brought about by using a new IT. One should see this construct as belonging to an organizational context (Venkatesh et al., 2012). However, according to Venkatesh et al. (2003), performance expectancy encompasses constructs with the same meaning from adoption models preceding UTAUT such as perceived usefulness from TAM (Davis, 1989) and TAM2 (Venkatesh & Davis, 2000). Therefore, we use performance expectancy and perceived usefulness concepts interchangeably as adoption literature research often does.

An EMR should be useful for promoting higher-quality care, reduced errors, lower costs, and increased patient and clinician satisfaction (Lee, Cain, Young, Chockley, & Burstin, 2005). One can achieve such things by customizing IT systems to match and support desired office workflows and healthcare outcomes. Other reports suggest that, on the contrary, EMR use often leads to higher billings and reductions in provider productivity with no change in provider-to-patient ratios (Sidorov, 2006). Further, research has reported error reduction as inconsistent and yet to link it to savings in malpractice premiums. However, despite inconclusive previous research, as interest in patient centeredness, shared decision making, teaming, group visits, open access, and accountability in health provision grows, healthcare systems are likely to view EMR as a necessary ingredient to achieve these health service goals in the long run. For these reasons, medical practitioners need to perceive EMR as helping them perform better. As such, we hypothesize:

Hypothesis 1: Performance expectancy has a positive effect on behavioral intention to adopt.

3.3 Effort Expectancy

Effort Expectancy, coming from an organizational perspective, has similarities with perceived ease of use and ease of use (Venkatesh et al., 2003) and is the opposite of complexity attitudinal beliefs in DTPB. Thus, research sees low effort expectancy in using an IT as similar to a higher perception of ease of use for that IT. Ease of use is particularly important for physician support during consultations because, if the physician pays attention to the computer, it may distract from the quality of the physician-patient interaction (Coiera, 2004; Yi et al., 2006). Users also perceive an easy-to-use system to be more useful and easier to accept (Davis, 1989; Venkatesh & Davis, 2000). These items can and should enter into every situation that involves acquiring, installing, and using an EMR system in an organizational setting. Consequently, we propose:

Hypothesis 2: Effort expectancy has a positive effect on performance expectancy.

Hypothesis 3: Effort expectancy has a positive effect on behavioral intention to adopt.

3.4 Perceived Risk

Perceived risk refers to an individual's perceiving fears of negative real or virtual consequences from interacting with IT. Borrowed in IS research from consumer behavior research, many studies acknowledge perceived risk as a multi-dimensional construct (Laroche, McDougall, Bergeron, & Yang, 2004; Lim, 2003; Stone & Grønhaug, 1993). We consider that the basic multi-faceted risk perception that Featherman and Pavlou (2003) propose covers the various risks relevant to the EMR adoption process model. However, we did not take into account physical risk (i.e., perceiving the IT as directly harming users) and social risk (i.e., perceiving social disapproval from using the IT) that are not meaningful for this technology and context. We also replaced Featherman and Pavlou's (2003) privacy risk construct, which expresses fears concerning the inappropriate use of personal information through the IT application, with the slightly wider legal and privacy risk. This perception includes both privacy risk and legal liability and involves the potential loss of patient privacy and issues of liability for problems caused by a defective system or process. Both are particularly relevant to using EMRs in a medical setting (Angst & Agarwal, 2009).

Therefore, following examples of previous work (Cocosila & Archer, 2010; Featherman & Pavlou 2003), we captured risk views associated with the adoption of an EMR system as a second-order perceived overall risk construct (that evaluates all criteria together) from the five first-order risk facets listed in Table 1. Perceived overall risk is a trade-off construct combining the various risk facets in Table 1 into one risk perception (for instance, a health practitioner may see an EMR deployment in a clinic as being costly (and, hence, involving a high resource risk) but of good quality and user friendly (and, hence, involving less performance, psychological, legal and privacy, and time risks).

Table 1. Perceived Risk Components Associated with EMRs

Perceived risk	Description
Resource	Monetary loss associated with purchasing the system
Performance	Failure of the system to perform as expected
Psychological	Mental stress because of a doubtful system acquisition
Legal and privacy	System does not protect privacy and may create legal liabilities
Time	Waste of time while acquiring and implementing the system

We also consider that one can reduce other concepts of risk perceptions sometimes found in the literature regarding IT use by physicians to the elementary risk facets widely used in consumer behavior and, more recently, in IS literature (Cocosila et al., 2009; Featherman & Pavlou, 2003; Lim, 2003). For instance, one can capture “perceived threat of an IT to professional autonomy” of physicians that Walter and Lopez (2008) propose through perceived psychological risk. Also, doubts may arise regarding the decision to adopt EMRs, the implementation process, the consequences regarding the activity of the clinic itself, and the lack of clear benefits (like return on investment) that research has found to be barriers to EMR adoption and use (Shea & Hripcsak, 2010; Torda, Han, & Scholle, 2010). One can capture such potential user doubts through one or several of the elementary risk perceptions that Featherman and Pavlou (2003) adapted from the consumer behavior literature.

Previous research has demonstrated consistently that risk perceptions affect both performance expectancy (or perceived usefulness) and intention to use the technology (Cocosila et al., 2009; Featherman & Pavlou, 2003). On the other hand, Featherman and Pavlou (2003) also found that a higher ease of use diminishes risk concerns associated with handling an IT system. As such, we hypothesize:

Hypothesis 4a: Perceived resource risk increases perceived overall risk.

Hypothesis 4b: Perceived performance risk increases perceived overall risk.

Hypothesis 4c: Perceived psychological risk increases perceived overall risk.

Hypothesis 4d: Perceived legal and privacy risk increases perceived overall risk.

Hypothesis 4e: Perceived time risk increases perceived overall risk.

Hypothesis 5: Perceived overall risk has a negative effect on performance expectancy.

Hypothesis 6: Perceived overall risk has a negative effect on behavioral intention to adopt.

Hypothesis 7: Effort expectancy has a negative effect on perceived overall risk.

3.5 Job Relevance, Facilitating Conditions, and Social Influence

Because the complexity of the small medical practices in Canada influences practitioner perceptions of EMR benefits and risks, we expect additional factors to intervene in the adoption equation. For instance, practitioners often express concern that replacing paper record systems with EMRs may reduce physicians' and their staff members' productivity. In fact, research has shown that introducing EMRs to replace paper records may result in a short-term productivity drop of over 20 percent for physicians with a recovery after six months or more to slightly above initial levels for internal medicine specialists and little or no productivity improvements for general practitioners and pediatricians (Bhargava & Mishra, 2014). Further, it is not clear from Bhargava and Mishra (2014) whether physicians further used the EMRs in question by taking advantage of their digital functionalities. For example, adopting EMRs becomes attractive when provincial healthcare agencies offer preventive medicine incentives to healthcare providers for regular checkups to patients, such as diabetic patients (foot examinations, etc.), pap smears

for female patients, and so on. Being able to remind patients belonging to particular groups of their current need for checkups is very easy with a digital system but almost impossible for paper record systems. An additional advantage includes the ability to receive digital data online such as lab results, hospital discharge summaries, consulting reports, and transmitting data such as prescriptions. As such, EMRs offer providers with more timely information so they can make better decisions concerning patients and are more efficient. Provincially certifying EMRs that meet certain standards before qualifying for adoption subsidies can greatly improve the ease with which such systems can interoperate with other healthcare systems and, thus, enable multiple digital systems to communicate data more easily. The financial incentives of provincial subsidies support healthcare providers by allowing them to work more productively, which will be more likely to occur if healthcare providers have and use additional interoperable functionalities after implementing an EMR.

As one possible approach to capture such sophisticated influences into an adoption model of EMRs, one can add three antecedent factors whose role research has demonstrated in an organizational context: job relevance, facilitating conditions, and social influence. Thus, previous studies have linked user acceptance to variables that reflect job relevance (Kim, 2008; Leonard-Barton & Deschamps, 1988) and task-technology fit (Goodhue, 1995). A job relevance construct may be associated with compatibility attitudinal beliefs in DTPB (Taylor & Todd, 1995a, 1995b). Therefore, we expect individuals' perceptions about the relevance of an EMR to their jobs to reinforce behavioral intention to adopt indirectly by strongly influencing performance expectancy directly.

Facilitating conditions reflect perceptions of internal and external constraints on behavioral control, facilitating conditions, and the technology's compatibility (Venkatesh et al., 2003). This construct encompasses self-efficacy, resource facilitating conditions, and technology facilitating conditions and, thus, captures perceived behavioral control beliefs in DTPB (Taylor & Todd, 1995a) and includes the perception of an innovation as being consistent with values, needs, and experience of potential adopters (Moore & Benbasat, 1991). All of these factors will have a positive effect on performance expectancy for EMR decision makers/users in using the system since they reflect computer knowledge and expertise, availability of resources, and fit with individual work style.

Social influence relates to subjective norm (Davis et al., 1989) and the influence of colleagues and others on choosing to adopt a system. Social influence is an expression of subjective norm beliefs in DTPB (Taylor & Todd, 1995a) that reflects a participant's perception that most people who are important to the participant think that the individual should or should not perform the behavior in question. It can also involve image (Moore & Benbasat, 1991), which is the degree to which one perceives that using an innovation enhances one's image or status in the social system or community to which one belongs (in this case, healthcare practitioners). We expect that a higher influence of significant other colleagues in or from outside the clinic to help practitioners perceive how EMRs would help them improve their work. As such, we hypothesize:

Hypothesis 8: Job relevance has a positive effect on performance expectancy.

Hypothesis 9: Facilitating conditions has a positive effect on performance expectancy.

Hypothesis 10: Social influence has a positive effect on performance expectancy.

3.6 Personal IT Innovativeness

Innovation studies have shown that personal IT innovativeness, or an individual's willingness to try out new IT applications, plays a role in determining the outcomes of users' adopting a technology. This variable relates to individual characteristics and derives from innovation diffusion theory (Agarwal & Prasad, 1998; Rogers, 2003). Although scholars agree that personal IT innovativeness has a direct effect on behavioral intention to use a technology, more refined analysis has shown that its effect is channeled through salient factors of technology adoption such as the perceptions of usefulness and ease of use (Jackson, Yi, & Park, 2013; Klein, 2007; Lu, Liu, Yu, & Wang, 2008). Personal IT innovativeness can also be associated with the compatibility attitudinal beliefs in DTPB. Thus, individuals more skillful with and receptive to using a new technology may tend to see better reasons to use it and perceive it as easier to use and, thus, develop more positive beliefs about it (Lewis, Agarwal, & Sambamurthy, 2003). Similarly, research has shown a construct capturing personal innovativeness in IT to play a significant role in physicians' adopting the technology (Yi et al., 2006). Accordingly, physicians more receptive to IT devices and software in general (such as computers, mobile devices, or e-banking) may also be more favorable to

adopting EMRs because they would see such systems more useful for their work and as not requiring a significant effort to use overall. As such, we hypothesize:

Hypothesis 11: Personal IT innovativeness has a positive effect on effort expectancy.

Hypothesis 12: Personal IT innovativeness has a positive effect on performance expectancy.

Hypothesis 13: Personal IT innovativeness has a positive effect on behavioral intention to adopt.

Figure 1 presents the theoretical model proposed by this research. Table 2 categorizes the model constructs in terms of their association with the DTPB three belief components (attitude, subjective norm and perceived behavioral control), context (organizational or individual), and effect on adoption intention (favorable or unfavorable).

Figure 1. Theoretical Model of EMR Adoption in Canadian Medical Practices

Table 2. Categorization of DTPB Belief Components and Theoretical Model Constructs

DTPB belief component	Model construct	Context	Effect on adoption intention
Attitude	Performance expectancy	Organizational	Favorable
	Effort expectancy	Organizational	Favorable
	Perceived overall risk	Individual	Unfavorable
	Job relevance	Organizational	Favorable
	Personal IT innovativeness	Individual	Favorable
Subjective norm	Social influence	Organizational	Favorable
Perceived behavioral control	Facilitating conditions	Organizational	Favorable

4 Methodology

We designed a cross-sectional experiment to test the theoretical model we construct in Section 3. We created this experiment to capture the image of EMR adoption across a representative sample of Canadian medical practices at the same point in time. Starting from measures validated in relevant literature (see Section 3), we developed a questionnaire capturing the latent variables in the model and

the relevant demographics in both of Canada's official languages (English and French). Appendix A shows the constructs and their included items and the reference sources from which we adapted them.

We pre-tested the survey, including for content validity, with four PhD students and pilot tested it with three practicing physicians. As a result, we corrected definitional and structural errors. Following that, we launched a Canada-wide survey targeting physicians in medical practices. Because medical practitioners are very busy and difficult to recruit for studies such as this one, we outsourced the survey administration to a commercial firm that used an Internet panel of pre-recruited Canadian physicians. We compensated participants for completing the survey, which took about 20 minutes. We collected data from 119 physicians working in medical practices or clinics (distributed proportionally with provincial populations across the country) that used EMRs. Unless working in solo practices, these physicians worked as partners and decision makers with other physicians in their practices.

Physicians answered question items in the constructs presented to them on a Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). We collected data for this study as part of a larger project we conducted in that setting. Of the 119 practices, one could classify 50 as small (employing either one or two physicians) and 69 as larger (with more than two physicians). An additional characteristic of the sample was that there were 54 primary care practitioners (general practitioners) and 65 specialists, with each group split approximately equally across small and larger practices.

5 Results

We considered all 119 participant questionnaires recorded as complete (since only less than 5 percent of the data were missing for some cases). A demographic analysis indicated that the average medical experience of the respondents was 18.25 years, that 73.1 percent of the respondents were male, and that 96.6 percent worked full-time. The median number of physicians per practice (for both full-time and part-time) was 5.0.

Out of the 119 participants, 54 were family physicians. The remaining 65 were specialists who worked in a variety of 12 specialties ranging from internal medicine (22), surgery (16), dermatology (11), anesthesiology (5), emergency medicine (4), and so on in declining numbers. Small medical practices with one or two physicians were evenly divided between family medicine and specialist practices (25 in each case). Twenty six of the family medicine participants worked in clinics with more than two physicians (which reflects a growing trend towards family health teams that provide better coordination of general practice with allied health professionals such as dietitians and kinesiologists). Seven specialists worked in clinics with more than two physicians. The remaining specialists and two family physicians worked in hospital settings, which, of course, reflects the other side of the dichotomy between small privately owned practices and large public healthcare organizations. In all such organizations, physicians were involved in the decision making process about adopting, implementing, and using EMRs.

We analyzed the data primarily with the partial least squares (PLS) methodology due to its suitability for complex models and exploratory (rather than confirmatory) research (Bontis, Crossan, & Hulland, 2002). In addition, PLS makes no assumptions about the distribution of the sample data (Jöreskog & Wold, 1982) and works well with formative indicators (Andreev, Heart, Maoz, & Pliskin, 2009; Thomas, Lu, & Cedzynski, 2005) and relatively small samples (Chin & Newsted, 1999). The PLS analysis included two successive evaluations: the measurement model and the structural model. We assessed perceived overall risk as a second-order construct using a repeated indicators approach (Lohmoller, 1989); that is, through the indicators of the five primary risk facets.

5.1 Measurement Model

We ran SmartPLS (Ringle, Wende, & Will, 2005) and conducted the analysis according to Gefen and Straub (2005). A first analysis of the results indicated that we needed to drop six measurement items out of the total of 40 due to relatively poor Cronbach's alpha reliability and to low item-to-total correlations and factor loadings for five constructs. We ran SmartPLS for the remaining items. This time, all items displayed item-to-total correlations above 0.4 and factor loadings above 0.7, significant at the 0.01 statistical level or better. As Table 3 shows, Cronbach's alpha was above 0.7 for all constructs except perceived resource risk and perceived psychological risk for which alpha values were slightly below this recommended threshold. However, the average variance extracted (AVE) coefficient was above 0.5 and the composite reliability above 0.7 for all constructs. These findings indicate that, according to the literature, all

constructs had satisfactory reliability and convergent validity (Bontis, 1998; Bontis, 2004; Jarvenpaa, Shaw, & Staples, 2004, Fornell & Larcker, 1981).

Table 2. Statistics of the Measurement Model

Item	Mean	Standard deviation	Factor loading	Error	Item-total correlations	Composite reliability (Cronbach's alpha; AVE)
PRR1	5.04	1.56	0.892	0.266	0.473	0.851 (0.653; 0.741)
PRR3	5.02	1.61	0.828	0.272	0.532	
PPER2	4.66	1.77	0.846	0.043	0.642	0.911 (0.853; 0.773)
PPER3	4.16	1.76	0.902	0.020	0.747	
PPER4	4.70	1.69	0.888	0.024	0.719	
PPSR1	2.72	1.85	0.729	0.062	0.424	0.815 (0.661; 0.597)
PPSR2	3.66	1.75	0.707	0.077	0.426	
PPSR3	4.30	1.95	0.872	0.020	0.583	
PLPR1	3.92	1.90	0.877	0.034	0.737	0.906 (0.845; 0.763)
PLPR2	4.28	1.93	0.878	0.026	0.722	
PLPR3	3.53	1.77	0.866	0.033	0.678	
PTR1	4.54	1.83	0.913	0.016	0.665	0.910 (0.801; 0.834)
PTR2	3.68	1.87	0.914	0.019	0.583	
JR1	6.09	1.11	0.949	0.081	0.874	0.940 (0.904; 0.840)
JR2	6.09	1.12	0.943	0.093	0.839	
JR3	6.21	1.09	0.855	0.082	0.721	
FC1	5.42	1.42	0.853	0.071	0.712	0.895 (0.832; 0.741)
FC2	5.46	1.40	0.833	0.086	0.712	
FC4	5.18	1.60	0.894	0.037	0.646	
SI3	3.82	1.41	0.789	0.139	0.562	0.863 (0.710; 0.760)
SI4	4.05	1.72	0.948	0.039	0.462	
PIT11	4.86	1.63	0.939	0.023	0.841	0.947 (0.916; 0.855)
PIT12	4.68	1.68	0.910	0.025	0.808	
PIT13	5.28	1.54	0.925	0.027	0.839	
EE1	5.17	1.51	0.952	0.013	0.798	0.953 (0.925; 0.870)
EE2	5.20	1.49	0.926	0.018	0.818	
EE3	5.08	1.53	0.920	0.030	0.765	
PE1	5.78	1.35	0.907	0.022	0.800	0.921 (0.887; 0.746)
PE2	5.23	1.63	0.877	0.031	0.753	
PE3	4.81	1.73	0.804	0.064	0.691	
PE4	5.11	1.57	0.864	0.035	0.755	
BI1	6.36	1.09	0.837	0.055	0.568	0.899 (0.833; 0.749)
BI2	5.70	1.32	0.915	0.021	0.650	
BI3	5.43	1.55	0.843	0.045	0.714	

Note: PRR: perceived resource risk, PPER: perceived performance risk, PPSR: perceived psychological risk, PLPR: perceived legal & privacy risk, PTR: perceived time risk, JR: job relevance, FC: facilitating conditions, SI: social influence, PIT1: personal IT innovativeness, EE: effort expectancy, PE: performance expectancy, BI: behavioral intention.

We used a test to assess discriminant validity to build a matrix of loadings and cross-loadings of first-order constructs. The results (see Table 4) show that items had higher loadings on the constructs they were supposed to measure than on other constructs, which indicates appropriate discriminant validity (Gefen & Straub, 2005). The results in Table 5, which display the square root of first-order construct AVEs on the

diagonal and construct correlations off diagonal, strengthen this conclusion. Since diagonal elements are larger than off-diagonals on the corresponding rows and columns, discriminant validity was appropriate (Bontis, 2004).

Table 3. Loadings and Cross-loadings of First-order Constructs

	PRR	PPER	PPSR	PLPR	PTR	JR	FC	SI	PITI	EE	PE	BI
PRR1	0.892	0.247	0.017	0.057	0.233	0.107	-0.053	0.128	0.025	-0.243	-0.174	-0.095
PRR3	0.828	0.151	0.087	0.036	0.196	0.227	-0.021	0.150	0.040	-0.061	0.077	-0.020
PPER2	0.097	0.846	0.481	0.476	0.510	-0.182	-0.329	-0.078	-0.113	-0.279	-0.208	-0.228
PPER3	0.237	0.902	0.612	0.480	0.607	-0.121	-0.480	0.052	-0.245	-0.478	-0.360	-0.364
PPER4	0.278	0.888	0.618	0.486	0.565	-0.237	-0.479	0.065	-0.176	-0.396	-0.323	-0.365
PPSR1	0.057	0.420	0.729	0.404	0.398	-0.315	-0.425	0.033	-0.387	-0.328	-0.291	-0.432
PPSR2	-0.003	0.445	0.707	0.362	0.305	-0.336	-0.357	-0.010	-0.073	-0.207	-0.089	-0.315
PPSR3	0.066	0.622	0.872	0.561	0.544	-0.235	-0.379	0.061	-0.382	-0.321	-0.189	-0.340
PLPR1	0.056	0.441	0.441	0.877	0.295	-0.115	-0.309	-0.099	-0.284	-0.136	-0.144	-0.288
PLPR2	0.038	0.509	0.492	0.878	0.354	-0.138	-0.343	-0.046	-0.212	-0.171	-0.169	-0.284
PLPR3	0.051	0.480	0.588	0.866	0.441	-0.237	-0.463	0.008	-0.274	-0.288	-0.131	-0.374
PTR1	0.220	0.584	0.498	0.397	0.913	-0.216	-0.451	-0.042	-0.209	-0.433	-0.318	-0.338
PTR2	0.238	0.584	0.511	0.369	0.914	-0.286	-0.543	0.060	-0.225	-0.550	-0.509	-0.486
JR1	0.231	-0.154	-0.325	-0.158	-0.239	0.949	0.442	0.218	0.262	0.336	0.256	0.345
JR2	0.142	-0.233	-0.381	-0.215	-0.285	0.943	0.521	0.162	0.228	0.389	0.304	0.383
JR3	0.142	-0.164	-0.302	-0.139	-0.226	0.855	0.407	0.178	0.147	0.303	0.232	0.389
FC1	-0.066	-0.438	-0.402	-0.410	-0.471	0.390	0.853	0.191	0.413	0.546	0.394	0.639
FC2	-0.054	-0.373	-0.426	-0.370	-0.419	0.441	0.833	0.143	0.566	0.569	0.326	0.654
FC4	-0.012	-0.448	-0.450	-0.348	-0.501	0.464	0.894	0.193	0.346	0.730	0.583	0.678
SI3	0.205	-0.015	0.002	-0.165	0.091	0.180	0.122	0.789	0.107	0.022	0.175	0.024
SI4	0.110	0.033	0.055	0.018	-0.034	0.180	0.219	0.948	0.042	0.189	0.336	0.148
PITI1	0.057	-0.212	-0.378	-0.259	-0.219	0.235	0.471	0.060	0.939	0.368	0.255	0.483
PITI2	-0.045	-0.231	-0.364	-0.304	-0.273	0.144	0.433	0.075	0.910	0.298	0.214	0.422
PITI3	0.089	-0.122	-0.303	-0.253	-0.165	0.270	0.443	0.067	0.925	0.309	0.167	0.411
EE1	-0.129	-0.390	-0.353	-0.227	-0.462	0.397	0.712	0.192	0.395	0.952	0.563	0.609
EE2	-0.238	-0.424	-0.335	-0.217	-0.530	0.376	0.681	0.169	0.250	0.926	0.627	0.539
EE3	-0.158	-0.424	-0.354	-0.200	-0.518	0.276	0.652	0.046	0.345	0.920	0.495	0.538
PE1	-0.104	-0.310	-0.303	-0.192	-0.412	0.334	0.543	0.182	0.244	0.628	0.907	0.627
PE2	-0.098	-0.370	-0.223	-0.199	-0.532	0.281	0.494	0.288	0.140	0.567	0.877	0.539
PE3	0.022	-0.256	-0.116	0.020	-0.303	0.139	0.320	0.300	0.159	0.414	0.804	0.417
PE4	-0.043	-0.230	-0.178	-0.175	-0.288	0.219	0.449	0.346	0.256	0.440	0.864	0.482
BI1	-0.064	-0.227	-0.302	-0.269	-0.260	0.360	0.633	0.068	0.344	0.442	0.450	0.837
BI2	-0.103	-0.383	-0.486	-0.370	-0.451	0.328	0.701	0.113	0.573	0.619	0.553	0.915
BI3	-0.008	-0.321	-0.386	-0.290	-0.437	0.378	0.641	0.120	0.278	0.479	0.565	0.843

Table 4. Square Root of AVE and Correlations of First-order Constructs

	BI	EE	FC	JR	PE	PITI	PLPR	PPER	PPSR	PRR	PTR	SI
BI	0.866											
EE	0.603	0.933										
FC	0.762	0.732	0.861									
JR	0.406	0.377	0.503	0.916								
PE	0.607	0.603	0.533	0.291	0.864							
PITI	0.477	0.354	0.486	0.234	0.232	0.925						
PLPR	-0.363	-0.231	-0.430	-0.190	-0.169	-0.293	0.874					
PPER	-0.367	-0.442	-0.492	-0.204	-0.342	-0.205	0.547	0.879				
PPSR	-0.463	-0.372	-0.496	-0.370	-0.246	-0.379	0.584	0.652	0.773			
PRR	-0.071	-0.187	-0.045	0.186	-0.071	0.037	0.055	0.236	0.056	0.861		
PTR	-0.451	-0.539	-0.544	-0.275	-0.453	-0.237	0.419	0.640	0.552	0.251	0.913	
SI	0.118	0.148	0.208	0.201	0.315	0.072	-0.050	0.019	0.041	0.159	0.010	0.872

Results in Tables 3-5 demonstrate that the model constructs had adequate convergent and discriminant validity and good reliability. Therefore, we proceeded with the structural analysis of the model results.

5.2 Structural Model

We obtained path coefficients and significance levels by running SmartPLS with bootstrap with 200 re-samples. Figure 2 and Table 6 present the results.

As Figure 2 and Table 6 show, our results support 11 out of the 17 hypotheses. As expected, performance expectancy, effort expectancy, and personal IT innovativeness were significant and strong factors that favored behavioral intention to adopt directly or indirectly and perceived overall risk was an obstacle to adoption. All facets hypothesized as being components of second-order perceived overall risk had a significant contribution to this construct except perceived resource risk.

Figure 2. Structural Evaluation of the Model of EMR Adoption in Canadian Medical Practices (Significance levels: * = 0.05; ** = 0.01; * = 0.001)**

Table 5. Hypothesis Test Results

Hypothesis	Path	Path coefficient	t-value	p-value	Outcome
1	Performance expectancy -> behavioral intention	0.35	3.7945	<0.001	Supported
2	Effort expectancy -> performance expectancy	0.44	3.5480	<0.001	Supported
3	Effort expectancy -> behavioral intention	0.21	1.7366	N.S.	Rejected
4a	Perceived resource risk -> perceived overall risk	0.06	1.6048	N.S.	Rejected
4b	Perceived performance risk -> perceived overall risk	0.36	16.6974	<0.001	Supported
4c	Perceived psychological risk -> perceived overall risk	0.27	11.2444	<0.001	Supported
4d	Perceived legal & privacy risk -> perceived overall risk	0.30	11.1508	<0.001	Supported
4e	Perceived time risk -> perceived overall risk	0.26	11.5061	<0.001	Supported
5	Perceived overall risk -> performance expectancy	-0.13	1.6156	N.S.	Rejected
6	Perceived overall risk -> behavioral intention	-0.17	2.0629	<0.05	Supported
7	Effort expectancy -> perceived overall risk	-0.52	8.9782	<0.001	Supported
8	Job relevance -> performance expectancy	-0.01	0.0388	N.S.	Rejected
9	Facilitating conditions -> performance expectancy	0.10	0.5723	N.S.	Rejected
10	Social influence -> performance expectancy	0.23	3.0848	<0.01	Supported
11	Personal IT innovativeness -> effort expectancy	0.35	3.5479	<0.001	Supported
12	Personal IT innovativeness -> performance expectancy	-0.03	0.3016	N.S.	Rejected
13	Personal IT innovativeness -> behavioral intention	0.27	2.7059	<0.01	Supported

The theoretical model demonstrated moderately high explanatory power. Thus, the variance explained by behavioral intention and performance expectancy was $R^2 = 0.552$ and $R^2 = 0.437$, respectively, whereas the values for perceived overall risk and effort expectancy were comparatively smaller ($R^2 = 0.267$ and $R^2 = 0.125$, respectively) but still at an acceptable level in information systems studies (Moon & Kim, 2001).

We tested the number of the respondents' years of practice, gender, and specialty (general practice/specialist) together with the number of employees in the practice and its size (up to/more than two medical practitioners) as possible control variables. We noticed small increases in the average variance explained of the endogenous variables in some cases (Table 7), but we found no changes in the measurement model (hence, the R^2 increases were due to structural causes).

Table 6. Variance Explained by Endogenous Constructs

Control variable	Perceived overall risk	Performance expectancy	Effort expectancy	Behavioral intention
<i>Uncontrolled model</i>	<i>0.267</i>	<i>0.437</i>	<i>0.125</i>	<i>0.552</i>
Years of practice	0.271	0.447	0.128	0.556
Gender	0.270	0.438	0.128	0.562
Number of employees	0.279	0.439	0.127	0.553
Specialty (General/Specialist)	0.281	0.443	0.126	0.554
Medical practice size	0.268	0.445	0.151	0.559

Besides the small increase in the variance explained in some situations, we noticed no significant paths from the tested control variables to the endogenous constructs. We could not use work pattern (full-time/part-time) as a control variable since 96.6 percent of the participants reported working full-time.

As a more granular investigation of the role of the only barrier to adoption that the model considered (i.e., perceived overall risk), we also conducted mediation and moderation tests regarding its influence. We applied the Baron and Kenny (1986) procedure and Sobel (1982) test to investigate the possible mediation effect of perceived overall risk on effort expectancy and behavioral intention or on effort expectancy and performance expectancy. In both cases, we detected no significant effect (p-value = 0.07 and 0.08, respectively). We obtained a similar result when investigating the possible mediation effect of

performance expectancy on perceived overall risk and behavioral intention: (p -value = 0.09). We then followed a two-step procedure as Chin, Marcolin, and Newsted (1996) recommend to test for interaction effects between perceived overall risk and performance expectancy over behavioral intention and between perceived overall risk and effort expectancy over behavioral intention: we found that both were non-significant at the 0.05 level. However, perceived overall risk appeared to act as a moderator for the relationship between effort expectancy and performance expectancy: we obtained a path coefficient of 0.48 that was significant at the 0.05 level from the interaction construct to performance expectancy and an increase of R^2 from 0.437 to 0.469 for this latter factor.

SmartPLS also provided the total effect coefficients (i.e., direct and indirect) in the theoretical model. Table 8 presents these coefficients for behavioral intention. Results show that effort expectancy had the largest positive total effect despite the non-significance of its direct path to behavioral intention. Personal IT innovativeness had the second largest positive total effect, and perceived overall risk was the only factor with a negative effect. The absolute value of this latter factor's coefficient was about 50 percent of that of the most important two positive factors of influence.

Table 7. Total Effects on Behavioral Intention

Factor of influence	Total effect coefficient	t-value	p-value
Performance expectancy	0.35	3.4590	0.001
Effort expectancy	0.48	3.9867	0.000
Personal IT innovativeness	0.42	4.8146	0.000
Facilitating conditions	0.03	0.4694	0.640
Job relevance	0.00	0.0319	0.975
Social influence	0.08	2.2103	0.029
Perceived overall risk	-0.22	2.4879	0.014

6 Discussion and Conclusions

In this paper, we look at the salient favoring and disfavoring factors associated with the deployment of electronic medical record systems in Canadian medical practices in the broad scope needed to better understand adoption issues from the practitioners' point of view. The topic is interesting to study because, from a decision making point of view, these practices blend the characteristics of organizations and practitioners with the responsibility for managing them. Furthermore, our findings may apply to healthcare systems in other countries that also have a significant portion of similar types of small healthcare practitioner organizations. To achieve the study's purpose, we constructed a theoretical model that comprised both opportunities and obstacles from the literature on IS adoption, consumer behavior, and healthcare. We tested the model by surveying 119 physicians in medical practices currently using EMRs across Canada.

We posed the following research question: "What are the key positive factors and the most important negative factors influencing the adoption of EMRs in Canadian medical practices?". In validating this model, we found that, as expected from the IS literature, performance expectancy (i.e., the perception of usefulness) and effort expectancy (i.e., the perception of ease of use) are key positive antecedents of the intention to adopt EMRs through both direct and total effects (Davis, 1989; Venkatesh & Davis, 2000; Venkatesh et al., 2003). Personal IT innovativeness is another significant reason for people to use EMRs: practitioners who manifest an interest in IT are likely to favor using EMRs, which corresponds to previous literature as well (Yi et al., 2006). Our analysis also confirmed that people with higher IT innovativeness tend to perceive the technology as being easy to use although not necessarily useful. This finding appears to be logical since Canadian medical practices are generally in the early stages of EMR adoption, and the sample population would likely be primarily innovators or early adopters (Rogers, 2003).

Similar to consumer behavior research that has found perceived risk to negatively affect the intention to purchase (Laroche et al., 2004) and information systems research that has showed risk perceptions discourage intention to use electronic services (Featherman & Pavlou, 2003), we found that perceived overall risk deterred practitioners from intending to use EMRs. Fears that the system may not perform as expected (i.e., performance risk), doubts about the justification of acquiring the system (i.e., psychological

risk), possible problems with privacy and liability (i.e., legal & privacy risk), or perceptions about time wasted during the process of acquiring and implementing the system (i.e., time risk) influence physicians' risk perceptions, which aligns with major findings of previous studies (Davidson & Heslinga, 2007). Surprisingly, though, we found that perceived resource risk (i.e., monetary barriers associated with the purchase) did not play a significant role in the overall risk perception, which is not consistent with previous research (Cocosila et al., 2009; Featherman & Pavlou, 2003). Possible explanations for this finding may be that many of these medical practices may have received external (government) support to purchase their EMRs or that the respondents participating in this research were not affected directly by acquisition expenses.

Effort expectancy appears to play a central role in the proposed adoption model. Although it had no significant direct path to behavioral intention, it channeled the positive influence of personal IT innovativeness, had a strong positive effect on performance expectancy, and also had a mitigating influence on risk perception: in other words, if respondents find EMRs easy to use, they tend to see smaller risks associated with their adoption. Indeed, the complexity of the model we propose can capture the less obvious influence of ease of use on adoption intention by attenuating risk perceptions.

We found that job relevance and facilitating conditions did not play a role in the adoption model. A possible explanation for these findings is that, despite the fact that EMR applications can support much functionality (e.g., basic office functions, health information and data management, order entry management, sending/receiving data electronically, results management, clinical decision support (DesRoches, Campbell, & Sowmya, 2008)), existing implementations may not fully use these capabilities. Therefore, respondents may not perceive the relevance of EMRs for their overall jobs or that EMR deployment is important in the existing environment. Another explanation is that, in some small clinics, those who are in other job roles (e.g., nurses) might be in a better position than physicians to appreciate the functionality of EMR systems for their jobs. The lack of job relevance's and facilitating conditions' impact on performance expectancy may also explain the insignificant influence of perceived overall risk on this latter construct. As respondents likely did not use system capabilities fully, they were also unaware of possible risks affecting these capabilities. Furthermore, for low-level use of EMR functionality, IT skills are less important to fully use the system features, which possibly explains the non-significant influence of personal IT innovativeness on performance expectancy.

On the other hand, we found that social influence was a key antecedent of performance expectancy, which is consistent with previous studies showing the role of subjective norm in technology adoption (Venkatesh & Davis, 2000). In a sensitive sector such as healthcare where physicians in medical practices are linked to and communicate with colleagues and others in many other medical institutions, one would expect social influence to be a key factor favoring adoption of EMRs.

6.1 Contributions to Research

With this study, we make three contributions to research. First, we propose a comprehensive theoretical model of EMR adoption in Canadian small medical practices that we built on the foundation of the decomposed theory of planned behavior (DTPB). This model also blends positive and negative factors from one point of view and organizational and individual factors from another point of view. As a major theoretical contribution, we captured negative user perceptions on technology use as a second-order perceived risk construct, included in DTPB's attitudinal belief component. We found that the data supported over two-thirds of the model hypotheses we formulated at highly significant levels. Most of the hypothesized paths showed moderately high coefficients. Two of the four endogenous constructs (performance expectancy and, especially, behavioral intention) showed relatively high values for the variance explained. According to the literature, one can consider a model with most of the hypothesized paths significant, along with high R^2 values, as appropriate (Bontis, Keow, & Richardson 2000). Therefore, we believe that our model is an appropriate and suitable reflection of medical practice adoption of EMRs in Canada.

Second, we found that, surprisingly, effort expectancy had the largest total effect on adoption intention because of its combined indirect influence through performance expectancy and perceived overall risk. This finding indicates that the perception of ease of use, although in general found to be of secondary importance (after performance expectancy) in IS adoption studies (Venkatesh et al., 2003), may play a key role in deploying IT in sensitive areas such as healthcare.

Third, we found an interaction effect between effort expectancy and perceived overall risk that may mitigate some of the negative perceptions associated with EMR deployment (similar to (Featherman & Pavlou, 2003)) and increase the perception of usefulness. This finding reinforces the surprisingly pivotal role played by effort expectancy in small clinics' adopting EMRs.

6.2 Contributions to Practice

Our results also provide some technological and managerial implications. Because effort expectancy had the largest total effect and played a key role in adoption intention, developers and vendors of EMRs need to try to improve the ease of use of these systems to make them more acceptable. Although user resistance is a negative side of new IT implementations, assessing this factor (materialized as perceived risk in this case) has beneficial implications since it draws attention to problems from a user perspective. Addressing these issues and especially the risks we found to be significant (i.e., perceived performance risk, perceived psychological risk, perceived legal and privacy risk, and perceived time risk) would, therefore, increase the chances of successful implementations (Klaus & Blanton, 2010).

We found that personal IT innovativeness played a significant positive role in the adoption process. This finding indicates that, to increase the chances of success for new EMR system development and to strengthen the move in the right direction, implementations should start with clinics whose physicians have already proven to be more receptive to using new IT devices and software in general (e.g., electronic banking or mobile devices).

Since we confirmed performance expectancy as a key positive factor in the adoption equation of EMRs, developers and vendors of these systems should make the necessary efforts to promote system capabilities among current and potential users, which appears necessary since, despite the potential of the systems for supporting an array of functionalities, participants did not perceive these capabilities appropriately since job relevance and facilitating conditions did not play a significant role in the adoption equation.

Overall, our findings indicate that physicians may perceive gains from implementing EMRs but that they need to introduce and use the appropriate functionalities to support preventive care and easy interchange of data that both the patient's care providers and hospitals generate. Some practitioners feel that their EMRs are not being used to their appropriate capacity, which must be addressed with priority if the full effectiveness and efficiency of electronic patient records is to become a reality. Otherwise, electronic records will not fulfill their promise and could easily result in a reduction in care and loss of productivity by both primary and specialist care physicians.

6.3 Limitations and Future Research

As in any similar information systems study, this research has some limitations. The first and foremost issue was the relatively small sample size relative to the domain surveyed. Thus, although a sample size of 119 respondents was sufficient to meet all basic statistical and PLS methodology standards regarding the number of items and construct links (Bontis, 1998; Chin, 1998; Jarvenpaa et al., 2004), it is difficult to argue that all of the respondents worked in a homogeneous set of practices. In reality, medical practices differ from each other in many ways (e.g., the number of physicians and other employees, their specialties, the characteristics of their patients, etc.). Although none of the potential control variables considered for this research had an effect on the model, future research should consider possible subsamples that differentiate among physician specialties, size of the practice, existence of additional IT applications besides EMRs, regularly exercised links to or from external sources of clinical patient data (e.g., test labs, hospitals, etc.), or type of Internet access.

Second, although the survey gathered participant feedback on the status of their EMR implementations, the overall research did not differentiate among the types of possible EMR use. Given the dynamic nature of EMR acquisition and use at the time, there was a wide range in the reported status of these systems. Less than 40 percent (46) of the participants felt that their systems were operational and being used effectively for managing patients and patient populations. Of the remainder, 23 were in the process of acquiring and implementing their systems, 48 were operational but not to their full potential, and two had basically failed. Accordingly, some practices may use only EMR's basic functionalities; although the physicians might be satisfied with doing so, they may not perceive that the system has much relevance to their jobs, while physicians in other practices may use more complex functions that contribute more extensively to their decision making and, therefore, encounter different types of user problems.

Consequently, we considered capturing “intention to adopt” in this context an appropriate overall measure of whether participants felt they had taken the right course in system adoption and whether the implementation process had resulted in value for money.

Third, we made no attempt to differentiate between medical practitioners involved (effectively or not) in one or several of the key phases about purchasing, implementing, or using the system. As such, some respondents in this study may have had different views of the facets of perceived risks.

Fourth, the study included only those physicians who had already adopted EMRs, but significant differences between the views of these physicians and those who have not yet adopted EMRs may exist. A comparison investigation based on the theoretical model introduced by this study would, therefore, bring another interesting view to the incipient research in this area (Archer & Cocosila, 2011).

All the limitations that arise from the difficulty of conducting a more comprehensive study could be addressed in future research by using samples of practitioners from more homogeneous sets of clinical work environments. Future research could also attempt to confirm the key role we found for effort expectancy in the adoption equation and the surprisingly non-significant role of financial considerations (captured through perceived resource risk).

Overall, this study is one of the first few detailed investigations of the complex issue of the adoption and use of online clinical records by Canadian physicians in medical practices through an innovative blended model. This issue is critical and must be resolved to the satisfaction of all the stakeholders (physicians and other healthcare providers, citizens, government agencies, and healthcare institutions) before we can realize significant improvements from using information technology by physicians in the support of healthcare.

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Appendix A: Questionnaire Constructs and Reference Sources

Table A1. Construct Items and their Sources

Construct/Item	Reference
Behavioral intention to use the system	Venkatesh et al. (2003)
I use the system multiple times every day	
I am comfortable using the system	
I use the system effectively during patient encounters	
I use the system effectively for population based management for panels of my patients	
Performance expectancy	Venkatesh et al. (2003)
I find the system useful in my job	
Using the system improves my productivity	
Using the system increases my chances of getting ahead	
Using the system helps me to make fewer errors	
Effort expectancy	Venkatesh & Davis (2000)
It has been easy for me to become skilful at using the system	
I find the system easy to use	
Learning to operate the system has been easy for me	
Using the system takes too much time from my normal duties	
Perceived resource risks	Featherman & Pavlou (2003)
My organization has had to use significant additional resources to acquire and operate the system	
My organization has shared its risk through government agency support to acquire and/or operate the system	
My organization has used additional resources to convert to the system	
My organization relied on outside support to help decide on a suitable system	
Perceived performance risks	Featherman & Pavlou (2003)
My organization had to develop innovations in internal practices in order to effectively use the system	
I have had concerns about risks from inability to get immediate assistance from the vendor if we experience system difficulties	
I have had concerns about risks arising from day to day operations of the system	
I have had concerns that the system will not work as expected	
Perceived psychological risks	Featherman & Pavlou (2003)
I have resisted the use of the system	
I am concerned that others in my organization are resisting the use of the system	
I was concerned about the stress placed on myself, colleagues, and staff during system acquisition and implementation	
Perceived privacy and legal risks	Featherman & Pavlou (2003)

Table A1. Construct Items and their Sources

I am concerned about patient privacy with the system through unauthorized access	
I am concerned about liability issues with the system, if data are lost, mislaid, or stolen	
I am concerned about liability issues with the system, if practitioners make the wrong decisions based on recommendations	
Perceived time risks	Featherman & Pavlou (2003)
I lost a lot of valuable time during the implementation process	
It is now taking longer to perform my regular work duties	
I lose valuable time when the system is unavailable due to system failure	
Job relevance	Kim (2008)
In my job, usage of the system is important	
In my job, usage of the system is relevant	
In my job, usage of the system is frequent	
Facilitating conditions for users	Venkatesh, Brown, Likoebé, & Bala (2008)
I have the resources necessary to use the system	
I have the knowledge and training necessary to use the system	
The system is compatible with other systems I use	
Using the system fits well with my work style	
Social influence	Davis, Bagozzi, & Warshaw (1989)
People who influence my behavior think that I should use the system	
People who are important to me think that I should use the system	
People in the organization who use the system have more prestige than those who do not	
Having an EMR system is a status symbol for my organization	
Personal information technology innovativeness	Agarwal & Prasad (1998), Yi et al. (2006)
If I hear about a new information technology, I look for ways to experiment with it	
Among my friends and colleagues, I am usually the first to try out new information technologies	
I like to experiment with new technologies	

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Mihail Cocosila is an associate professor at the Faculty of Business, Athabasca University, Canada. He holds a PhD in Business Administration from McMaster University in Canada and a PhD in Engineering from the Polytechnic University of Bucharest, Romania. He has held research and faculty positions and has been involved in pioneering several information technology applications in Canada and Romania. His current research interests include information technology adoption and use, research topics in information systems, human-computer interaction, mobile and wireless services, and health informatics. He has published journal publications in *Communications of the Association for Information Systems*, *Communications of the ACM*, *Canadian Journal of Administrative Sciences*, *Electronic Markets*, and *Journal of Medical Internet Research*.

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