MEANINGFUL ELECTRONIC MEDICAL RECORD USE: A SURVEY OF FAMILY PRACTICE CLINICS

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Dedication

This thesis is dedicated to my life love, Bernardo Perez, and to my dear friends Valerie Moldowin, Nicole Hemsing, Krista Craik, and Christine Kennedy for carrying me through this long process. It is also dedicated to Dr. Rozemin Kizuk, who first gave me the opportunity to learn and explore the possibilities of how EMRs can transform a physician clinic. Finally, to my supervisor - Dr. Claudia Steinke, who never let me give up on myself.

Abstract

This thesis explores the factors related to increased meaningful use of Electronic Medical Records (EMRs) in family physician clinics in Alberta, Canada. Measurements were made using the Innovation Implementation scale (Klein & Sorra, 1996) and the Meaningful EMR Use scale, newly developed by Price, Lau, and Lai (2011). Demographics were collected for profession, age, gender, years of experience, and took into account the participation of the clinic in government improvement programs including Physician Office Systems Program (POSP) and primary care networks (PCNs). Implementation Climate was found to be the most important factor in predicting high levels of EMR use. Historically documented barriers to EMR implementation were neither as significant nor impactful as the literature suggested.

Acknowledgements

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Chapter One: Introduction

This purpose of this research was to assess the level of meaningful electronic medical record (EMR) usage of several family practice clinics throughout the province of Alberta. The researcher chose to explore this area of study due to her professional experience working in a family practice clinic and her efforts to increase the level of meaningful EMR use within the clinic. In addition, the researcher was motivated by the fact that Canada historically lags when it comes to EMR adoption, reporting 27.7% adoption rates (Canadian Medical Association, 2010) in comparison to those in the 90% range in other parts of the world (Jha, Doolan, Grandt, Scott, & Bates, 2008). Even when an EMR system has been implemented, it does not necessarily mean that it is being used in a meaningful, thorough, or high-level way (i.e., to its full capacity).

There were three key reasons why this was an important area to research: First, the current literature was limited and there were very few existing studies examining meaningful EMR use in family practice clinics. Second, this was an important safety issue to the general public. For example, if a family physician owned an EMR that had the capability to protect a patient from a serious medication interaction, there would be an expectation that the technology would be used. Unfortunately, that was often not the case. Last, in the Province of Alberta, taxpayer money had gone to support the adoption and use of EMRs through a program called the Physician Office Systems Program (POSP). Between 2001 and 2014, POSP provided funding, information technology services and change management services to help physicians automate their practices. With so many resources being allocated to this adoption process, this researcher feels there should also be accompanying efforts (and evaluation of efforts) to ensure high levels of meaningful

EMR usage. The research applied a quantitative study to explore current levels and contributing factors to having high levels of meaningful EMR usage within family practice clinic in the Province of Alberta, Canada.

Background Information

The first conceptualization of a computerized medical record was in the 1960s by an American physician named Lawrence L. Weed; his goal was to improve patient care by automating and enhancing accessibility to their information (Pinkerton, 2006). This work went on to form the PROMIS project at the University of Vermont, where they aspired to develop the first EMR. The Mayo clinic also began emerging with ideas during this time. More and more companies and academic institutions developed systems in the coming decades, including Harvard's COSTAR system, the Technicon system, the HELP, system, the Duke's 'The Medical Record', and the Regenstrief record in Indiana (Pinkerton, 2006).

Although the concept for an EMR originated in North America, Canada and the United States have remained the two countries with the lowest clinical EMR usage at 20–28% (Jha et al., 2008). In fact, according to MacKinnon and Wasserman (2009), the health care industry was "decades behind other industries with respect to information technology (IT) adoption and utilization" (p. 50). It has been only recently, however, that incentives like POSP have been offered to physicians in order to entice EMR adoption. In contrast, countries such as in Australia, Germany, Netherlands, New Zealand and the United Kingdom, have reached EMR adoption levels of over 90% (Jha et al., 2008). In New Zealand, the adoption tactics have been much more strategic than those in North America. The New Zealand government started a three-stage plan in 1992 that ended 17

years later with 100% EMR adoption rate, 75% claiming to utilize functionality in a meaningful way (Jha et al., 2008). This was accomplished mainly through the development of a national health identifier database, privacy and information-sharing agreements, one-time grants to physicians to purchase hardware, and mandatory electronic billing. As of 2009, there was one privately owned company, HealthLink, which was the sole provider for all electronic health care services (Protti, Dip, & Johansen, 2008a, 2008b).

Chapter Two: Review of the Literature

Benefits of EMR Use

The benefits of EMR usage are plentiful. Some are as rudimentary as the benefits of a computer. Others are broader and look to improve the health care system at large. These benefits include improved efficiency and patient care, financial benefits, and support for future health care.

Improved efficiency. One way of showing the administrative benefits of EMR use is to shed light on the drawbacks of paper charts: inconsistent abbreviations, illegible handwriting, and difficulty in searching for specific information in a timely manner. In contrast, with an EMR, information is available and legible to all. Multiple people can access a chart simultaneously. Forms and requisitions can be set up to pull demographics and other data from the chart instantaneously. This eliminates the need for duplicate data entry, and sifting through several sheets in a paper chart. Referral letters and billing can be done at the time of the appointment, instead of being done after hours or in between patients. The cost of paper goes down as forms and referrals can be e-faxed. Templates can be created to reduce the number of steps to chart and bill for common procedures or visit types (Eichenwald Maki & Petterson, 2008; Gartee, 2007; Lai, Lau, & Shaw, 2009; Miller & Sim, 2004).

The availability of EMR-integrated messaging systems also improves timeliness and accuracy of inter-office communication, and can take the place of post-it notes around the office. Tasks are easily transferred from one clinic employee to another, thereby reducing “dropped balls” (Miller & Sim, 2004, p. 119).

Improved patient care and safety. The usage of EMRs supports clinical decision-making, improves coordination and quality of care, and increases patient safety (Gartee, 2007). The existence of built-in medical libraries improves the physician's ability to access these resources within the EMR, reducing the need to go to an external source. Clinical decision supports such as allergy alerts, drug incompatibilities, and prompts to follow protocols reduce errors and improve patient safety. This increased safety impacts not only the patient, but the health care system at large. The use of EMRs also provides a landscape conducive to the proactive management of all patients, especially those with chronic diseases like diabetes, hypertension and heart failure. Proactive management includes screening reminders and vaccination recommendations, while tracking test-order status and improving coordination of care across providers (Eichenwald Maki & Petterson, 2008; Fraser et al., 2005; Gartee, 2007, 2011; Lai et al., 2009; Miller & Sim, 2004).

Financial benefits. Improved efficiency provides indirect financial benefits of running a more efficient office. However, there are more direct financial benefits from EMRs that serve both the health care system and the physician. An EMR is able to improve efficiency of care for patients by reducing duplicate testing. This ability is especially important to taxpayers in the Canadian health care system, in which every test is covered by public funds. For the most part, Canadian physicians use fee-for service as their funding model. This means that for each type of visit and service that a physician provides, there is a specific fee code attached. The physician reports the visit type and service that they provide, bill for the service, and receive payment from the provincial college of physicians and surgeons. The 2010 National Physician Survey reported that for

those physicians reporting a primary remuneration method, 41.9% used fee-for-service. Of the 32.3% reporting a blended method, 46.36% of that blend was fee-for service (Canadian Medical Association, 2010). With the integration of EMR and electronic billing services, there is an improved process of data capture within the clinic visit that can ensure that the physician bills for all of the services provided (Miller & Sim, 2004).

Support for future health care. An EMR helps those who provide health care to think past the present moment, and plan for the future. When data are entered, it is entered in such a way that is retrievable in a meaningful way down the road. Diagnoses, medications, laboratory results, and many other bits of information are recorded as discrete pieces of data in an organized database. This opens the door for clinical practice reporting, program reporting, and research in a way that would be extremely cumbersome to the point of being nearly impossible with paper charts (Lai et al., 2009). It also paves the way for the possibility of interoperable health information systems. At this point in the computer age, our health information should transfer from one end of the country to the other with the ease and security.

Barriers to EMR Use

There are several reasons why Canada lags behind in EMR implementation. The literature shows barriers including financial concerns, trust in technology, perception of insufficient IT support, steep learning curve, complex technology, and difficulty with EMR implementation.

Financial concerns. Cost has been one of the first issues identified by physicians as the most common reason for not adopting in the early days of EMRs in the late 1990s and early 2000s (Valdes, Kibbe, Tolleson, Kunik, & Petersen, 2004). These costs

involved four main categories. The first was initial start-up costs, including all hardware as well as the loss of productivity during the changeover period. The second was staff training and EMR customization costs. The third category was ongoing costs to maintain the system, including monthly fees to the vendor. The final category was the matter of return on investment. This potential barrier continues to be a particularly troublesome one, as the family practice clinics see the direct impact of the outgoing costs, but it is the healthcare system that reaps the rewards of proactive care. The return on investment is therefore seemingly intangible and uncertain for family physicians (Boonstra & Broekhuis, 2010).

Trust in technology. Unfortunately, in the early years, some issues arose relating to EMR vendor reliability. Schmitt and Wofford (2002) declared there has been volatility in the health care IT industry, and that it is only recently that EMR vendors have started to fulfill what they have been promising. In a study of computer-naïve primary care centres in Greece in 2007, frequent system "breakdowns" were reported (Samoutis et al., 2007). A review of the literature by Boonstra and Broekhuis (2010) revealed that there was much evidence to support the notion that physicians were concerned about the stability, safety, and access to their patients' data in the event of viruses, computer crashes, or power outages. However, Dawes and Chan (2010) insisted that EMRs were a safe way to collect and store patient data. Their review of the literature found no reported incidences of "catastrophic data loss" (Dawes & Chan, 2010, p. 16).

Perception of insufficient technology support. Simon et al. (2007) found that two thirds of physicians identified a lack of technical support as a major barrier to their clinics adopting EMR systems. The literature showed that physicians feel like the IT

support is inadequate, and that there was slow turn-around time by vendors for solving technical issues once an EMR had been implemented (Boonstra & Broekhuis, 2010; Ludwick & Doucette, 2009b; Samoutis et al., 2007).

Steep learning curve. As EMR systems are attempting to simulate the complex problem solving that occurs in a physician's mind during a patient encounter, they are likewise, complex. To some physicians and support staff with less familiarity with technology, the learning curve is very steep. This is seen as quite the burden to physicians (Boonstra & Broekhuis, 2010). In a study in Greece, physicians reported "poor usability" and "non-user friendly interface features" in the initial implementation phase, which surprised the researchers, because they had selected the EMR taking ease of navigation into account (Samoutis et al., 2007). The authors concluded that this finding was due to the lack of base level skill of some physicians and support staff, and that more attention to workflow development was needed.

Difficulty with EMR implementation. The enormity of the project of implementing an EMR is the most daunting barrier of all. Implementing an EMR changes everything about the way the office runs. There are processes for how a patient is booked, how they are checked in, how they are processed at the time of their appointment, and how the appointment is conducted. Even after the patient is gone, there are workflows for completing billing. As Lyons and Klasko (2011b) attested, "The introduction of an EMR into the practice precipitates the need to re-think nearly every process in the office – even some processes that appear, upon first glance, to be unrelated to the task of recording medical information" (p. 38). The proper functioning and usability of the EMR tomorrow depends on the quality of the information entered in today.

Research has shown that EMR implementations are costly, time consuming, and failure rates are high. A recent case study in Canada following three hospitals as they implemented EMR solutions in a hospital setting saw a success rate of only 33% (Lapointe & Rivard, 2005). This means that of the three hospitals that attempted the implementation of an EMR system, two of them eventually announced the implementation a failure, stopped using the software entirely, and reverted back to their original workflows. This is a situation not unique to health care. Even in the management world, failure rates as high as 50% are reported for large-scale company-wide IT implementations that are business-world equivalents of EMRs (Bradley, 2009).

Even if an implementation initially succeeds, there is still the phenomenon of Information System (IS) Avoidance, which Kane and Labianca (2011) defined as "an individual's preference to avoid working with an information system despite the need and opportunity to do so" (p. 505). As Kane and Labianca further described, there are a range of resistance behaviours that range from active (physical destruction or vandalism) to passive (lack of cooperation or apathy) that thwart the long-term success of an EMR implementation.

Comparing Benefits and Barriers

Many literary sources have documented numerous benefits that prove to offset the cost of the EMR, including reduction of clerical labour, transcription costs, order entry, documentation time, and storage and supply costs (Renner, 1996; Schmitt & Wofford, 2002). An EMR system also increases ease of access to and availability of patient information, standardization of documentation, and inter-staff communication. EMR use also allows for better data and patient panel analysis and reporting, including billing

maximization (Miller & Sim, 2004; Schmitt & Wofford, 2002). When discussing this issue, Walker (2005) concluded, "We have enough estimates. They suggest, as persuasively as such estimates can, that well-implemented EMRs have the potential to improve health care at an acceptable cost" (p. 1120).

Critical Success Factors

Since significant resources are invested into the adoption of EMRs, there has been much research into critical success factors investigating this topic. Individual factors found in the literature are a having a business case, physician support, an internal project champion, a planning phase, strong project management skills and process reengineering.

Business case. Just like any other business venture, there must be a strategic and economic justification for implementing an EMR, as well as a way to measure the return on the investment (MacKinnon & Wasserman, 2009). Wang et al. (2003) statistically hypothesized one such business case using an actual patient panel from a primary care ambulatory setting in Massachusetts. Wang et al. used variations that included "light EMR users" (p. 400), "full EMR users" (p. 400), "most pessimistic assumptions" (p. 397), and "most favourable assumptions" (p. 399), and concluded that the potential net benefit over a 5-year period showed a range of $2,300–330,900 USD, with an average of $86,400 USD per provider. Their research suggested that there is a solid 5-year business case for every family practice clinic to adopt an EMR, even for the most minimal users, under the most modest of circumstances (Wang et al., 2003).

Physician support. Technology implementation projects require the strong support of the physicians involved. This is, however, not an easy feat to accomplish. In a clinic, the physicians are in the unique position of having top management authority and

also being involved in the day-to-day use of the software. As Mishra, Anderson, Angst, and Agarwal (2012) described it, physicians have historically had unprecedented autonomy and independence when it came to conducting their work routines. With the introduction of EMRs, physicians can perceive this intrusion in one of two ways: they can see it as either reinforcing or a deteriorating their perceived care provider identity. Mishra et al. found that if the local community of physicians saw the adoption of an EMR as something positive that would reinforce the provider identity, then the EMR would be assimilated well into physician practice. Conversely, if the local community of physicians saw the adoption of an EMR as something that would deteriorate the perceived identity, the EMR assimilation would not go well.

Another study regarding physician attitudes and EMR adoption used social network theory as its framework. The authors divided up health care personnel into three groups: physicians; paraprofessionals (nurses, physician assistants, technicians, and those who are in direct or indirect care-giving roles); and administrative personnel (Venkatesh, Zhang, & Sykes, 2011). They looked at in-group ties (e.g., physician to physician) and out-group ties (e.g., physician to paraprofessional) and studied the effect these ties had on EMR use. Venkatesh et al. (2011) found that with every profession except physicians, both in-group and out-group ties led to a positive effect on EMR use. However, with physicians, in-group ties led to a negative effect on EMR use, and out-group ties led to no effect on use. According to Venkatesh et al. (2011), only physicians who are on the social periphery of the network will be less influenced by their peers, and are more likely to explore the use of an EMR system.

Although a very complicated phenomenon, without the local physician support throughout the process of adoption and implementation, there is a great risk of the project failing (MacKinnon & Wasserman, 2009). Ultimately, it is up to the implementation team to negotiate the relationship with the physician throughout the implementation process in order to have a successful outcome.

Local champion. Several pieces of literature identify the importance of a local project champion or "super-user" (Duperier, 2011, p. 29), who may or may not be a physician (Dawes & Chan, 2010; Duperier, 2011; Ludwick & Doucette, 2009a; MacKinnon & Wasserman, 2009). Gagnon et al. (2010) was more specific with the roles and characteristics this champion would ideally possess. They asserted that champions act as a bridge between the software developers and the clinical users. Champions participate in the design and decision making, ensuring that their "vision" is always kept as the goal. They lead and train the team, while providing technical support along the way. This point person can act as the direct liaison with the project manager, as the natural family practice office environment can have diffuse authority, leading to confusion of who to turn to for problem-solving (Lyons & Klasko, 2011a).

Planning phase. A deliberate planning phase is often neglected in smaller non-management organizations, such as medical practices. This phase, however, is absolutely essential to ensure that the business case is translated into clear goals and objectives with concrete processes and timelines (MacKinnon & Wasserman, 2009).

Project management skills. Project managers are as essential as champions in the transition process. They act as a liaison between the EMR vendor and the clinic, orchestrating the initial rollout procedure, and addressing post-implementation concerns.

Often, smaller healthcare organizations do not have personnel who possess project management skills, and so must fill this need by looking to independent contractors or vendor consultants (MacKinnon & Wasserman, 2009).

Process reengineering. During an EMR implementation, there are massive changes in clinic workflow processes as well as business processes, including accounting and other reporting structures. It is critical that a point person carefully thinks about all of these processes, creates new workflows, and then implements proper training for all of the employees that will be using the new system (MacKinnon & Wasserman, 2009). Venkatesh et al. (2011) cited this as a roadblock seeing as it is typical of the health care system to inflict new software on its professionals with little or no training or process support. This causes delayed full adoption and delayed realization of benefits.

Meaningful EMR Use

The concept of "meaningful use" of an EMR originated from a report put out by the U.S. Department of Health and Human Services (2010). It outlined a program for financial compensation for EMR usage called the Health Information Technology for Economic and Clinical Health Act (2009). In order to access this staged funding, and to avoid penalties, physicians needed to meet three stages of meaningful use by 2015. Stage 1 criteria involved "electronically capturing health information in a structured format" (U.S. Department of Health and Human Services, 2010, p. 44321). Stage 2 criteria involved "expand[ing] upon stage 1 criteria to encourage the use of health IT for continuous quality improvement at the point of care and the exchange of information in the most structured format possible" (U. S. Department of Health and Human Services, 2010, p. 44321). Stage 3 criteria required the following:

> Focus on promoting improvements in quality, safety, and efficiency leading to improved health outcomes, focusing on decision support for national high priority conditions, patient access to self-management tools, access to comprehensive patient data through robust, patient centered health information exchange and improving population health. (U. S. Department of Health and Human Services, 2010, p. 44322)

Canada has also created a program to utilize funding geared towards enhancing EMR solutions, called Electronic Medical Records and Integration (Canada Health Infoway, 2014). This program used Clinical Value Levels to outline EMR capabilities. Clinical Value Level 1 includes using the EMR to "enter patient demographics; record encounters, problem lists, allergies, immunizations; record and print prescriptions; generate alerts and reminders; and receive laboratory tests" (Zucker, 2011, para. 4). Clinical Value Level 2 focused on interoperability of electronic prescribing with established drug information systems in place in many provinces and territories.

In the past few years, Alberta has surged ahead of other provinces in Canada and greatly increased the number of family practice clinics operating an EMR. One private, unpublished study by POSP reported a 79.4% EMR adoption rate among general family physicians (D. Sheplawy, personal communication, January 29, 2013). However, this study simply asked the question of whether or not the physician's office owned and operated EMR software. It did not ask any questions regarding how much it was being used, what and how data were being captured, nor did it assess the meaningfulness of the use. The use of an EMR is a vast spectrum of greys that must be defined, if it is going to be studied.

Measurement. The standard scale for measuring clinical meaningfulness of EMR usage is Healthcare Information and Management Systems Society (HIMSS) analytics. This scale was first developed to measure EMR use in hospitals in the United States, but

has also been applied in hospitals in Canada (HIMSS Analytics™, 2015a). There are seven stages of use, with the higher the number being a more advanced level of use. The questionnaires to produce these results are not available to the public, but the can be viewed on the HIMSS Analytics™ (2015b) webpage (www.himssanalytics.org/stagesGraph.asp).

There are few existing studies that have examined the actual level of EMR usage in family practice clinics, but researchers' estimates suggest EMRs are being utilized at only a fraction of their potential capacity. Despite Canada's good intentions to increase the number of physicians using EMR systems, Dermer and Morgan (2010) claimed that only 14% of those physicians are using their EMRs to capture data in a meaningful way.

One would expect to also see research documenting EMR implementation failure rates in family practice offices, but repeated searches by this researcher did not yield any results. The researcher's experience working in a family practice clinic, and in speaking to others in the same position, leads her to arrive at the conclusion that when EMR implementations go wrong in a family practice clinic, physicians and clinic managers are simply not in a financial position to declare an adoption a "failure" and walk away from it. Instead, they simply must bear with the situation because they have invested too much money to go back (Cramer, 2010, p. 30). These clinics will achieve only a low "stage" of EMR use.

Researchers at the eHealth Observatory at the University of Victoria in British Columbia adapted the HIMMS analytics scale used in hospitals in the United States and Canada in order to be used in family practice clinics (Price, Lau, & Lai, 2011). This scale measures meaningful EMR use in stages from 0–5 (see Table 1). Throughout this paper,

the terms meaningful use, stage, and level of EMR use will be used as interchangeable concepts.

Table 1

eHealth Observatory's Meaningful EMR Use Stages

Stage	Cumulative Capabilities
0	Traditional paper-based practice.
1	Electronic reference material, but still paper charting.
2	Partial use of computers at point of care for recording patient information.
3	Computer has replaced paper chart.
4	Advanced clinical decision support in use, including practice level reporting.
5	Full EMR interconnected with regional/community hospitals, other practices, labs and pharmacies for collaborative care.

Price et al. (2011) organized their scale into 10 functional categories: Health Information, Laboratory Management, Diagnostic Imaging, Prescription Management, Referrals, Decision Support, Electronic Communication & Connectivity, Patient Support, Administrative Processes, and Reporting and Population Health Management.

The only research found applying this same staging tool was a case study reported by Price et al. (2011) that was performed in a full-service family practice clinic in rural British Columbia documenting their stage of EMR use at two months after adopting an EMR, and then a follow-up at eight months post-adoption (see Figure 1). The data showed that from month two to month eight there was an EMR stage increase from 2.17 to 2.87. However, not all categories had equal improvement. The greatest improvement was in practice reporting and reflection.

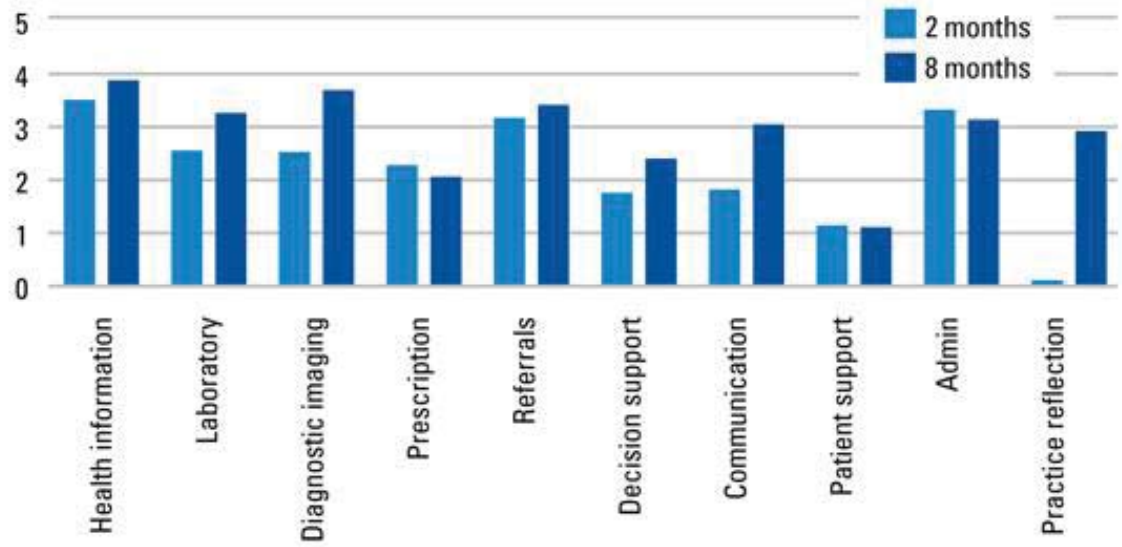

Figure 1. Differences in EMR adoption assessments of one case study clinic at two and eight months post EMR adoption measuring several aspects of EMR functioning.

Note. From "Measuring EMR adoption: A framework and case study" by M. Price, F. Lau, and J. Lai, 2011, *Electronic Health Care, 10*(1), p. e26. Copyright 2011 by Longwoods.

It is important to note that in order to attain a Level 5 there needs to be certain provincial infrastructure in place. For example, if there is no provincial repository for prescription information and no system for e-prescribing, there is a ceiling effect that keeps a clinic at a Level 4 until such a time that those larger provincial systems are available.

It was only after this researcher had undertaken her study using the above-described measurement tool when the HIMSS Analytics™ (2015b) website released a set of results for a questionnaire based on an ambulatory or clinic-based EMR. Like the other HIMSS Analytics™ measurement tools, the actual questionnaire itself is not available for the public, but the results can be viewed on the HIMSS Analytics™ website (www.himssanalytics.org/emram/index.aspx).

Theoretical Framework

The main theoretical framework for this study is based on the work of Klein and Sorra (1996) and their Innovation Implementation Model.

Innovation implementation model. Katherine Klein and Johann Sorra coined the term of Innovation Implementation in their seminal work "The Challenge of Innovation Implementation" published in 1996. Since their model focused on "innovations that require the active and coordinated use of multiple organizational members to benefit the organization" (Klein & Sorra, 1996, p. 1057), this model is appropriate to use when assessing EMR implementations (see Figure 2).

There were some basic definitions Klein and Sorra (1996) used in their model that were slightly different than the typically understood meanings. Klein and Sorra defined Innovation Adoption as "a decision, typically made by senior organizational managers, that employees within the organization will use the innovation in their work" (p. 1055). In contrast, they defined Innovation Implementation as "the transition period during which targeted organizational members ideally become increasingly skillful, consistent, and committed in their use of an innovation" (Klein & Sorra, 1996, p. 1057). Implementation Failure is said to occur when "employees use the innovation less frequently, less consistently, or less assiduously than required for the potential benefits of the innovation to be realized" (Klein & Sorra, 1996, p. 1055). More and more, they claimed, it is the implementation of the innovation that is to blame for failures, not the innovation itself.

Climate for implementation. When describing the climate in an organization during the implementation of a specific innovation, Klein and Sorra (1996) referred to "a

targeted employees' shared summary perceptions of the extent to which their use of a specific innovation [would be] rewarded, supported, and expected within their organization" (p. 1060). In order to gain a positive climate for implementation, Klein and Sorra scoured existing literature and found several techniques, policies and practices that may influence how an innovation is used. Techniques included adequate training, user support, time for users to experiment with the innovation, and praise from supervisors for innovation use. Policies included constraints on budgetary expenses during implementations, job reassignment, or even job elimination for employees who did not learn to use the new innovation (Klein & Sorra, 1996).

Klein and Sorra (1996) applied a three-pronged approach to foster a strong implementation climate by "(a) ensuring employee skill in innovation use, (b) providing incentives for innovation use and disincentives for innovation avoidance, and (c) removing obstacles to innovation use" (p. 1060). Klein, Conn, and Sorra (2001) validated the concept of climate for implementation in their study when it came to management support, financial resource availability, policies and practices, and overall climate. The validation study conducted by Holahan, Aronson, Jurkat, and Schoorman (2004) found that climate for implementation is a key predictor for implementation effectiveness, especially when measured as a quality of innovation use and consistency of use. They also found that an organization's receptivity towards change was an important antecedent of climate (Holahan et al., 2004). Osei-Bryson, Dong, and Ngwenyama (2008) discovered an unexpected finding utilizing a data analysis method called the multivariate adaptive regression splines technique, which is "a technique used for discovering, evaluating, and describing the causal links between factors in any theoretical model"

(p. 510). Osei-Bryson et al. discovered that managers have the ability to manipulate both the Implementation Climate and the Innovation-Values Fit in order to achieve innovation implementation. The proposed causal links in Klein and Sorra's (1996) innovation implementation model is discussed below (see Figure 2).

Ensuring that a climate for implementation exists in family practice clinics refers to employee perceptions of the practices, procedures, and behaviours that get rewarded, supported, and expected with regard to the use of EMRs. An example of this is when members of clinic staff are consistently informed about new updates to the technology, software, and changes to the workflow (i.e., mean emphasis). These actions help maintain their interest about why they should care about the system by making it feel like "their" system (i.e., goal emphasis). Task Support empowers them by giving them the tools to keep them up to date with training, and Reward Emphasis serves as a reward system and cause employees to be extrinsically motivated to use the system better.

Innovation-values fit. Klein and Sorra (1996) also hypothesized that "employees' commitment to the use of an innovation is a function of the perceived fit of the innovation to employees' values" (pp. 1062–1063). They also state that "innovation-values fit describes the extent to which targeted users perceive that use of the innovation will foster (or conversely, inhibit) the fulfillment of their values" (Klein & Sorra, 1996, p. 1063). As mentioned above, Osei-Bryson et al. (2008) found evidence that managers have the ability to manipulate Innovation-Values Fit in order to improve the implementation of innovations. An unexpected finding was that there was the influence of innovation-values fit on implementation effectiveness. These researchers stated that high Innovation-Values Fit helped users to obtain better skills, perceive less obstacles,

and feel more motivated while using the system. One explanation for this was that if users felt that the innovation would help them solve their work-related problems, they would internalize the benefits of the system. They would, therefore, be more open to learning about and mastering the system, thus becoming more intrinsically motivated. Dong, Neufeld, and Higgins (2008) replicated these findings in their study.

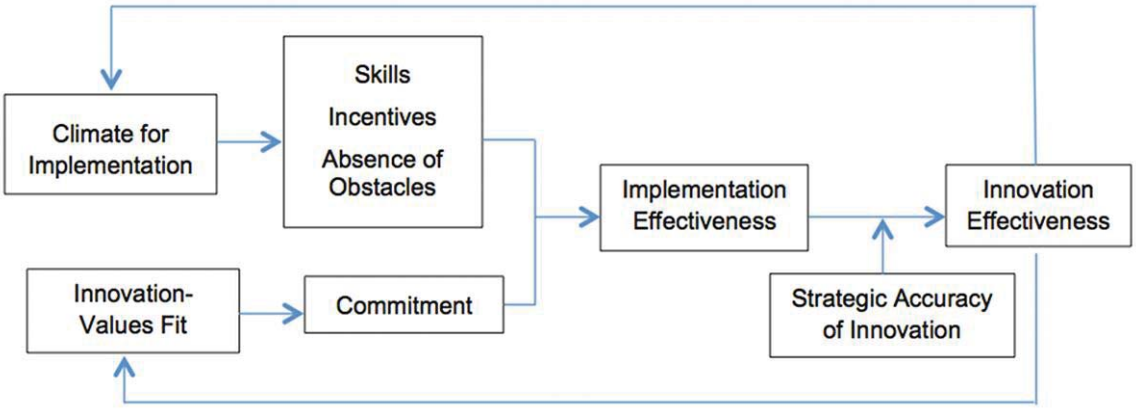

Figure 2. Klein and Sorra's Model: Determinants and Consequences of Implementation Effectiveness.

Note. From "The Challenge of Innovation Implementation," by K. J. Klein & J. S. Sorra, 1996, *Academy of Management Journal, 21,* p. 1056. Copyright 1996 by Klein & Sorra. Reprinted with permission.

Skills, incentives, absence of obstacles and commitment. If the family practice clinic can establish an Implementation Climate and ensure an effective Innovation-Values Fit, the presence of these things can help to facilitate enhanced Skills (e.g., a higher-order understanding of the EMR, and how some parts of the EMR system link with other parts of the system); facilitate the Absence of Obstacles (e.g., identifying and removing organizational or technical barriers for using the EMR system); ensure Incentives (e.g., determining if employees are discouraged or motivated to use the EMR system); and facilitate employee Commitment (e.g., seeks to understand if employees attach

personal meaning to the EMR system, and if they enjoy mastering it and discussing it with other colleagues).

Implementation effectiveness. The combination of the above stated measures can lead to Implementation Effectiveness. In this state, employees choose to use the system given the opportunity, and feel it is a valuable addition to the work practices of the organization.

Strategic accuracy of innovation. In their original article, Klein and Sorra (1996) did not mention "strategic accuracy of innovation" (p. 1056) outside of the diagram of the actual model. In a correspondence with K. Klein (personal communication, November 28, 2012), the researcher was told that this measure indicated whether the innovation was actually appropriate for the organization. However, Klein stated that this measure has not been empirically tested, as there is currently no "formal" measure for doing so. It is for this reason that this researcher decided to exclude this from her conceptual framework.

Innovation effectiveness. The final measure of Klein and Sorra's (1996) model titled Innovation Effectiveness (p. 1056) is intended to be measured by a scale assessing the level of use for the innovation under study. Therefore, in this case, this researcher chose to apply Price et al.'s (2011) measure of Meaningful EMR Use into this portion of the model. The measure of Meaningful EMR Use looked at the extent to which clinics optimize the capabilities of their EMR system.

Chapter Three: Research Design

Research Objectives

The primary research objective for this study was to assess meaningful EMR use in family practice clinics across the Province of Alberta. In conducting this project, this researcher did the following:

- Applied the Klein and Sorra (1996) model for innovation implementation to understand the importance of developing a climate for implementation with EMRs in family practice clinics.
- Explored the Implementation Climate and the level of Meaningful EMR Use that existed within family practice clinics in the province of Alberta.
- Examined the importance of innovation values fit in achieving meaningful EMR use.
- Provided family practice clinics with a measure with which they could gauge the extent of EMR use.

Research Hypotheses

The following hypotheses guided this research study:

- Hypothesis 1: In the family practice clinics under study, there is a positive relationship between Implementation Climate and Meaningful EMR Use.
- Hypothesis 2: In the family practice clinics under study, there is a positive relationship between Innovation-Values Fit and Meaningful EMR Use.
- Hypothesis 3: The stronger the implementation climate for a given innovation (i.e., EMRs), the greater employees' use of that innovation (i.e., meaningful EMR use), provided there are high levels of commitment.

- Hypothesis 4: Some of the barriers to EMR use identified in the literature will also be found in the present study (e.g., lack of training and support).

Research Design

The research consisted of a pilot study followed by a quantitative study. The full survey for Meaningful EMR Use can be found in Appendix A along with the Letter of Informed Consent (see Appendix B).

Phase I: pilot study. The researcher first conducted a pilot study to assess the overall data collection process including the online survey instrument. The researcher was interested in assessing the time it would take to complete the survey, the flow of questions, wording, and to ensure face and content validity.

The pilot study consisted of a convenience sample of five participants ($n = 5$) from one single physician family practice clinic, which was the primary place of employment of the researcher. The sample included one family practice physician, one receptionist, one registered nurse, and two medical office assistants. To avoid conflict of interest, this pilot study data was not included in the final analysis. The setting, sample, instrument and measures, and methods for data collection and data analysis were similar to what is described below in Phase II, only differing in the means for recruitment and the sample size. The researcher chose this clinic because in November of 2010 this clinic switched EMR systems, moving from the EMR Clinicare to the EMR Telus Med-Access. In addition, the clinic voiced support for the study and agreed to participate.

The pilot study participants were asked to complete the online survey and then provide feedback on their experience with the survey. Some of the feedback received pointed to a few missing commas, misspelled words. It was also reported that the survey

was quite long. In addition, Question 10 originally reading, "Is your clinic a Family Care Clinic (FCC)," was confusing to the respondents. They mistakenly identified their primary care network (PCN) clinic as a family care clinic (FCC). Question 10 was then changed to, "Is your clinic a Family Care Clinic (FCC)? (Definition: An FCC is one of the 24 facilities announced for creation throughout Alberta by [former] Premier Alison Redford in June 2013. A clinic cannot be both a PCN facility and an FCC facility)." The researcher did not conduct statistical analysis of the pilot study data due to the small sample size.

Phase II: Quantitative survey. The changes suggested by the participants in the pilot study were made. Next, a quantitative survey was conducted.

Setting. The setting for this study involved family practice clinics within the industry of health care in the Province of Alberta. According to a representative at POSP, at the time the study was conducted, there were approximately 845 family practice clinics and 2,895 family practice physicians in Alberta (D. Sheplawy, personal communication, March 24, 2013). Within this number, approximately 2,300 of these physicians used an EMR system (D. Sheplawy, personal communication, January 29, 2013).

Family practice clinics serve as a first point of contact for the public entering the health care system. Family doctors are held as the most responsible person to create and maintain a patient's health care record over the years. Patients go to their family doctor for episodic care such as infections, intermittent care such as prenatal care, and chronic care such as diabetes and hypertension management. They also manage patients who have complex multiple conditions, and those who are on multiple continuous prescriptions. The responsibility for regular screening for things like breast, colon, and

cervical cancer, as well as several other diseases and conditions also falls on the shoulders of the family physician.

Some clinics in this research had only the reception staff and one physician, while others had a number of multidisciplinary staff members (e.g., dieticians, physiotherapists, registered nurses, etc.). In addition, some clinics were members of the PCN and some were funded through POSP while others were not. Regardless of these factors, participants had only to fulfill the criteria of working in a family practice clinic in Alberta that had some sort of EMR system currently in place.

Sample. At the organizational level of analysis, there were approximately 845 (N = 845) family practice clinics in Alberta and 2,895 family practice physicians. Assuming one assistant per physician, the researcher aimed to recruit 338 (n = 338) participants in order to have a 95% CI, or n = 247 to have a 90% CI. Due to unexpected recruitment difficulties, the researcher was only able to recruit 139 participants (41% success rate) during the 8-month period that she attempted to collect data.

Inclusion criteria involved clinics located within any one of the five zones within Alberta Health Services (refer to Appendix C: Alberta Health Services Zone Map) who currently had an EMR system in place (e.g., Telus Wolf, Practice Solutions, Telus Med-Access, etc.). The researcher attempted to acquire data from PCN and non-PCN clinics as well as POSP and non-POSP clinics.

Data collection method. Study participants were recruited through convenience sampling. The researcher chose to apply a quantitative method to this study through the use of an online survey. The following steps were applied for data collection:

Step 1: Recruit participants. A faxed letter to inform (i.e., Call for Participants) was the primary means for recruiting participants (refer to Appendix D). This faxed letter was sent to all physician clinics in the Province of Alberta; a list that was acquired from the College of Physicians and Surgeons website. Of the 845 family practice clinics listed on the College of Physicians and Surgeons of Alberta (n.d.) website, 802 clinics had fax numbers, and 43 did not. The researcher sent faxes to each of the 802 clinics with fax numbers, and sent paper copies to the other 43 clinics. One month later, the letter was faxed again to those clinics who had not yet responded. Realizing that this population was quite difficult to access, the researcher decided to employ other strategies to acquire participants. The researcher networked with her professional contacts across the province. A call for participants was put in both the Primary Care Initiative and Alberta Medical Association's monthly electronic newsletter. There was a notice to POSP employees, a post placed on a professional networking site, Yammer (2015), and a message sent out to the Alberta Screening and Prevention Improvement Facilitators Network group (AS@p). Finally, some cold calls were done to clinics in specific health care zones in which limited interest was shown initially. Through various efforts, 47 clinics responded with interest to participate in the survey. Of those 47 clinics, 44 ultimately did complete the survey, which provided a clinic participation rate of 93.6%. In looking at the response rate of 44 clinics out of the total 845 clinics in the province, the response rate is 5.2%.

Step 2: Secure participants and distribute memo to inform. During the recruitment process (i.e., in the Call for Participants letter; see Appendix D), interested subjects were asked to contact the researcher directly for further information. Once participants emailed the researcher to express their interest, the researcher then emailed them the Description

of Research Study (see Appendix E). The most crucial part to the smooth progression of the data collection process was that the participants followed the instructions on the Call for Participants. The participants were asked to include the name of their clinic and the city or town name so that the researcher could generate a clinic code, which was used to keep all clinic specific data together. If a participant emailed their interest without including these details, the researcher responded with an email requesting this information. The intent in following this procedure was that the researcher could produce customized reports for participating clinics and provide a more thorough analysis at the level of the organization. This was a preferable method because it would avoid the potential for entry errors that would compromise the integrity of the data set. If a participant had concerns about providing this information, it was stressed that only the researcher would have the master list of which clinics belonged with which clinic codes, and that this information would remain private and in a secured location known only to the researcher and her supervisor.

Step 3: Distribute letter of consent with customized survey link. Once participants were confirmed, the researcher then followed up with an email that contained the Letter of Informed Consent (see Appendix B), and another email containing a customized link to the online survey. In the body of this email, the researcher asked the participant to complete the survey within a two-week time frame. The participant was encouraged to tell others who would also qualify for the research (family physician with an EMR). If the participant knew of other people in another clinic who would like to participate, the individual was asked to email the researcher with the name of the new clinic and the city or town to ensure the new clinic had a code in order to complete the survey.

The call for participants was almost always responded to by the clinic manager. Acting as a point person, the manager emailed the researcher to express interest in having their clinic participate. The manager then inquired amongst staff members of their clinic as to who wanted to participate, and then provided a list of email addresses to the researcher. The researcher registered the participants in the database using SurveyMonkey® (2015). She then emailed each of the participants individually with a unique link to the online survey, as well as the document Description of Research Study found in Appendix E. If a participant had not responded to their unique link within a 2-week time period, a reminder email was sent.

Step 4: Participants complete the survey. The online survey was completed by the participants using SurveyMonkey® (2015), which is a web survey development cloud-based company. When participants clicked on the survey link provided to them and completed the survey, the data were automatically compiled into the online database. The survey took approximately 25 minutes to complete (refer to Appendix D for survey questions). Of the 194 participants emailed from within the 44 (n = 44) participating clinics, 139 (n = 139) completed the survey, providing a response rate of 72% (attrition rate of 28%). The researcher chose to analyze the data at two levels of analysis: the clinic or organizational level (n = 44) as well as the individual level (n = 139).

Data collection experience. Upon reflecting on the process of recruitment and data collection, several challenges, limitations, and strengths were discovered that merit discussion. These items are discussed in the following section.

Challenges and limitations. In general, the researcher experienced many difficulties in accessing this population. The researcher had to be quite persistent with

those clinics and individuals who had agreed to participate in order for them to follow through to completion.

Having a unique link sent to each participant was found to be a detriment to participation. There were times that a participant wanted to "send the link" to their colleague. Instead, the researcher had to get the email address of the colleague and go through the SurveyMonkey® (2015) registration process in order to have the new individual participate. As a result, some participants expressed hesitancy to complete the survey because their responses were going to be temporarily connected to their email addresses. The reason for this process was clearly explained to the participants in the "Description of Research Study" document (see Appendix E), but nevertheless this remained a factor for some participants.

The researcher found that in speaking with health care leaders at a program planning level there was great interest in and support for the study, and many expressed a desire to participate; however, because they did not work at a clinic level, they did not fit the criteria, and could not participate. These people would try to recruit down to specific clinics they worked with, but this method didn't yield any new participants. This spoke to the difficulty of getting those at a clinic level to participate in practice assessment, even when they were invited by their direct leaders.

It was also challenging to recruit several employees from one clinic. Most times, a clinic had less than five people participating, and many times only the clinic manager completed the survey. This was an unexpected phenomenon. The researcher did emphasize that there would be a benefit to the clinic if there were many participants,

since participating clinics would receive a customized report with a summary of findings. However, this did not sufficiently motivate the target group.

The length of the survey deterred many from participating. There were several participants who didn't finish the entire survey in their first session. These people usually did not return on their own to finish it, and reminder emails ad to be sent requesting the participants to complete the survey.

Strengths. Many of the people contacted throughout the process were pleased that research was being done in this area, and expressed a desire to view the results once the study was complete.

Although the unique links and registration process made it difficult to recruit participants, knowing a participant's clinic opened up interesting possibilities for analysis that would not otherwise exist. The registration process also allowed for a very accurate calculation of participation rates. The length of the survey, though identified as one of the challenges to recruitment, allowed for a comprehensive view of the study topic.

Instrument and measures. The survey instrument used in this study included well-established measures borrowed from the literature, and a recently developed measure borrowed from industry. The well-established (scholarly) measure was the Klein and Sorra (1996) 50-item measure for assessing innovation implementation (i.e. Innovation Implementation Model). The industry measure was developed by Price et al. (2011), and was a 30-item EMR adoption survey measure (Meaningful EMR Use). In addition, some demographic questions were included that assessed attributes of participants' clinics (including number of general practice physicians and number of non-physician health care employees in the clinic), and personal demographics such as age

and gender. By asking these questions, the researcher hoped to explore the relationship between innovation implementation and meaningful EMR use as it related to employee composition, age, and gender. The survey instrument contained a total of 80 questions and 20 demographic questions with an estimated completion time of 25 minutes.

Klein and Sorra's innovation implementation model. The content validity of the Innovation Implementation Model and its measures came from its long-established use in several studies across several sectors. Construct validity was also shown by the established reliabilities between $\alpha = 0.78$ to 0.92 reported in the literature. The first 50 items came directly from Klein and Sorra's (1996) Innovation Implementation questionnaire, and were categorized according to the following measures: Implementation Climate, Innovation-Values Fit, Skills, Absence of Obstacles, Incentives, Commitment, and Implementation Effectiveness. Factor analyses were conducted for all of these measures, and are included in the Appendix G with a sample presented in Table 2.

Table 2

Innovation Implementation Items

Variable	Questionnaire Item	Description
Implementation Climate	17 items; 14a–14q	• Mean Emphasis 14a–14c • Goal Emphasis 14d–14f • Task Support 14g–14l • Reward Emphasis 14m–14q
Innovation-Values Fit	13 items; 15a–15m	• Quality 15a–15f • Locatibility 15g–15j • Flexibility and Coordination 15k–15m
Skills	6 items; 16a–16f	
Absence of Obstacles	3 items; 17a–17c	
Incentives	2 items; 18a–18b	

Variable	Questionnaire Item	Description
Commitment	4 items; 19a–19d	
Implementation Effectiveness	5 items; 20a–20e	

Implementation Climate assessed "employees shared summary perceptions of the extent to which their use of a specific innovation is [would be] rewarded, supported, and expected within their organization" (Klein & Sorra, 1996, p. 1060). This 17-item measure (Cronbach's $\alpha = 0.90$) was based on the work of Kopelman, Brief, and Guzzo (1990) and Dong et al. (2008), and included the sub-measures of Mean Emphasis, Goal Emphasis, Task Support, and Reward Emphasis. Items were assessed in a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Higher scores were indicative of higher levels of implementation climate.

- Mean emphasis: These three items (14a, 14b, 14c) focused on the extent to which employees are made aware of methods and procedures. An example item was "Employees were told about the changes in the work procedures due to the implementation of the system."
- Goal emphasis: These three items (14d, 14e, 14f) focused on goal emphasis, which is the extent to which employees are made aware of outcomes and standards. An example was "Employees were told the types of outcomes that they needed to accomplish in using the system."
- Task support: These six items (14g, 14h, 14i, 14j, 14k, 14l) focused on how much employees felt they were being supported and supplied with necessary resources to do their jobs, including equipment, services, and training. An

example item was: “Employees were given sufficient time to learn the new system before they had to use it.”

- Reward emphasis: These five items (14m, 14n, 14o, 14p, 14q) sought to understand employees’ perceptions on the connection between job performance and organizational rewards. An example item was: “Employees were told the potential risk if they did not use the new system.”

A factor analysis with Varimax rotation converged in six iterations and yielded four factors with an eigenvalue greater than 1.00 that explained 74.3% of the variance (Cronbach’s $\alpha = 0.91$). Attempting to categorize the components, the researcher discovered that the yielded groupings were inconsistent and ambiguous and some items were loading on multiple components. These items (items g, l, and m) were removed. From here a second factor analysis was run using Varimax rotation, which converged in five iterations and explained 72.63% of the variance. Although the reliability was slightly lower (Cronbach’s $\alpha = 0.89$), there was much more clarity to these categorizations. The researcher identified these categories as employee awareness (items 14a, 14b, 14c, 14d, 14e, 14f), which assessed the degree to which employees are aware of the methods, procedures, and expectations when using the system (six items; Cronbach’s $\alpha = 0.93$). The next component that emerged focused on external rewards (14n, 14o, 14p, 14q), which looked at employees’ perception of the evaluation of their performance and recognition of effort (four items; Cronbach’s $\alpha = 0.89$). Finally, there was a component featuring training and support (items 14h, 14i, 14j, 14k), which spoke of the resources available to employees in order to further their knowledge and skill in operating the EMR

(four items; Cronbach's α = 0.80). A complete set of factor analyses are found in Appendix G.

Innovation-Values Fit assessed "the extent to which targeted users perceive that the use of the innovation will foster (or conversely, inhibit) the fulfillment of their values" (Klein & Sorra, 1996, p. 1063). This measure contained 13 items (Cronbach's α = 0.92), which were divided into the following three sub-dimensions: Quality, Locatibility, and Flexibility and Coordination. Dong et al. (2008) developed this 13-item construct based on research by Goodhue and Thompson (1995), and Valle, Martin, Romero, and Dolan (2000). The sub-measures are explained as follows:

- Quality: This sub-measure contained six items and assessed the extent to which information was current, up to date, and useful.
- Locatibility: This four-item sub-measure assessed how easy it was to locate the desired information. Some wording was modified in this item to better suit the context of family practice clinics.
- Flexibility and Coordination: This final sub-measure consisted of three items and assessed the extent that the system enhanced the work process. This researcher changed the wording from "departments" to "departments or working groups" to make it more appropriate for family practice clinics.

A factor analysis with Varimax rotation produced two components with an eigenvalue greater than 1.00 that explained 62.4% of the variance. The rotation converged in three iterations, Cronbach's α = 0.92. The researcher attempted to group components in a more distinct way by forcing number of components to be in line with the literature (i.e., three components). However, the explanation of variance did not

improve, and some components continued to load onto multiple components. Refer to Appendix G for detailed factor analysis matrix.

The six item Skills measure (Cronbach's $\alpha = 0.90$), was developed by Dong et al. (2008). These authors partially based this item on training material from an enterprise system vendor, and sought to discover if a user had a higher-order understanding of the EMR, and how some parts of the EMR system linked with other parts of the system. An example item was, "I am very knowledgeable about how the system works." A factor analysis produced one component (Cronbach's $\alpha = 0.84$) with an eigenvalue greater than 1.00 that explained 56.25% of the variance. As only one component was extracted, the solution could not be rotated. An example of the factor analysis for this item is shown in Table 3. A complete set of factor analyses are provided in Appendix G.

Table 3

Factor Analysis for Skills

Items: Skills	Component
16d. I know how data in my work group links to data in other work groups.	0.83
16e. I know which work groups receive the information I input into the system.	0.77
16b. I understand all of the special features of the system.	0.76
16a. I am very knowledgeable about how the system works.	0.75
16f. I can interpret the data shown in the system without problems.	0.73
16c. I can enter into the system whenever I need to.	0.65

Note. Extraction Method: Principal Component Analysis; 1 component extracted; Cronbach's $\alpha = 0.84$; Eigenvalue = 3.38; % Variance = 56.25%.

The three-item Absence of Obstacles scale (Cronbach's $\alpha = 0.83$) was created by Dong et al. (2008). This scale was based on Klein and Sorra's (1996) definition to assess if the use of a computerized system was being supported or blocked. All items were

reverse-scored as stated in the literature (e.g., "Due to the lack of technical support, I have found the system difficult to use"). A factor analysis produced one component with an eigenvalue greater than 1.00 that explained 75.05% of the variance. Again, because only one component was extracted, the solution could not be rotated (α = 0.83).

The two item Incentives scale (Cronbach's α = 0.78) was created by Dong et al. (2008), and was based on the work Klein and Sorra (1996). This measure determined if employees were discouraged or motivated to use the EMR system. An example items was, "I am motivated to use the system." A factor analysis produced one component (α = 0.70), with an eigenvalue greater than 1.00 that explained 78.64% of the variance. Again, because only one component was extracted, the solution could not be rotated.

The four item Commitment scale (Cronbach's α = 0.84) was created by Dong et al. (2008) by adapting the measure of Meyer and Allen (1991). This item sought to understand if employees had begun to attach personal meaning to the EMR system, and if they enjoyed mastering it and discussing it with other colleagues. An example item was, "Using the system is personally meaningful to me." A factor analysis produced one component (Cronbach's α = 0.84), with an eigenvalue greater than 1.00 that explained 68.00% of the variance. Again, because only one component was extracted, the solution could not be rotated.

The five item Implementation Effectiveness scale was created by Dong et al. (2008) by adapting Klein et al. (2001). This measure explored if employees would choose to use the system given the opportunity, and if they felt it was a valuable addition to the work practices of the organization. Klein et al. (2001) originally developed three sub-measures for this scale as avoidance, endorsement, and quality of use. The corresponding

Cronbach's α were 0.68, 0.85, and 0.75, respectively, and 0.89 for the measure as a whole. However, in Dong et al.'s (2008) work there was no division into sub-measures. This researcher slightly modified the wording of one item to make it more relevant to family practice clinics - the word "plant" was replaced with "clinic." All five items in this scale were reverse-scored as shown in the literature. An example item was, "If I had my way, this clinic would go back to the old way and forget the system." A factor analysis produced one component measure (α = 0.88) with an eigenvalue greater than 1.00 that explained 70.47% of the variance. Again, because only one component was extracted, the solution could not be rotated.

Meaningful EMR use. There were 30 items with 10 dimensions that assessed EMR usage from a scale adapted from Price et al. (2011). The researcher modified some items to make them less wordy and to remove any reference to programs and tools used exclusively in the province of British Columbia, where the scale was created. The responses were placed on a continuum from 0 (zero) to 5, with zero representing minimal use and 5 representing high-stage and meaningful use. The original scale (eHealth Observatory, 2011) has 10 items in which there are blanks within the 0 - 5 range. According to the principal author, Morgan Price, "The gaps are intentional - we were not able to find realistic examples of that feature at that level" (M. Price, personal communication, November 13, 2012). This researcher adapted nine of these items to have full-scale range, leaving only one item without a fifth-range option. Up until Price et al.'s study, no validations had been performed on this scale and no assessments done beyond simple reporting (M. Price, personal communication, November 13, 2012), there were no established Cronbach's α values to report. Since this scale was not yet tested, this

researcher attempted to gain some content validity by consulting with those professionals working in physician offices to ensure that the tool appeared to measure what it set out to measure, and that the levels of use were realistic. Determining the reliabilities for the items and offering some initial quantitative content validity is a contribution to the literature made through this study by this author. The Cronbach's α for the full 30-item measure was α = 0.88. The 10 dimensions of the measure were as follows:

- Health Information: (three items; 21–23)
- Medications (four items; 24–27)
- Laboratory (two items; 28–29)
- Medical Imaging: (three items; 30–32)
- Referrals: (three items; 33–35)
- Decision Support: (four items; 36–39)
- Electronic Communication and Connectivity (three items, 40–42)
- Patient Support: (two items; 43–44)
- Administrative Processes: (four items; 45–48)
- Reporting and Population Health Management (two items; 49–50)

The three item Health Information measure was originally created by Price et al. (2011) to assess the level at which general patient information was being kept in the clinic. An example was "Where do you keep a patient's medical summary?" Response 0 (zero) read "I maintain a separate face sheet in the paper chart that I manually update." A response of 5 indicated, "as described above, (I use my EMR, which stores all my patient information in a structured form, e.g., Coded problem lists, drop-downs, pick lists, etc.), but the EMR also syncs summary data with a provincial electronic health record." A

factor analysis produced one component (α = 0.45) with an eigenvalue greater than 1.00 that explained 52.78% of the variance. As only one component was extracted, the solution could not be rotated. These numbers indicate that this is only a moderately reliable measure.

The four item Medications measure was originally created by Price et al. (2011) to assess the level at which medication information was being created and supported in the clinic. An example item was "How do you write new drug prescriptions?" A response of 0 (zero) stated "I write them on my RX pad and record them in the patient's paper chart," whereas a response of 5 was "I write them for all patients using my EMR which has an advanced RX module and is linked to a province wide ePrescription system that is linked to pharmacies." A factor analysis produced one component Cronbach's α = 0.64 with an eigenvalue greater than 1.00 that explained 52.86% of the variance. Since only one component was extracted, the solution could not be rotated.

The two item Laboratory measure was originally created by Price et al. (2011) to assess the processes for ordering and receiving lab tests in the clinic. An example was, "How do you receive, review, and process lab results?" A response of 0 (zero) stated, "Lab reports of tests I ordered (or were copied to me) are received in paper form by mail and/or fax and filed in the paper chart." However, a response of 5 corresponded to "All lab results I ordered (or were copied to me) are downloaded into my EMR, which also has a viewer to integrate and display all available lab data on a patient from multiple lab databases and hospitals." A factor analysis produced one component (Cronbach's α = 0.52) with an eigenvalue greater than 1.00 that explained 68.95% of the variance. As only

one component was extracted, the solution could not be rotated. These numbers indicate that this is only a moderately reliable measure.

The three item Medical Imaging measure was originally created by Price et al. (2011) to assess the processes for ordering and receiving medical imaging tests in the clinic. An example item was: "How do you order diagnostic tests?" (i.e., X-rays, U/S, MRI, PFT, stress tests, etc.). A response of 0 (zero) read, "I complete a paper requisition specific to each diagnostic center," whereas a response of 5 stated "I use an advanced diagnostic test requisition manager in my EMR that is securely linked to diagnostic test sites so that I can order, record and reconcile tests electronically. No paper requisitions are generated." A factor analysis produced one component (Cronbach's $\alpha = 0.22$) with an eigenvalue greater than 1.00 that explained 39.14% of the variance. These low numbers indicate that this is not a reliable measure.

The three item Referrals measure was originally created by Price et al. (2011) to assess the processes for ordering, receiving, and managing referrals in the clinic. An example was, "How do you make a referral?" A score of 0 (zero) stated, "I hand write the referral letter. My MOA arranges the appointment." A score of 5 claimed, "I use my EMR's referral manager, which is linked on a secure network with consultants located in private offices and/or hospitals. The consultant can view referral data when an electronic request is sent. Referral appointments can be made online within the network." A factor analysis with Varimax rotation produced two components (Cronbach's $\alpha = 0.09$) with an eigenvalue greater than 1.00 that explained 70.08% of the variance. This extremely low Cronbach's of 0.09 indicated that this was not a reliable measure, likely due to the large number of excluded responses (54%) in this item. The first component was identified by

the researcher as referral management, and included items 34 and 35. The second component was identified as referral requests, and consisted of only item 33.

The four item Decision Support measure was originally created by Price et al. (2011) to assess the extensiveness of the use of decision supports for patient care in several areas of clinical practice. One example was, "How are patient reminders (for follow-up and prevention) generated in your office?" A score of 0 (zero) corresponded to, "Manually: when I see a patient I record a follow-up in the patient's chart or I rely on my memory." A score of 5 stated, "I use an EMR with a rule-based reminder system that also leverages information on provincial and other external repositories to adjust rules (e.g., will confirm if patients have had immunizations from public health)." A factor analysis with Varimax rotation produced two components (Cronbach's $\alpha = 0.59$) with eigenvalue greater than 1.00 that explained 72.44% of the variance. There were 64.0% of responses excluded. The first component was identified by the researcher as reminder systems, and included items 38 and 39, Cronbach's $\alpha = 0.68$. The second component was identified as reference materials, and included items 36–37 (Cronbach's $\alpha = 0.24$). These numbers indicated that both the total measure, as well as the reminder systems component, were moderately reliable measures. However, the second component, reference materials, was not a very reliable measure.

The three items Electronic Communication and Connectivity measure were originally created by Price et al. (2011) to measure the integrity and accessibility of patient records both within and from outside the clinic. An example was, "How do you access your records while you are out of the office?" A score of 0 (zero) stated, "I cannot access information in my records while I am out of the office." A score of 5 indicated,

"As described above (I regularly access my EMR through a secure connection, e.g., by Remote Desktop, Citrix, or a secure website, but I can also access my EMR from the hospital." A factor analysis produced one component with an eigenvalue greater than 1.00 that explained 49.89% of the variance with Cronbach's $\alpha = 0.48$. These numbers indicated that this was only a moderately reliable measure.

The two item Patient Support measure was originally created by Price et al. (2011), and measured the level of support provided to patients through the use of different means of health information (e.g., information handouts). An example was, "How do you share the patient's own information with them?" A score of 0 (zero) indicated, "I do not provide patients copies of results." A score of 5 corresponded to, "Our EMR can send data to our patients' Personally Controlled Health Record. This is used by at least 10% of patients in the practice." A factor analysis produced one component (Cronbach's $\alpha = 0.29$) with an eigenvalue greater than 1.00 that explained 59.14% of the variance. As only one component was extracted, the solution could not be rotated. These low numbers indicated that this was not a very reliable measure.

The four item Administrative Processes measure originally created by Price et al. (2011) looked at the level of efficiency of administrative processes in the clinic. An example was, "How do you bill in the practice?" A score of 0 (zero) read, "I write my billings on paper and send them to a billing service OR I submit on paper." A score of 5 stated, "I use my EMR and it auto-populates the billing codes based on my notes in the patient chart. These can be edited and managed within the EMR." A factor analysis produced one component (Cronbach's $\alpha = 0.58$) with an eigenvalue greater than 1.00 that

explained 46.19% of the variance. These low numbers indicated that this was only a moderately reliable measure.

The two item Reporting and Population Health Management measure, originally created by Price et al. (2011), looked at the extent to which the clinic is capable of running customized reports and managing disease registries. An example item was, "How do you run reports or create recall lists in your practice?" A score of 0 (zero) said, "We do not. OR We have paper lists and calendars where we put recalls for mammograms etc. OR we rely on the provincial programs for recalls." A score of 5 claimed, "As described above (we have complex reports in our EMR that we use e.g., diabetics with A1C over 8% who haven't been seen in three months, and we create our own reports), but the report queries also include additional data from regional/provincial systems in some way." A factor analysis produced one component (Cronbach's $\alpha = 0.74$) with an eigenvalue greater than 1.00 that explained 79.45% of the variance. As only one component was extracted, the solution could not be rotated. These numbers indicated that this was a reliable measure.

Up until this time, the Meaningful EMR Use scale had not yet been established in the literature. This research study was the first to report reliability and variance statistics for each measure. Many of these tests showed low reliability (see Table 4), and this researcher recommends that further development to be done to improve the measure.

Table 4

Reliability and Variance for the measure of Meaningful EMR Use

Sub-Measures of Meaningful EMR Use	Cronbach's α	Components Extracted	% Variance Explained
Reporting and Population Health Management	0.74	1	79.45%
Medications	0.64	1	52.86%
Decision Support	0.59	2	72.44%
- Reminder Systems	0.68	-	45.62%
- Reference Materials	0.24	-	26.83%
Administrative Process	0.58	1	46.19%
Laboratory	0.53	1	68.95%
Electronic Communication and	0.48	1	49.89%
Health Information	0.45	1	52.78%
Patient Support	0.29	1	59.14%
Medical Imaging	0.22	1	39.14%
Referrals	0.09	2	73.64%
- Referral Management	0.08	-	40.01%
- Referral Request	-	-	33.63%

Note. EMR = Electronic Medical Record; Overall α = 0.88.

Demographics questions: About you. There were five questions in the personal demographics section that assessed role or position in the clinic, tenure or length of time working at the clinic, age, and gender. These questions provided some context to the responses and allowed comparisons to be made within the data.

Demographics questions: About your clinic. There were eight questions in the clinic demographics section that assessed different aspects of the clinic environment. A few examples were "In which zone is your clinic located," "Which EMR does your clinic use," and "Is your clinic part of a Primary Care Network?" These questions allowed potential correlations to be drawn between health care zones, between EMR systems, and

between funded or non-funded networks, and so forth. These questions also served to shed light on the duration of a clinic's use of an EMR and whether it correlated with its level of use, and so on.

Data analysis. The researcher conducted a variety of statistical analyses through the software program known as the Statistical Package for the Social Sciences (SPSS). Data were aggregated to allow for a comparison between measures. Descriptive statistics, ANOVA, pairwise correlations and multiple regression analyses were performed. The ANOVA was used to analyze the data to assess if there were statistically significant differences between (a) POSP versus non-POSP funded clinics, (b) primary versus non-primary care clinics, (c) the five health zones within Alberta, or (d) professions. For each of these categories, pairwise correlations were performed between Implementation Climate (14a–q) and Meaningful EMR Use, as well as Innovation-Values Fit (15a-m) and Meaningful EMR Use. The units for analysis of this study were at the organizational (e.g., family practice clinics) and individual (e.g., the various health professionals that responded) levels of analysis. As established in the literature, a total of 10 items were reverse-coded: 15b, 17a, 17b, 17c, 18a, 20a, 20b, 20c, 20d, and 20e.

Ethics. The research was conducted in accordance with the second edition of the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans* (Canadian Institutes of Health Research, Natural Sciences and Engineering Council of Canada, & Social Sciences and Humanities Council of Canada, 2010). As this study involved surveying human participants, ethics approval was attained prior to the onset of data collection. The researcher received approval from the Human Subjects Research Committee at the University of Lethbridge for this study. Finally, because the research

was conducted province-wide, the researcher also received ethical approval from the Community Research Ethics Board of Alberta. It also abided by principles of the Health Information Act, Freedom of Information and Protection, and Personal Protection Information Act.

Chapter Four: Discussion of Results

Demographics: Organizational Level of Analysis

The call for participants was sent to 802 family practice clinics throughout Alberta by fax and the remaining 43 by paper mail. A total of 44 clinics participated, yielding a 5.2% participation rate by clinic. From those clinics, there was a response range of 1 - 21 respondents per clinic, with an average of 3.2 respondents per clinic. Most clinics were part of a PCN (83.5%). FCCs accounted for 2.2%, and 14.0% were not sure. This is an interesting finding, suggesting that there were several clinic employees who were not aware of the health care delivery improvement programs being used in their clinics. As illustrated in Table 5, the majority of responding clinics were located in the Calgary Zone (*n* = 14, 31.8%), followed by the South Zone (*n* = 12, 27.3%).

Table 5

Most Common EMR by Health Zone

Zone	Frequency (No. of clinics)	Percent	Cumulative %	Most Common EMR (by No. of clinics)
North	3	6.8%	6.8%	Telus Wolf
Edmonton	6	13.6%	20.4%	Telus Med-Access
Central	9	20.5%	40.9%	Telus Med-Access
South	12	27.3%	68.2%	Telus Wolf
Calgary	14	31.8%	100.0%	Telus Wolf

There were a wide variety of EMR systems in place; however, the two most frequently used EMRs were Telus Wolf (*n* = 16, 36.4%), followed by Telus Med-Access (*n* = 15, 34.1%; see Table 6 for more detail). The majority had been using their system for a median of 3.0 years.

Table 6

Most Common EMR Programs by Respondent and Clinic

	Respondent			Clinic		
EMR	Total (n = 139)	Percent	Cumulative Percent	Total (n = 4)	Percent	Cumulative Percent
Telus Wolf	42	30.2%	30.2%	16	36.4%	36.4%
Telus Med-Access	52	37.4%	67.6%	15	34.1%	70.5%
Health Quest	16	11.5%	79.1%	4	9.1%	79.6%
Practice Solutions	9	6.5%	85.6%	3	6.8%	86.4%
Jonoke	12	8.6%	94.2%	2	4.5%	90.9%
Oscar	2	1.4%	95.6%	1	2.3%	93.2%
Telin	1	0.7%	96.3%	1	2.3%	95.5%
JET	4	2.9%	99.2%	1	2.3%	97.8%
Accuro	1	0.7%	100.0%	1	2.3%	100.0%

Note. EMR = Electronic Medical Record.

It was an interesting phenomenon that there was a convergence of EMR system distribution, with two systems emerging distinctly as the most common. There were several possible causal factors. Both of the most common EMRs, Telus Wolf and Telus Med-Access, were two of the three systems supported by POSP funding. This support would have increased the likelihood of clinics choosing to migrate to the supported EMRs because of funding, and because of the assurance that POSP-supported EMRs had met certain quality standards. The different EMR systems have a lot of variability in their capabilities to capture searchable data. There are also different levels of advanced features, including identifying a patient's interdisciplinary team, the ability to receive labs electronically, and having a reconciliation system in place for imaging, labs, and consults that have been ordered. As there is an increasing trend towards interoperability,

medical software companies who have the resources to accomplish this will naturally emerge as more commonly used.

Demographics – Individual Level of Analysis

Survey links were sent to 194 participants, of which 139 responded, which provided a 72% response rate (attrition rate 28%). Physicians made up the largest responding group (*n* = 30, 21.6%), followed by medical office assistants (MOAs; *n* = 29, 20.9%), nurses (registered nurses and licenced practical nurses; *n* = 23, 16.5%), and clinic managers (*n* = 17, 12.2%). Other roles were each made up of less than 6.0% of the responding population. The respondents were most likely to have worked at the clinic in the role indicated for one to five years (*n* = 73, 52.5%), and also to have worked at the clinic in any role for one to five years (*n* = 70, 50.4%). The majority of respondents were female (*n* = 119, 85.6%) and between the ages of 26–35 (*n* = 35, 25.2%). Of the five health zones, the largest number of responses came from the Central zone (*n* = 46, 33.1%).

The most common EMR system used among the respondents (refer to Table 6) was Telus Med-Access (*n* = 52, 37.4%), followed by Telus Wolf (*n* = 42, 30.2%), Health Quest (*n* = 16, 11.5%), and Jonoke (*n* = 12, 8.6%). The rest of the participants were distributed amongst five less common EMRs. The median for duration of use on their indicated EMR was 3.00 (between 3 - 4 years).

The majority of participants indicated that their clinic was part of a PCN (*n* = 116, 83.5%), and also that it was not a FCC (*n* = 117, 84.2%). POSP was currently, or had in the past, provided funding to just over half of the respondents' clinics (*n* = 80, 57.6%). Most clinics had two to five physicians (*n* = 50, 36.0%), and 11–20 non-physician health

care employees (n = 46, 33.1%). A sample of the frequencies of key demographics can be found in Table 7. Comprehensive tables for all demographics can be found in Appendix F.

Table 7

Summary of Demographic Information

Measure	Items	No.	%	Most Common EMR Use Duration
Role	Billing Clerk	4	2.9%	3–4 years (50%)
	Booking Clerk	5	3.6%	3–5+ years (50%)
	Change Management Advisor	1	0.7%	3–4 years (100%)
	Data Entry Staff	2	1.4%	3–4 years (100%)
	Interdisciplinary Educator	4	2.9%	0–5+ years (100%)
	Information Technology Specialist	4	2.9%	3–5+ years (50%)
	Licensed Practical Nurse	5	3.6%	3–4 years (60%)
	Manager	17	12.2%	3–4 years (41%)
	Medical Office Assistant	29	20.9%	3–4 years (45%)
	Nurse Practitioner	0	0.0%	N/A
	Physician	30	21.6%	5+ years (63%)
	Physician's Assistant	3	2.2%	5+ years (67%)
	Receptionist	4	2.9%	5+ years (67%)
	Registered Nurse	18	12.9%	5+ years (61%)
	Supervisor	5	3.6%	3–4 years (60%)
	Other	8	5.8%	3–4 years (43%)
Health Zone	Calgary	24	17.3%	5+ years (67%)
	Central	46	33.1%	3–4 years (63%)
	Edmonton	23	16.5%	3–4 years (48%)
	North	8	5.8%	1–2, 5+ (38%)
	South	38	27.3%	5+ years (73%)

Measure	Items	No.	%	Most Common EMR Use Duration
EMR	Accuro	1	0.7%	
	Health Quest	16	11.5%	
	Jonoke	12	8.6%	
	Oscar	2	1.4%	
	Practice Solutions	9	6.5%	
	Telus Med-Access	52	37.4%	
	Telin	1	0.7%	
	Telus Wolf	42	30.2%	
	JET	4	2.9%	
No. of Family Physicians	0	1	0.7%	
	1 doc	5	3.6%	
	2–5 docs	50	36.0%	
	6–10 docs	39	28.1%	
	11–15 docs	31	22.3%	
	16+ docs	13	9.4%	
No. of Employees	1–5 employees	22	15.8%	
	6–10 employees	30	21.6%	
	11–20 employees	46	33.1%	
	21–30 employees	16	11.5%	
	31+ employees	24	17.3%	
	No Response	1	0.7%	

Note. n = 139; EMR = Electronic Medical Record.

Descriptive Statistics

Descriptive statistics were performed on the demographic questions, measures from the Innovation Implementation Model and Meaningful EMR Use survey.

Innovation implementation model. Below is a brief summary of the descriptive statistics and frequencies from the Innovation Implementation Model. Comprehensive tables for all Innovation Implementation Model items can be found in Appendix G.

Implementation climate. The majority of respondents (*n* = 136) strongly agreed that they were provided with the computer technology (e.g. hardware, software) necessary to perform their tasks with the system (item 14g; M=4.35, SD=0.76). They also stated agreement about being told about work procedures (item 14a; M=4.19; SD=0.81) for using the system and changes in work procedures due to the implementation of the system and any subsequent changes or upgrades in the work flow (item 14b; M=4.16; SD=0.83). They stated agreement about being told about the methods for using the system (item 14c; M=4.17; M=0.78). However, respondents largely disagreed (n=110) that there were performance-based incentives (e.g. a bonus or a raise) in their workplace for using the system (item 14o; M=2.55; SD=1.25). They also disagreed with the statement that the more they knew about the system, the better their chances were of getting a job promotion (item 14n, M=2.70, SD=1.22). Cronbach's α measured in this research (0.91) for this scale was similar to the established statistic (0.90; Dong et al., 2008, p. 247). These findings suggest that employees perceive they have adequate resources for using their systems but performance based incentives are lacking.

Innovation-values fit. Most respondents (*n* = 136) agreed that their EMR system maintained their data at an appropriate level of detail in order for them to carry out their tasks (item 15d; M=4.07; SD=.78). There were mixed feelings towards whether or not the system was missing critical data that would be very useful to their tasks (item 15b; M=3.04; SD=1.16). Respondents also voiced uncertainty in deciding whether or not it

was easy to find out what data the systems maintained on a given subject (item 15i; M=3.53; SD=1.03), and whether it really helped them to understand the meaning of data easily (item 15j; M=3.53; SD=1.03). Cronbach's α measured in this research (0.92) was similar to the established statistic (0.93; Dong et al., 2008, p. 247). These findings suggest that the current data management capabilities in the respondents' EMRs are adequate for their needs.

Skills. Most respondents (*n* = 134) agreed that they were able to enter data into the system whenever they needed to (item 16c; M=4.13; SD=1.09). The weakest agreeable response indicated relative ambivalence towards the statement, "I understand all of the special features of the system" (item 16b; M=3.10; SD=1.09). Cronbach's α measured in this research for this scale (0.84) was somewhat similar to the established statistic (0.90; Dong et al., 2008, p. 247). These findings suggest that the respondents are able to sufficiently utilize the EMR for their regular tasks, but that these skills may not extend into an understanding of advanced features.

Absence of obstacles. All of the items in this scale were reverse coded. Most disagreed (*n* = 133) with the notion that there were organizational barriers that prevented them from using the system effectively (item 17c; M=3.92; SD=0.85). There was also slight disagreement with the idea that there was a lack of time, training (item 17a; M=3.60; SD=1.02) and technical support (item 17b; M=3.75; M=0.98). Cronbach's α measured in this research (0.83) was the same as the established statistic (Dong et al., 2008, p. 247). This information weakly suggests that there are no identified barriers to using their systems.

Incentives. Most people (*n* = 134) agreed that they were motivated (item 18b; M=4.28; SD=0.83) and not discouraged from using the system (item 18a; M=4.54; SD=0.58). Cronbach's α measured in this research for this scale (0.70) was lower than the established statistic (0.78; Dong et al., 2008, p. 247). In the current atmosphere, there is adequate motivation to utilize EMRs.

Commitment. There was a slight trend towards agreeing (*n* = 134) that the system was personally meaningful to them (item 14a; M=3.84; SD=0.90), and that they would enjoy discussing and mastering the system (item 19b; M=3.78; SD=1.01). The most ambivalent responses were associated with the statement, "I really feel as if the system is my system" (item 19c; M=3.30; SD=1.05). There were no items that indicated disagreement. Cronbach's α measured in this research (0.84) was the same as the established statistic (Dong et al., 2008, p. 247). This information suggests that, at best, there is some sense of commitment to the EMR systems (see Table 8).

Table 8

Descriptive Statistics and Frequencies for Commitment

Item		19a	19b	19c	19d
Strongly Disagree	No.	1	4	3	3
	%	0.7%	3.0%	2.2%	2.2%
Disagree	No.	8	7	30	21
	%	6.0%	5.2%	22.2%	15.7%
Neither Agree Nor Disagree	No.	37	40	47	35
	%	27.6%	29.9%	34.8%	26.1%
Agree	No.	54	46	34	49
	%	40.3%	34.3%	25.2%	36.6%
Strongly Agree	No.	34	37	21	26
	%	25.4%	27.6%	15.6%	19.4%

Item		19a	19b	19c	19d
Total		134	134	135	134
Missing	No.	5	5	4	4
	%	3.6%	3.6%	2.9%	3.6%
M		3.84	3.78	3.30	3.55
SD		0.90	1.01	1.05	1.04

Implementation effectiveness. All items in this scale were reverse coded. Respondents stated that they did not avoid using the system (item 20c; M=4.63; SD=0.54) and that whenever they could, they utilized the system to accomplish their tasks (item 20c and d; $M = 4.44$; $SD = 0.76$). Cronbach's α measured in this research for this scale (0.88) was almost the same as the established statistic (0.89; Dong et al., 2008, p. 247). This indicates that the implementations were effective and a good use of resources.

Meaningful EMR use. The following section explores the results of survey questions regarding the level of meaningful EMR use. Each item(s) of the sub-measures were rated on a scale of 1 to 6 with 1 being a lower level of meaningful use and 6 being a high level of meaningful use.

Recoding for meaningful EMR use. In the original research, responses were collected for physicians and MOAs only. There was a separate survey for each of these two groups; therefore all questions were applicable to all respondents. In the study performed by this researcher, it was desirable to obtain a richer data set from all professions found in a physician clinic environment. Roles of clinic staff tend to be fluid, and vary from clinic to clinic, and this researcher wanted to capture the entire span of experiences. The same survey was presented to all professions, with the understanding

that there would be several questions that were not applicable to all respondents. For example, it may not be applicable for a receptionist to respond to questions about the process for creating prescriptions, and it may be not applicable for a physician to respond to questions about scheduling or billing practices. Respondents were given instructions to mark the question as "not applicable" rather than to leave the question blank. In order to accommodate the analysis of this scale, it was necessary to re-code the responses (see Table 9). In order for the large number of appropriately identified "not applicable" responses to not skew the applicable responses, they were removed from the descriptive statistics analysis below using the SPSS function of "discrete missing values."

Table 9

Recoded Responses for Meaningful EMR Use Scale

Stage (Original Scale)	Stage (Recoded Scale)	Cumulative Capabilities
0	1	Traditional paper-based practice.
1	2	Electronic reference material, but still paper charting.
2	3	Partial use of computers at point of care for recording information.
3	4	Computer has replaced paper chart.
4	5	Advanced clinical decision support in use, incl. practice reporting.
5	6	Full EMR program interconnected with regional and community hospitals, other practices, labs and pharmacists for collaborative care.
	7– N/A	Item not applicable for respondent

Note. EMR = Electronic Medical Record.

Health information. The overall mean for the Health Information items was 4.68 (*SD* = 0.61). This was the item with the highest meaningful EMR use out of all

components in this measure. This placed the level of use between 4 and 5, and indicated that there is minimal variation between responses for how patient demographics and medical summary encounter notes are kept in the practice. The computer has replaced the paper chart for the recording of demographics, health summaries and patient visits, and there is capability for practice reporting. The distinguishing factor between achieving a level 4 or level 5 for this item was whether or not the demographics in the EMR were connected to an integrated billing system. See Table H1 in Appendix H for frequencies and descriptive statistics.

Medication. For this item, the overall mean was 4.13 (*SD* = 0.56). This again placed the level of use for medication between 4 and 5, and showed only minor variance among respondents. For the most part, prescriptions were found to be managed through the EMR's drug database, and there was some usage of decision support tools and capability for practice level reporting. See Table 10 for a sample of descriptive statistics and frequencies from the Meaningful EMR Use scale with focus on medications.

Table 10

Descriptive Statistics and Frequencies for "Medications" Item

Scale		Item 24	Item 25	Item 26	Item 27
1	No.	0	0	2	2
	%	0.0%	0.0%	4.2%	5.0%
2	No.	0	0	0	15
	%	0.0%	0.0%	0.0%	37.5%
3	No.	0	0	1	11
	%	0.0%	0.0%	2.1	27.5%
4	No.	29	10	24	9
	%	69.0%	24.4%	50.0%	22.5%
5	No.	11	27	21	2
	%	26.2%	65.9%	43.8%	5.0%

Scale		Item 24	Item 25	Item 26	Item 27
6	No.	2	4	0	1
	%	4.8%	9.8%	0.0%	2.5%
Total		42	41	48	40
N/A	No.	92	93	86	94
	%	66.2%	66.9%	61.9%	67.6%
Missing	No.	5	5	5	5
	%	3.6%	3.6%	3.6%	3.6%
M		4.36	4.85	4.29	2.93
SD		0.58	0.57	0.87	1.12

Laboratory. The overall mean for this item was $M = 4.10$, $SD = 0.79$, putting meaningful use for laboratory management between a level 4 and 5, and showing only minor variance among respondents. These numbers show that there was a lower use of EMR features when ordering labs compared to the processes for receiving, reviewing, and processing lab results. These findings indicated a lower capability to keep track of lab tests that have already been ordered. This could potentially lead to double-ordering, costing the health care system physician time as well as the resources of labs in order to reconcile the tests. With increased use, the organization of tests from the lab's side will hopefully support and promote increased tracking mechanisms from the clinic side. See Table H3 in Appendix H for frequencies and descriptive statistics.

Medical imaging. The overall use of EMR features related to medical imaging comes in slightly lower, between levels 3 and 4 ($M = 3.75$; $SD = 0.93$). These results show that viewing the actual images from scans is much less common in family practice clinics than reading an imaging report. However, physicians may feel that typed reports are sufficient for their decision making, and therefore may not have strong motivation for

developing image-viewing capabilities. See Table H4 in Appendix H for frequencies and descriptive statistics.

Referrals. Meaningful EMR use for referrals was between level 4 and 5, (M = 4.18), and fairly consistent among respondents (SD = 0.57). Interpretations must be made with caution however, since the Cronbach's alpha for this item was 0.09. These findings suggested a phenomenon opposite of that for ordering and processing lab tests. In this case, outgoing requests utilized more EMR functionality, and incoming reports were often still scanned from paper copies. This difference is in line with the fact that fewer specialist offices use EMRs when compared to family practice clinics. This makes it more likely that the results yielded from specialists are provided only in hard copy. See Table H5 in Appendix H for frequencies and descriptive statistics.

Decision support. There were lower levels of meaningful use found in decision support. Responses fell between level 3 and 4 (M = 3.45) and with a standard deviation of 0.88. Reminder systems for performing chronic disease management were common, yet systems for providing the latest evidence for how best to carry out this service were used less often. Clinical practice guidelines were usually referred to on a more manual basis, as opposed to being integrated within the patient chart. The increased use of reminder systems to identify patients with chronic disease may be related to financial motivations. In April of 2009, Alberta Health began offering a billing code for physicians to use when providing a yearly care plan to patients who met specific combinations of diagnostic requirements such as diabetes with hypertension or asthma with chronic obstructive pulmonary disease (Government of Alberta, 2014b, pp. 23-24). This billing code pays approximately $216 per visit (limit one per year) compared to a regular office visit that

pays $36 (Government of Alberta, 2014a, pp. 9, 17). See Table H6 in Appendix H for frequencies and descriptive statistics.

Electronic communication and connectivity. A lower level of meaningful use was reported for using EMR systems for communication and connecting within an office, between offices and accessing the EMR remotely (M = 3.87). There was also a large variation among respondents (SD = 1.10). The results suggest that there are low levels of informal consultation between family physicians and specialty programs and providers. See Table H7 in Appendix H for frequencies and descriptive statistics.

Patient support. Patient support was the item with the lowest level of meaningful EMR use, between a level 2 and 3 (M = 2.45), with a moderate amount of variability between responses (SD = 0.96). This shows that there was very little incorporation of electronic systems when providing information to patients. This is in stark contrast to the digital access that people have to their own information in other areas such as banking, education, and personal communication. The current medical system is not meeting the expectations that most people hold as standard in today's world. As the development of patient portals within EMRs increases, this situation will improve. See Table H8 in Appendix H for frequencies and descriptive statistics.

Administrative process. The use of administrative processes is fairly high between a level 4 and 5 (M = 4.39), and is quite consistent across responses (SD = 0.67). Though most items in this sub-measure reported that most administrative practices were being conducted at fairly high levels of use, the meaningful recording of who was on the patient's care team did not reflect the same practices. As we have seen with two other items in this scale, referrals and electronic communication and connectivity, activities

involving care coordination with other health professionals were associated with lower levels of meaningful EMR use. See Table H9 in Appendix H for frequencies and descriptive statistics.

Reporting and population health management. The aggregate mean for reporting capabilities was between a level 3 and 4 (M = 3.58) and had the highest variability of all the items in this scale (SD = 1.56). The responses indicated that if reports for population health management were already built into the EMR, they were used to generate registries and recall lists. However, few clinics created their own customized reports. This may be something for medical software companies to consider when developing reporting tools that can be used right out of the box. More communication between medical professionals and medical software companies about the kind of reports that are needed could potentially enhance meaningful use. Also, this speaks to the need for increased IT savvy employees in physician clinics, who are able to create customized reports for themselves. See Table H10 in Appendix H for frequencies and descriptive statistics.

Summary of meaningful EMR use. When comparing all of the Meaningful EMR Use sub-measures, Health Information and Administrative Processes were used at the highest level. Decision Support and Patient Support had low levels of meaningful use. These findings suggest that the mechanics of data entry have become routinized, but the complex processing of the data leading to higher-level functionality is not being utilized. See Table H11 for a list of means in descending order.

Table 11

Descriptive Statistics for Meaningful EMR Use Categories (Sub-Measures)

Meaningful EMR Use Sub-Measures	*N*	*M*	*SD*
Health Information	96	4.68	0.61
Administrative Process	48	4.39	0.67
Referrals	53	4.18	0.57
Medications	37	4.13	0.56
Laboratory	67	4.10	0.79
Electronic Communication & Connectivity	55	3.87	1.10
Medical Imaging	44	3.75	0.93
Reporting & Population Health Management	56	3.58	1.56
Decision Support	50	3.45	0.88
Patient Support	82	2.45	0.96

Note. EMR = Electronic Medical Record.

Analysis of Variance

Analysis of variance (ANOVA) tests were conducted to examine the relationship between various demographic variables and the Innovation Implementation and Meaningful EMR Use scales. The researcher was interested to see if there was a significant difference in either innovation implementation or meaningful EMR use when considering (a) whether or not the clinics had financial assistance from POSP, (b) whether or not the clinics were part of a PCN, (c) which health zone the respondents were from, (d) what profession the respondents were, as well as (e) participant age, and (f) gender.

POSP funding. This factor was challenging to analyze because of the large amount of respondents who did not know whether or not their clinic was funded by POSP. A total of 58.8% (n = 80) of participants said yes, 5.9% (n = 8) said no, and 34.5%

(n = 48) did not know. When considering whether or not clinics who had received financial assistance from POSP had higher levels of innovation implementation, the ANOVA was not significant, F (2, 64) = 2.81, p = 0.68. When the "I don't know" responses were removed and a two sample t-test was conducted innovation implementation was still not found to be significant, t (36) = -0.80, p = 0.43, equal variances assumed. However, the relationship between POSP and meaningful EMR use proved to be significant, F (2, 21) = 15.31, p < 0.001. The POSP program does appear to have a significant effect on increasing the level of meaningful EMR use.

Primary care network. Among the respondents, 84.1% (n = 116) indicated that their clinic was part of a PCN, 9.4% (n = 13) said no, and 6.5% (n = 9) did not know. The relationship between being part of the PCN membership and innovation implementation proved to be insignificant (F = 1.45, p >.05.) The relationship between PCN and meaningful EMR use was also found to be insignificant t (1.02) = -0.60, p = 0.65.

Health zone. The health zone of respondents was assessed to see if this was associated with a significant difference in innovation implementation. The ANOVA was not significant, F (4,63) = 0.52, p = 0.72. However, there was a significant difference when looking at health zone and meaningful EMR use, F (3,21) = 5.17, p = 0.008 A list of the descriptive statistics for meaningful EMR use by health zone is displayed in Table 12. Follow-up tests were conducted to evaluate pairwise differences among means. As variances were assumed equal, the Tukey's test was used for post hoc comparisons. It was found that the meaningful EMR use was significantly highest in the Edmonton Zone (M = 4.59). This was significantly higher than in the South Zone (M = 3.65), which had

the lowest level of meaningful use. Small sample size limits interpretation of the results (see Table 13).

Table 12

Analysis of Variance for Health Zones – Innovation Implementation and Meaningful EMR Use

Scale	Analysis	Sum of Squares	*df*	*MS*	*F*	Sig.
Innovation Implementation (items 14–20)	Between Groups	.527	4	.132	.519	.722
	Within Groups	15.998	63	.254		
	Total	16.525	67			
Meaningful EMR Use (items 21–50)	Between Groups	3.195	3	1.065	5.167	.008
	Within Groups	4.328	21	.206		
	Total	7.523	24			

Table 13

Comparison of Means Between Health Zones Used in ANOVA

Zone		Innovation Implementation	Meaningful EMR Use
North	*M*	3.78	Insufficient
	N	3	data
	SD	.72	
Edmonton	*M*	3.93	4.59
	N	10	6
	SD	.64	.68
Central	*M*	3.73	3.80
	N	22	3
	SD	.44	.35
Calgary	*M*	3.78	4.00
	N	11	8
	SD	.40	.33

Zone		Innovation Implementation	Meaningful EMR Use
South	*M*	3.66	3.65
	N	22	8
	SD	.50	.37
Total	*M*	3.75	4.00
	N	68	25
	SD	.49	.60

Note. EMR = Electronic Medical Record.

Profession. The profession of respondents was considered as a factor in innovation implementation. This comparison however was not significant, F (13,54) = 1.17, p = 0.33. This was an interesting non-significant finding. Profession did not have an impact on the perception of the practices, procedure and behaviours that get supported, rewarded and expected with regards to the EMR. When attempting to make comparisons between profession and meaningful EMR use, this comparison was also not significant F (2, 22) = 2.37, p = 0.12. The lack of significant difference in meaningful EMR use between professions was an interesting finding, which demonstrated that within their scope of practice, all users maintain a similar skill level, regardless of their profession.

Age. The difference between group means when looking at the age of respondents and perceptions of innovation implementation was not significant (F (4,62) = .65, p = 0.63), Age also proved to be insignificant when looking at meaningful EMR use, F (3,21) = 0.94, p = 0.44. This lack of significant difference when considering age was an unexpected finding. There was an assumption that younger users would be more willing to implement new technology and would use the technology to a higher degree. This was not found to be the case with this data set.

Gender. The difference between group means when looking at the gender of respondents and perceptions of innovation implementation was insignificant (t (66) = 0.13, p = 0.90). There was also no significant difference when looking at meaningful EMR use (t (23) = -1.14, p = 0.27). The findings showed that gender did not play a role when assessing the implementation or level of meaningful use of an innovation in this setting.

Correlations

Innovation implementation correlations. All correlations between the Innovation Implementation Model measures and sub-measures were significant. This validated that this well-established scale was appropriate for use in family physician clinics. Most items also showed a high reliability (α = 0.70 to 0.92; see Table 14).

The absence of obstacles item had some of the strongest significant correlations: Implementation Climate (r = 0.62, $p \leq 0.01$), Innovation-Values Fit (r = 0.67, $p \leq 0.01$), and Skills (r = 0.58, $p \leq 0.01$). This showed that obstacles could be overcome if the employees had a good understanding of perceptions and expectations within the clinic, by having job tasks fit with existing values, and by developing strong EMR skills.

There was a strong significant correlation between Implementation Effectiveness and Incentives, which measured intrinsic motivation (r = 0.59, $p \leq 0.01$). However, extrinsic motivation, which was measured by Reward Emphasis (a sub-measure of Implementation Climate), was not significantly correlated with Implementation Effectiveness (r = 0.14, p = 0.21; see Table 15). These results showed that the employees in this data set were motivated by intrinsic factors, but were not motivated by extrinsic factors. See Appendix G for more correlations.

Table 14

Correlations for Innovation Implementation Model Measures

	Aggregated Items	*M*	*SD*	*n*	α	14	15	16	17	18	19	20
14	Implementation Climate	3.59	0.63	81	.91	1.00						
15	Innovation-Values Fit	3.77	0.65	126	.92	.59**	1.00					
16	Skills	3.74	0.71	126	.84	.45**	.46**	1.00				
17	Absence of Obstacles	3.77	0.83	129	.83	.62**	.67**	.58**	1.00			
18	Incentives	4.41	0.63	133	.70	.32**	.31**	.27**	.38**	1.00		
19	Commitment	3.63	0.82	132	.84	.56**	.44**	.46**	.49**	.44**	1.00	
20	Implementation Effectiveness	4.48	0.59	128	.88	.35**	.45**	.42**	.43**	.59**	.53**	1.00

Note. ** Correlation is significant at the 0.01 level (2-tailed).

Table 15

Correlation for Implementation Effectiveness and measures for motivation

Implementation Climate Measures		14d Reward Emphasis (Extrinsic Motivation)	18 Incentives	20 Implementation Effectiveness
14d	Reward Emphasis (Extrinsic Motivation)	1.00	0.10	0.14
18	Incentives (Intrinsic Motivation)	0.10	1.00	0.59**
20	Implementation Effectiveness	0.14	0.59**	1.00

Note. ** Correlation is significant at the 0.01 level (2-tailed).

Table 16

Correlations Between Meaningful EMR Use Sub-Measures

Item		*M*	*SD*	*n*	α	1	2	3	4
1	Health Information	4.68	.61	96	.45	1.00			
2	Medications	4.12	.56	37	.64	.30	1.00		
3	Laboratory	4.10	.80	67	.53	.03	.45**	1.00	
4	Medical Imaging	3.75	.93	44	.22	.08	.42*	.49**	1.00
5	Referrals	4.18	.57	53	.09	.33*	.14	.40**	.38*
6	Decision Support	3.45	.88	50	.59	.47**	.49**	.41**	.44*
7	Electronic Communication & Connectivity	3.87	1.10	55	.48	.40**	.29	.33*	-.06
8	Patient Support	2.45	0.96	82	.29	.45**	.28	.38**	.46**
9	Administrative Process	4.39	0.67	48	.58	.20	.33	.40*	.23
10	Reporting and Population Health Management	3.58	1.56	56	.74	-.01	.21	.16	.16

Note. * Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

Table 16

Correlations Between Meaningful EMR Use Sub-Measures (Continued)

Item	5	6	7	8	9	10
1 Health Information						
2 Medications						
3 Laboratory						
4 Medical Imaging						
5 Referrals	1.00					
6 Decision Support	.30	1.00				
7 Electronic Communication & Connectivity	.29	.33*	1.00			
8 Patient Support	.33*	.60**	.43**	1.00		
9 Administrative Process	.39*	.37*	.70**	.49**	1.00	

Item	5	6	7	8	9	10
10 Reporting and Population Health Management	-.04	.19	.22	.25	.25	1.00

Note. * Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

Meaningful EMR use correlations. As mentioned previously, the Meaningful EMR Use scale was a new measure and had varying levels of reliability (see Table 16). The fact that only half of the correlations within this measure were significantly correlated with each other strengthens the need for further testing and validity assessment. However, there were two strongly significant correlations to note. There was a statistically significant correlation between Administrative Process and Electronic Communication & Connectivity ($r = 0.70$, $p \leq 0.01$). This finding suggests that those clinics with more advanced administrative procedures will also likely be advanced in their communication processes as well. Also, there was a statistically significant correlation between Patient Support and Decision Support ($r = 0.60$, $p \leq 0.01$). It appears that if a clinic has systems in place to create alerts and warnings for patient care, they are also more likely to give educational handouts and provide patients with their own test results.

Testing the Hypotheses

The following subsections focus on testing the four hypotheses set out in the beginning of the study. Correlations and multiple regressions were used for this analysis.

Hypothesis 1. In the family practice clinics under study, there is a positive relationship between Implementation Climate and Meaningful EMR Use. Hypothesis 1 was supported and shown to have a strong, positive and statistically significant relationship between Implementation Climate and Meaningful EMR Use ($r = 0.79$,

$p \leq 0.01$; see Table 17). When calculating the R^2, 62% of the variance was accounted for by explaining Implementation Climate on Meaningful EMR Use. This means that one model was predicting 62% of the variance of the other.

Table 17

Correlations for Hypothesis 1

Measure	*M*	*SD*	α	1	2
1. Implementation Climate	3.59	.63	0.91	1.00	.785**
2. Meaningful EMR Use	4.01	.56	0.88	.785**	1.00

Note. ** Correlation is significant at the 0.01 level (2-tailed).

Next, the sub-measures of implementation climate were assessed for correlation with the Meaningful EMR Use scale. All of these correlations were statistically significant in the positive direction, but lowest with Mean Emphasis ($r = .41$, $p \leq 0.05$, see Table 18). The highest statistically significant positive correlation within this data set was between Meaningful EMR Use and Task Support ($r = .65$, $p \leq 0.01$). This finding highlighted the importance of providing employees with sufficient resources to support their initial training, ongoing learning, and troubleshooting needs.

Table 18

Correlations for Meaningful EMR Use and Implementation Climate Sub-Measures

Innovation Values Fit Items	Meaningful EMR Use
Mean Emphasis	0.41*
Goal Emphasis	0.53**
Task Support	0.65**
Reward Emphasis	0.58*

Note. * Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

Assessing the strength of the relations between the Implementation Climate scale and the sub-measures of Meaningful EMR Use scale revealed that approximately half of the correlations between the Meaningful EMR Use scale sub-measures were significant with the Implementation Climate scale (see Table 19). The findings also showed that Implementation Climate was significantly correlated with Decision Support ($r = 0.63$, $p \leq 0.01$), Electronic Communication and Connectivity ($r = 0.55$, $p \leq 0.01$), Patient Support ($r = 0.62$, $p \leq 0.01$), and Health Information ($r = 0.40$, $p \leq 0.01$). It was an interesting finding that the item with the lowest mean (Patient Support, M = 2.45), had one of the highest correlations with Implementation Climate ($r = 0.62$, $p \leq 0.01$). This suggested that the level of Patient Support could be improved by applying the principles of Implementation Climate.

Table 19

Correlations for Implementation Climate and Meaningful EMR Use Sub-Measures

Aggregate Measure and Sub-Measures	Implementation Climate
Meaningful EMR Use	0.79**
- Health Information	0.40**
- Medications	0.48*
- Laboratory	0.19
- Medical Imaging	0.49*
- Referrals	0.44*
- Decision Support	0.63**
- Electronic Communication & Connectivity	0.55**
- Patient Support	0.62**
- Administrative Process	0.34
- Reporting and Population Health Management	0.23

Note. EMR = Electronic Medical Record.
* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

Table 20

Correlation Between Implementation Climate Sub-Measures and Meaningful EMR Use Sub-Measures

Aggregate Measure and Sub-Measures	1.1	1.2	1.3	1.4	2.1	2.2	2.3
1.1 Mean Emphasis	1.00						
1.2 Goal Emphasis	0.78**	1.00					
1.3 Task Support	0.58**	0.60**	1.00				
1.4 Reward Emphasis	0.25*	0.39**	0.56**	1.00			
2.1 Health Information	0.13	0.25*	0.20	0.23	1.00		
2.2 Medications	0.007	0.16	0.15	0.51*	.30	1.00	
2.3 Laboratory	0.17	0.06	0.38**	-0.005	.03	.45**	1.00
2.4 Medical Imaging	0.38*	0.28	0.39*	0.35	.08	.42*	.49**
2.5 Referrals	0.36**	0.41**	0.65**	0.25	.33*	.14	.40**
2.6 Decision Support	0.43**	0.54**	0.41**	0.26	.47**	.49**	.41**
2.7 Electronic Communication & Connectivity	0.27*	0.34*	0.48**	0.40*	.40**	.29	.33*
2.8 Patient Support	0.24*	0.31**	0.24*	0.53**	.45**	.28	.38**
2.9 Administrative Process	0.29*	0.33*	0.45**	0.18	.20	.33	.40*
2.10 Reporting and Population Health Management	0.34*	0.29*	0.09	-0.05	-.01	.21	.16

Note. * Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

Table 20

Correlation Between Implementation Climate Sub-Measures and Meaningful EMR Use Sub-Measures (Continued)

Aggregate Measure and Sub-Measures	2.4	2.5	2.6	2.7	2.8	2.9	2.10
1.1 Mean Emphasis							
1.2 Goal Emphasis							
1.3 Task Support							
1.4 Reward Emphasis							
2.1 Health Information							
2.2 Medications							
2.3 Laboratory							
2.4 Medical Imaging	1.00						
2.5 Referrals	.38*	1.00					
2.6 Decision Support	.44*	.30	1.00				
2.7 Electronic Communication & Connectivity	-.06	.29	.33*	1.00			
2.8 Patient Support	.46**	.33*	.60**	.43**	1.00		
2.9 Administrative Process	.23	.39*	.37*	.70**	.49**	1.00	
2.10 Reporting and Population Health Management	.16	-.04	.19	.22	.25	.25	1.00

Note. * Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

Hypothesis 2. In the family practice clinics under study a positive relationship was found between Innovation-Values Fit and Meaningful EMR Use. The findings support Hypothesis 2 in that the data showed a strong, positive, and statistically significant relationship between Innovation-Values Fit and Meaningful EMR Use (see Table 21). The R^2 calculation revealed that 24% of the variance was accounted for by explaining Innovation-Values Fit on Meaningful EMR Use. This means that one model was predicting 24% variance of the other. This predictive strength was much less than

that of Implementation Climate on Meaningful EMR Use as mentioned previously. This suggested that the act of supporting employees through providing adequate training and resources was more effective at increasing meaningful EMR use than having an EMR system with higher functional capabilities.

Table 21

Correlations for Hypothesis 2

Measure	*M*	*SD*	α	1	2
1. Innovation-Values Fit	3.79	.65	0.92	1.00	0.49*
2. Meaningful EMR Use	4.01	.56	0.88	0.49*	1.00

Note. * Correlation is significant at the 0.05 level (2-tailed).

Next, the sub-measures of the Innovation-Values Fit scale were assessed for correlation with the Meaningful EMR Use scale. All of these correlations were significant at the 0.01 level (2-tailed). This suggests that the principles of data quality, locatibility, and the ability to coordinate the use of data in flexible ways were all significantly associated with higher levels of meaningful EMR use (see Table 22).

Table 22

Correlations for Meaningful EMR Use and Innovation Values Fit Sub-Measures

Innovation-Values Fit Sub-Measures	Meaningful EMR Use
2.1 Quality	0.46*
2.2 Locatibility	0.45*
2.3 Flexibility & Coordination	0.48*

Note. * Correlation is significant at the 0.05 level (2-tailed).

Next, Innovation-Values Fit was assessed for correlations with the sub-measures of the Meaningful EMR Use scale (see Table 23). There was statistical significance found

between Innovation-Values Fit and Laboratory ($r = 0.34$, $p \leq 0.01$), Medical Imaging ($r = 0.41$, $p \leq 0.01$), Administrative Processes ($r = 0.42$, $p \leq 0.01$), Referrals ($r = 0.29$, $p \leq 0.05$), Electronic Communication and Connectivity ($r = 0.32$, $p \leq 0.05$), and Patient Support ($r = 0.24$, $p \leq 0.05$). In other words, the EMR systems in place were shown to accomplish what people needed them to accomplish in terms of ordering lab tests, medical imaging, referrals, communicating electronically, providing patient support and completing administrative duties (see Table 23). However, it was interesting to find that some items lacked significance. For example, there were no statistically significant correlations noted between the perceived capability of the EMR systems and reporting practices.

Finally, the sub-measures of the Innovation-Values Fit scale were compared to the sub-measures of the Meaningful EMR Use scale (see Table 24). Again, there were no statistically significant correlations noted between the perceived capabilities of the EMR systems and reporting and population health practices. This means that the perceived capability of the EMR was not related to the level of reporting that would be necessary for the development of disease registries and recall lists. Also, levels of increased use of medication features were correlated with the use of decision support tools. This was an expected finding, since advanced prescription capabilities involve alerts for contraindications and other harmful interactions.

Table 23

Correlations Between Innovation Values Fit and Meaningful EMR Use Sub-Measures

Meaningful EMR Use Sub-Measures	Innovation Values Fit
2.1 Health Information	0.16
2.2 Medication	-0.03

2.3	Laboratory	0.34**
2.4	Medical Imaging	0.41**
2.5	Referrals	0.29*
2.6	Decision Support	0.24
2.7	Electronic Communication & Connectivity	0.32*
2.8	Patient Support	0.24*
2.9	Administrative Process	0.42**
2.10	Reporting	-0.05

Note. EMR = Electronic Medical Record.
* Correlations are significant to the 0.05 level. (2-2ailed) ** Correlations are significant to the 0.01 level (2-2ailed).

Table 24

Correlations Between Sub-Measures of Innovation Values Fit and Sub-Measures of Meaningful EMR Use

Measure & Submeasures	1.1	1.2	1.3	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.10
1.1 Quality	1.00												
1.2 Locatibility	0.73**	1.00											
1.3 Flexibility & Coordination	0.59**	0.68**	1.00										
2.1 Health Information	0.10	0.19	0.28**	1.00									
2.2 Medications	-0.07	0.07	0.17	0.30	1.00								
2.3 Laboratory	0.33**	0.35**	0.20	0.03	0.45**	1.00							
2.4 Medical Imaging	0.25	0.42**	0.56**	0.08	0.42*	0.49**	1.00						
2.5 Referrals	0.25	0.30*	0.26	0.33*	0.14	0.40**	0.38*	1.00					
2.6 Decision Support	0.18	0.29*	0.36*	0.47**	0.49**	0.41**	0.44*	0.30	1.00				
2.7 Electronic Communica-tion & Connectivity	0.40*	0.31*	0.27	0.40**	0.29	0.33*	-0.06	0.29	0.33*	1.00			

Measure & Submeasures	1.1	1.2	1.3	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.10
2.8 Patient Support	0.21	0.21	0.27*	0.45**	0.28	0.38**	0.46**	0.33*	0.60**	0.43**	1.00		
2.9 Administrative Process	0.46**	0.31*	0.31*	0.20	0.33	0.40*	0.23	0.39*	0.37*	0.70**	0.50**	1.00	
2.10 Reporting & Population Health Management	-0.06	0.005	-0.08	-0.01	0.21	0.16	0.16	-0.04	0.19	0.22	0.25	0.25	1.00

Note. EMR = Electronic Medical Record.
* Correlations significant at the 0.05 level. ** Correlations significant to the 0.01 level.

Hypothesis 3. The stronger the implementation climate for a given innovation (i.e. EMRs), the greater employees' use of that innovation (i.e., meaningful EMR use), provided there are high levels of commitment. First, a correlation was conducted to look at the strength of association between the measures. The findings showed positive and statistically significant relationships between Meaningful EMR Use and Implementation Climate and Commitment (see Table 25).

Table 25

Correlations Between Meaningful EMR Use, Implementation Climate and Commitment

Measure	*M*	*SD*	α	1	2	3
1. Meaningful EMR Use	4.01	.56	0.88	1.00	0.79**	0.43*
2. Implementation Climate	3.59	0.63	0.92	0.79**	1.00	0.56**
3. Commitment	3.63	0.82	0.84	0.43*	0.56**	1.00

Note. EMR = Electronic Medical Record.
* Correlations significant at the 0.05 level. ** Correlations significant to the 0.01 level.

Next, multiple regression analyses using simultaneous entry were conducted using Meaningful EMR Use as the dependent variable, and Implementation Climate and

Commitment as independent variables. In the first regression, Implementation Climate was included as the sole independent variable (F (1,11 = 17.620, $p \leq 0.01$) and was significant, explaining 58% of the variance. In the second regression, Commitment was included as the sole independent variable (F (1,23) = 5.076, p = 0.03) and was also found to be significant, explaining 14.5% of the variance. However in the third regression, when both Implementation Climate and Commitment were included as independent variables together, (F (2,10) = 8.093, p = 0.008), the regression coefficients indicated that Implementation Climate was the strongest predictor of Meaningful EMR Use (mean β of .74, p = .023, sr_i^2 = 0.028), followed by Commitment (mean β of .07, p = 0.81, sr_i^2 = 0.003). Commitment became non-significant in predicting Meaningful EMR Use when the measure of Implementation Climate was added to the analysis. According to the R^2 or the overall magnitude of regression, 54% of the variance of Meaningful EMR Use was accounted for by the independent or predictor variables. In other words, on their own, Implementation Climate and Commitment were each significant predictors of high levels of Meaningful EMR Use. However, when considering both factors simultaneously, Commitment was no longer significant. These results showed that Implementation Climate proved to be more predictive for Meaningful EMR Use than Innovation-Values Fit. It is essential to establish a Climate for Implementation in order to achieve advanced and meaningful use of EMR features.

From here, the researcher applied conditional process analysis to the regression to assess the interactive effect of using Commitment as a moderator and a mediator in the relationship between Implementation Climate and Meaningful EMR Use. The researcher was interested in exploring the interaction effect; the results are presented in Figures 3

through 6. See Figures 3 and 4 assessing Commitment as a moderator.

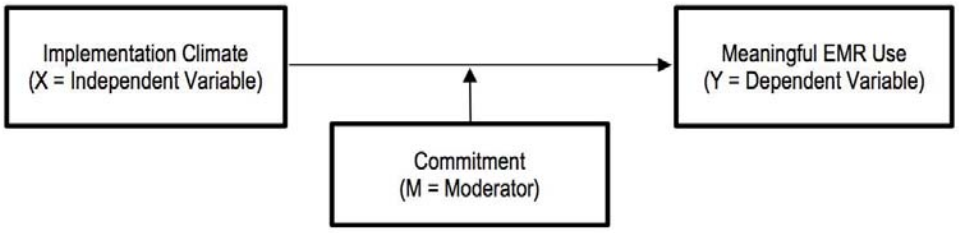

Figure 3. Model 1 with Commitment as a moderator – diagram

Note. EMR = Electronic Medical Record.

OUTCOME: Meaningful EMR Use
MODEL SUMMARY

R	R^2	*MSE*	*F*	*df1*	*df2*	*p*
.83	.68	.17	6.52	3.00	9.00	.01

MODEL	*coeff*	*SE*	*t*	*p*	*LLCI*	*ULCI*
constant	9.04	6.13	1.47	.17	-4.84	22.92
IVFCOMMI	-1.80	1.36	-1.31	.22	-4.87	1.28
IVFICLIM	-1.65	-1.79	-.92	.38	-5.70	2.40
Int_1	.53	.38	1.38	.20	-.34	1.41

R-square increase due to interaction(s):

	R^2-chng	*F*	*df1*	*df2*	*p*
Int_1	.07	1.90	1.00	9.00	.20

Conditional effect of X on Y at values of the moderator(s):

IVFCOMMI	Effect	*se*	*t*	*p*	*LLCI*	*ULCI*
3.33	.13	.56	.23	.82	-1.13	1.39
4.12	.55	.33	1.67	.13	-.19	1.30
4.90	.97	.32	3.13	.01	.26	1.68

Figure 4. Model 1 data output with commitment as a moderator – measurements

Note. Level of confidence for all confidence intervals in output: 95%.

The results of Model 1 show that the overall regression model was significant ($F(3,9) = 6.52$, $p \leq 0.01$) and explained 68% ($R^2 = .68$) of the variance in predicting Meaningful EMR Use. The interaction itself was not significant. Commitment only acted

as a significant moderator when levels were high. In other words, Commitment impacts Meaningful EMR Use only when there is personal meaning attached to the system, and a desire to achieve mastery of the features. These high levels of commitment are likely to only be reached by a few users. Developing and maintaining implementation climate was shown to be the most important factor in achieving meaningful EMR use.

Next, in Figures 5 and 6, Commitment as a mediator was assessed in the relationship between Implementation Climate and Meaningful EMR Use.

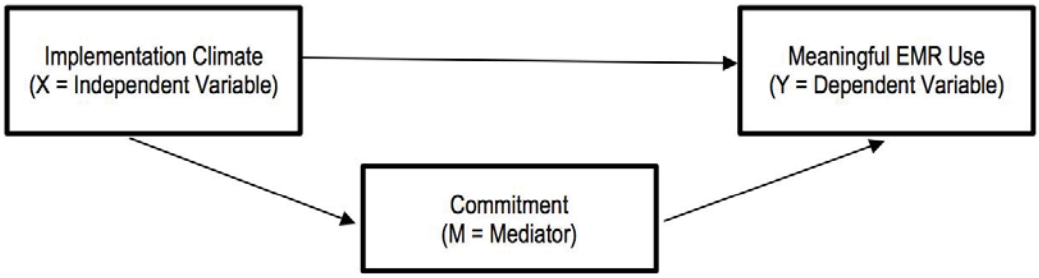

Figure 5. Model 4 with a Commitment as a mediator – diagram

Model 4 (Figure 5) shows Commitment as a mediator. Regression between Implementation Climate and Commitment was significant (F (2,10) = 8.09, $p \leq 0.01$), and explained 49% of the variance in predicting Meaningful EMR Use. Regression between Implementation Climate, Commitment, and Meaningful EMR Use was also significant (F (2,20), = 8.09, $p \leq 0.01$), and explained 62% of the variance in predicting Meaningful EMR Use (see Figure 6). However, when comparing direct vs indirect effects of Implementation Climate on Meaningful EMR Use, the direct effect is more powerful. Commitment did not act as a mediator in predicting EMR use. This means that again, implementation climate emerges as the most important and significant factor to leverage in increasing Meaningful EMR Use.

OUTCOME: IVF Commitment **MODEL SUMMARY**						
R	***R^2***	***MSE***	***F***	***df1***	***df2***	***p***
.70	.49	.35	10.60	1.00	11.00	.00
MODEL	**coeff**	***SE***	***t***	***p***	***LLCI***	***ULCI***
constant	.58	1.09	.53	.61	-1.84	2.99
IVFICLIM	.92	.28	3.26	.00	.29	1.53
OUTCOME: Meaningful EMR Use **MODEL SUMMARY**						
R	***R^2***	***MSE***	***F***	***df1***	***df2***	***p***
.79	.62	.19	8.09	2.00	10.00	.00
MODEL	**coeff**	**se**	**t**	**p**	**LLCI**	**ULCI**
constant	.65	.83	.78	.45	-1.20	2.51
IVFCOMM	.05	.23	.25	.80	-.44	.56
IVFICLIM	.79	.29	2.68	.02	.14	1.45
Direct effect of X on Y:						
	Effect	***SE***	***t***	***p***	***LLCI***	***ULCI***
	.79	.29	2.69	.02	.14	1.45
Indirect effect of X on Y:						
	Effect	**Boot *SE***	**Boot *LLCI***	**Boot *ULCI***		
IVFCOMMI	.05	.23	-.61	.34		

Figure 6. Model 4 data output with Commitment as a mediator – measurements

Note. Number of bootstrap samples for bias corrected bootstrap confidence intervals: 1000. Level of confidence for all confidence intervals in output: 95%.

Hypothesis 4. This hypothesis stated that 'some of the barriers to EMR use identified in the literature were also found to be present in the study (e.g., lack of training and support)'. As described in the literature review, five main categories of barriers were identified: financial concerns (Boonstra & Broekhuis, 2010; Valdes et al., 2004); trust in technology (Boonstra & Broekhuis, 2010; Dawes & Chan, 2010; Samoutis et al., 2007; Schmitt & Wofford, 2002); perception of insufficient technology support (Boonstra & Broekhuis, 2010; Ludwick & Doucette, 2009b; Samoutis et al., 2007; Simon et al., 2007); steep learning curve (Boonstra & Broekhuis, 2010; Samoutis et al., 2007); and difficulty with EMR implementation (Bradley, 2009; Kane & Labianca, 2011; Lapointe & Rivard, 2005; Lyons & Klasko, 2011c). The following 34 questions of the survey were analyzed in search for obvious barriers to EMR use (see also Table 32):

- Financial concerns: items 14i, 14l, 17a
- Trust in technology: items 15a, 15b, 15c, 15d, 15e, 15f, 15g, 15h, 15i, 15j, 15l, 15m
- Perception of insufficient technology support: items 14b, 14g 14h, 14j
- Steep learning curve: items 16a, 16b, 16c, 16d, 16e, 16f
- Difficulty with implementation: items 19a, 19b, 19c, 19d, 20a, 20b, 20c, 20d, 20e

Financial concerns. As identified in the above literature review, concern about financial impact was the earliest identified barrier. As discussed earlier, between 2001 and 2014, in order to offset these barriers and incentivize the switch to an EMR, an agency named POSP gave assistance to practices in the form of data migration tech support, hardware, money for initial set up, staff training, and a portion of ongoing IT

support for the first 5 years. This support from POSP directly addressed three of the four subcategories of financial concerns, leaving only return on investment as an intangible future promise. There were several respondents who weren't aware if their clinic had received funding from POSP or not (see Table 26). This could be attributed to the respondents' positions in the organization.

Table 26

Number of Respondents Working in POSP-Funded Clinics

Participant Response	*n*	%
Yes	80	58.8%
I Don't Know	48	35.3%
No	8	5.9%

Note. Mode = 1.00; *n* = 136.

Other items that spoke to financial matters showed that 58.1% of respondents agreed that employees were given sufficient time to learn the system before they had to use it (item 14i). Nearly half of the respondents (44.4%) were ambivalent about whether or not they felt money was readily available to support ongoing training (item 14l), and among those who voiced their opinion, only 37.9% agreed that this type of support was available. The majority of people (62.9%) disagreed with the notion that they had faced difficulties in learning the system due to the lack of organizational resources, such as time and training (item 17a). See Table 27 for details. These findings revealed that the perceived financial barriers are neither as prevalent nor impactful as the literature suggested.

Table 27

Items Correlated to Financial Concerns

				Disagree		Neither Agree nor Disagree		Agree	
Item	*M*	*n*	*SD*	*n*	%	*n*	%	*n*	%
Q14i	3.49	136	1.08	28	20.6	29	21.3	79	58.1
Q14l	3.28	124	1.06	22	17.8	55	44.4	47	37.9
Q17a	3.60*	132	1.02	83	62.9	27	20.5	22	16.6

Note. * Indicates a reverse-scored item.

Trust in technology. As discussed earlier, the literature revealed that physicians were concerned with the stability, safety and access to their patient data. The measures used for this research did not directly assess the perception of EMR system stability, but did look at the quality of data and to what extent it met the needs of the employees.

Five measures showed that the majority of respondents (77.2% – 86.0%) agreed that the system maintained current, detailed data that met their needs (see Table 28). There was slight disagreement (41.4%) with the idea that the system was missing critical data (item 15b). Most people (61.3%) agreed that it was easy to understand where data should go (item 15g), and even easier (75.2%) to locate this information when needed (item 15h). There was agreement to a lesser degree (57.4%) regarding whether data were being appropriately maintained (item 15i), and 57.0% felt that staff were aware of what the data meant (item 15j). The EMRs supported work processes (item 15k, 78.0%), work group cooperation (item 15l, 69.6%), and developed capability in the user (item 15m, 66.1%). Overall, the data supports the notion that technology can be relied on to assist in patient care (see Table 28).

Table 28

Items Correlated to Trust in Technology

				Disagree		Neither Agree nor Disagree		Agree	
Item	*M*	*n*	*SD*	*n*	%	*n*	%	*n*	%
15a	4.04	137	0.82	8	5.8	19	13.9	110	80.3
15b	3.04*	135	1.16	56	41.4	33	24.4	46	34.1
15c	3.99	135	0.75	7	5.2	17	12.6	111	82.2
15d	4.07	136	0.78	7	5.1	12	8.8	117	86.0
15e	3.89	136	0.85	13	9.6	18	13.2	105	77.2
15f	4.01	136	0.79	7	5.1	17	12.5	112	82.4
15g	3.64	137	1.03	19	13.8	34	24.8	84	61.3
15h	3.88	137	1.03	21	15.4	13	9.5	103	75.2
15i	3.53	135	1.03	27	19.9	30	22.2	78	57.4
15j	3.53	135	1.03	26	19.2	32	23.7	77	57.0
15k	3.93	136	0.78	8	5.9	22	16.2	106	78.0
15l	3.84	135	0.84	8	5.9	33	24.4	94	69.6
15m	3.68	133	0.94	18	13.5	27	20.3	88	66.1

Note. * Indicates a reverse-scored item.

Perception of insufficient technology support. A perceived lack of technical support is identified as a major barrier when considering implementing an EMR. This research showed that 71.6% of respondents disagreed with the idea that technical support was lacking (item 17b). Only 56.9% felt they had sufficient materials to support troubleshooting (item 14h), but 79.0% reported having a Help Desk available (item 14j). Finally, 91.2% of respondents said that they felt all necessary hardware and software were available for them to use (item 14g). See Table 29 for more details. These findings suggest that technology support was perceived as being adequate.

Table 29

Items Related to Perception of Insufficient Technology Support

				Disagree		Neither Agree nor Disagree		Agree	
Item	*M*	*n*	*SD*	*n*	%	*n*	%	*n*	%
14g	4.35	136	0.76	4	2.9	8	5.9	124	91.2
14h	3.50	137	1.08	28	20.4	31	22.6	78	56.9
14j	4.07	133	0.89	7	5.3	21	15.1	105	79.0
17b	3.75*	134	0.98	96	71.6	22	16.4	16	11.9

Note. * Indicates a reverse-scored item.

Steep learning curve. As discussed earlier, because of the complex nature of medical EMR software, those staff members who are less familiar with technology will experience a steeper learning curve. This likelihood was not a significant detriment to the attitude of the staff. Nearly all (97.0%) of respondents disagreed with the idea of feeling discouraged from using the system (item 18a), and 74.8% of staff reported that they were knowledgeable about how the system worked (item 16a). Respondents reported they could both enter and locate data easily (item 16c, 85.8%; item 15h, 75.2%), and 78.0% agreed that the EMR supported their repetitive and predictable work processes (item 15k). In total, 66.1% of respondents felt that the system assisted them in developing diverse capabilities needed to do their job (item 15m). The majority (69.6%) believed that the EMR supported cooperation between work groups (item 15l), and 72.9% knew which work groups received information that they inputted (item 16e). However, there was less agreement (57.0%) about knowing how data were linked between groups (item 16d). There was also less agreement (57.7%) towards easily understanding what data were maintained on a given subject (item 15i), and how well the meaning of that data were

understood (item 15j, 57.0%). These items support the idea that most users are comfortable enough with the basic use of their EMRs that they can easily accomplish their daily tasks both individually and as a group. However, when it came to asking if people understood the special features of their system, the results were split with only 41.0% agreeing, and 39.5% disagreeing (item 16b). Details of the items for steep learning curve are found in Table 30.

Table 30

Items Related to Steep Learning Curve

				Disagree		Neither Agree nor Disagree		Agree	
Item	*M*	*n*	*SD*	*n*	%	*n*	%	*n*	%
15h	3.88	137	1.03	21	15.4	13	9.5	103	75.2
15i	3.53	135	1.03	27	20.0	30	22.2	78	57.7
15j	3.53	135	1.03	26	19.2	32	23.7	77	57.0
15k	3.93	136	0.78	8	5.9	22	16.2	106	78.0
15l	3.84	135	0.84	8	5.9	33	24.4	94	69.6
15m	3.68	133	0.94	18	13.5	27	20.3	88	66.1
16a	3.89	135	0.94	15	11.1	19	14.1	101	74.8
16b	3.10	134	1.09	53	39.5	26	19.4	55	41.0
16c	4.13	134	0.87	9	6.7	10	7.5	115	85.8
16d	3.53	128	1.03	25	19.6	30	23.4	73	57.0
16e	3.85	129	0.97	15	11.7	20	15.5	94	72.9
16f	3.87	133	0.74	6	4.5	28	21.1	99	74.4
18a	4.54*	134	0.58	130	97.0	3	2.2	1	0.7

Note. * Indicates a reverse-scored item.

Difficulty with EMR implementation. The vast majority of respondents (86.7%) denied thinking that the system was a waste of resources (item 20a), and 91.6% did not wish things would go back to the old way (item 20b). Responses also indicated the absence of information system avoidance behaviours. In total, 97.0% of people indicated that they did not avoid usage, (item 20c), and most didn't choose to use other ways to accomplish a task (item 20d, 95.5%; item 20e, 88.0%).

When it came to active commitment to their systems, respondents agreed to a lesser extent. Only 65.7% said that the system was personally meaningful to them (item 19a), 61.9% said they enjoyed discussing their experiences with their colleagues (item 19b), and only 56.0% indicated that they liked spending time mastering the system (item 19d). Finally, there was no consensus with the staff identifying the system was 'my system' (item 19c). See Table 31 for details.

Table 31

Difficulty with EMR Implementation

				Disagree		Neither Agree nor Disagree		Agree	
Item	*M*	*n*	*SD*	*n*	%	*n*	%	*n*	%
19a	3.84	134	0.90	9	6.7	37	27.6	88	65.7
19b	3.78	134	1.01	11	8.2	40	29.9	83	61.9
19c	3.30	135	1.05	33	24.4	47	34.8	55	40.8
19d	3.55	134	1.04	24	17.9	35	26.1	75	56.0
20a	4.30*	135	0.79	117	86.7	13	9.6	5	3.7
20b	4.53*	131	0.74	120	91.6	7	5.3	4	3.1
20c	4.63*	134	0.54	130	97.0	4	3.0	0	0
20d	4.55*	132	0.63	126	95.5	4	3.0	2	1.5
20e	4.32*	133	0.88	117	88.0	6	4.5	10	7.5

Note. EMR = Electronic Medical Record. * indicates a reverse-scored item.

Factor analysis. From here the researcher examined the interrelationships among the variables to identify underlying constructs in the data set that would indicate the presence of the barriers suggested from literature, which were financial concerns, trust in technology, perception of insufficient technology support, steep learning curve and difficulty with EMR implementation. The researcher found 34 questions that corresponded to these barriers and ran a factor analysis with Varimax rotation that yielded seven components rotated in 12 iterations and with an eigenvalue greater than 1.00, explaining 71% variance. See Table 32 for factor loadings and descriptions of the seven components.

Table 32

Factor Loadings for Hypothesis 4 Items

	Component						
Item/Barrier	1	2	3	4	5	6	7
Trust: 15e	0.82						
Trust: 15f	0.74						
Trust: 15d	0.70						
Trust: 15c	0.65						
Trust: 15a	0.60						
Trust: 15h	0.56						
Trust: 15i		0.77					
Trust: 15j		0.76					
Financ: 17a		0.62					
Trust:15g		0.60					
Financ:14i		0.58					

	Component						
Item/Barrier	1	2	3	4	5	6	7
Learn Curv:16d			0.77				
LearnCurv:16e			0.76				
LearnCurv:16b			0.72				
LearnCurv:16a			0.68				
LearnCurv:16f			0.66				
LearnCurv:16c			0.49				
Difficul:20d				0.89			
Difficul:20c				0.85			
Difficul:20b				0.79			
Difficul:20a				0.68			
Difficul:20e				0.53			
TechSupp:14g					0.82		
TechSupp:14b					0.61		
TechSupp:14h					0.57		
Financ:14l					0.53		
TechSupp:14j					0.52		
Difficul:19b						0.81	
Difficul:19a						0.79	
Difficul:19d						0.71	
Difficul:19c						0.47	
Trust:15l							0.77
Trust:15m							0.55
Trust:15b							0.47
Cronbach's α=	0.89	0.84	0.88	0.79	0.84	0.84	0.73
Eigenvalue=	12.71	2.94	2.33	2.15	1.42	1.34	1.22
Variance=70.88%	37.37%	8.66%	6.85%	6.31%	4.17%	3.93%	3.60%

Note.

1. Component 1: *Data Quality* - How well the data in the EMR can be accessed to allow employees to complete daily tasks (items: 15a, 15c, 15d, 15e, 15f).
2. Component 2: *Ease of Use* - How easily the system capabilities can be used by the employee, which is based on training and understanding the system (items: 14i, 15g, 15h, 15i, 17a).
3. Component 3: *Skills* - To what degree users are able to utilize data in the system (items: 16a, 16b, 16c, 16d, 16e, 16f).
4. Component 4: *Integration* - To what degree users choose to adopt and use the system (items: 20a, 20b, 20c, 20d, 20e).
5. Component 5: *Training and Support* - To what degree time, money, and other supports are provided (items: 14b, 14g, 14h, 14j, 14l).
6. Component 6: *Personal Meaning* - To what degree the EMR system in place is personally meaningful to the user (items: 19a, 19b, 19c, 19d).
7. Component 7: *Interoperability* - To what degree the system supports interaction between work groups (items: 15b, 15l, 15m).

There is limited support for hypothesis 4. A series of frequencies and descriptive statistics revealed limited evidence of the barriers listed in the literature. Factor analysis showed seven components emerging rather than the five components shown in the literature. In comparing the barriers from the literature those found in this research, respondents in this data set were more concerned with the application of the EMR system and whether it had personal meaning for them versus the financial concerns and trust in the technical operations of the systems.

Chapter Five: Conclusion, Recommendations and Limitations

This research into the concepts of meaningful EMR use in family physician clinics, as well as possible business practices and clinic features associated with such use is preliminary. Nonetheless, it opens up possibilities for future discussion and research. As mentioned in the literature review, this was an under-researched area and has far-reaching implications for the future of medical care.

Demographics

In terms of the data set, demographic data were gathered at both the individual and organizational level. Demographics examined individual factors including job role, length of employment, age, and gender. Organizational demographic questions included health zone, EMR systems used, participation in government programs including POSP and Primary Care Network, clinic size, and employee composition. One of the most significant findings that emerged from the demographics was between POSP and Meaningful EMR Use. It seems that those clinics affiliated with POSP had higher levels of Meaningful EMR Use. Another interesting finding was the significance noted between health zone and meaningful EMR use whereby the Edmonton zone had the highest levels in Alberta. This is most likely due to Edmonton being the location of corporate headquarters for Alberta Health Services and the POSP organization. Lastly, the research found that the two systems most commonly in place were Telus Wolf and Telus Med-Access. The demographic information will serve as a baseline for future research in physician clinics.

Relationships Among the Measures

Overall, Klein and Sorra's (1996) Innovation Implementation model was statistically significant in its correlation with Meaningful EMR Use. Within this model, the most significant item of all was Implementation Climate, which refers to employee perceptions of the practices, procedures, and behaviours that get rewarded, supported, and expected with regard to the use of EMRs. Implementation Climate was also found to be the most significant predictor of Meaningful EMR Use. Within Implementation Climate, the sub-measures of Task Support (having sufficient resources to carry out daily work) and Goal Emphasis (having clear direction about the expected standards of use and outcomes) emerged as the most impactful factors. However, Implementation Climate had the lowest scoring mean of all items in the Innovation Implementation model. It is essential to improve Implementation Climate in order to increase Meaningful EMR Use.

Implementation Effectiveness referred to employees feeling that the system was a valuable addition to their work practices, and that they chose to use it when given the opportunity. This data set showed that Implementation Effectiveness is significantly correlated with intrinsic rewards (Incentives), but not with extrinsic rewards (Reward Emphasis). This phenomenon seems to be unique to the health care sector, as those who are drawn to helping professions may rely more heavily on intrinsic motivations. It is necessary to understand these distinctive motives, and should be taken into account when planning the implementation of an EMR. In this environment, the typical business model of providing external incentives will not increase use of most features.

Finally, Patient Support was the EMR module with the lowest mean. This means that clinics were not sufficiently empowering patients by providing them with their own

health information. This is in stark contrast to the digital access that people have to their own information in other areas such as banking, education, and personal communication. The current medical system is not meeting the expectations that most people hold as standard in today's world. Patient Support was found to be significantly correlated with Implementation Climate and Innovation-Values Fit, showing that there were techniques clinics could use to increase the level of patient support. As the development of patient portals within EMRs increases, this situation will improve.

Impact of Barriers

This study suggested that, in general, users felt that there were no strongly identified barriers to EMR implementation. Certain themes emerged from the data that could be viewed as potential barriers, but in this particular data set, evidence was lacking. As far as financial concerns, there was a high prevalence of participation in programs such as POSP or a PCN that worked to offset these concerns. Financial barriers were neither as prevalent nor impactful as the historical literature suggested. Technology proved to be an effective way to enter, store, and retrieve data, and was shown to enhance communication between work groups. Materials to facilitate troubleshooting the hardware and software were perceived as being only weakly adequate. However, the support of a Help Desk was perceived as being quite sufficient by most users. The concept of a steep learning curve emerged as a slight barrier only when approaching higher levels of complex EMR use. For the majority of basic everyday EMR functions, there were no barriers identified. Finally, though the literature described the difficult process of initially implementing an EMR, this barrier seemed to dissolve once the system was in place. Overall, implementations were seen as successful and a good use of

resources. There was adequate motivation for people to use the EMR, and there was no identification of use avoidance behaviours. Once the system was in place, the vast majority preferred the new way of doing things.

Other Findings

The study found that the data management capabilities of EMRs were adequate for users' needs, and that people were able to sufficiently utilize the EMR for their daily tasks individually, and as part of a work group. The modules with the highest Meaningful EMR Use were Health Information, Administrative Processes, Medications, and Laboratory. These were relatively basic features when compared to those of lower meaningful use such as Reporting and Population Health Management. Such skills for using these advanced features were less developed, and there were relatively low levels of personal connection and commitment to the EMR systems. Physicians emerged as the only group who had sufficient knowledge about all aspects of the EMR to answer most of the questions for the Meaningful EMR Use scale.

When interacting with other health care facilities to conduct activities including managing laboratory requisitions, reviewing medical imaging, and receiving specialist reports, there was a lower coordination of activities. There were also low levels of informal consultation between family physicians and specialty programs and providers, and there was usually no registry kept of the members of the patient care team.

It was interesting to discover that reminder systems for performing chronic disease management were common, yet systems for providing the latest evidence for how best to carry out this service were used less often. Clinical practice guidelines were

usually referred to on a more manual basis, as opposed to being integrated with the patient chart.

Conclusion

Several interesting findings emerged during the course of this research. These findings have the potential to guide future planning of EMR initiatives and improve the way care is delivered in family physician clinics.

Contributions and implications for practice. This research has made several contributions to practice and research through this study. First, the entire topic of research on medical software was much less explored than expected given the level of technology use in practically every other sector of society at this time. Medical systems fall short when compared to the capabilities people have to access their personal information in other areas of their lives (e.g. banking and education). The development of patient portals will improve ease of access to information, and may encourage people to be more actively involved in their health.

Within the realm of medical software use, the majority of the focus has been on EMR use in a hospital setting. When considering the much larger scale of care and finances that are involved in the operations of a hospital versus a physician's office, it is understandable that this electronic innovation would begin in large medical institutions. However, it is long past due to give this same attention to the facilities that provide initial access to the health care system.

The processes in a physician's office are incredibly different when compared to those in a hospital. Unique software is necessary in order to support the workflows of a family physician. There are very few systematic inquiries in how to best approach the

implementation of such software into the culture of a family practice clinic. This research has highlighted the critical importance of Implementation Climate with Meaningful EMR Use. The development of this knowledge and understanding is essential to developing best practices for this process. There must be a shift in the employee perceptions of practices, procedures, and behaviours that get rewarded, supported, and expected within their organization, in order for change to take place. This level of innovation is necessary for the EMR system product as well. The software must continually keep pace with the changing processes in physician's offices in order to support these improvements.

Finally, there was a scarcity of measurement scales to evaluate meaningful EMR use in physician offices. The measure used in this research was relatively new and had not yet been used to assess multiple clinics. There were no prior scale reliabilities established for this tool. The above research is a preliminary offering for this topic but requires much more development. The data set yielded from this research validates future exploration using this scale.

Limitations of the research. There were several limitations to this research. One of the most prominent limitations was the relatively small sample size. This small sample size decreased the ability to generalize the findings beyond the responding population.

As described in the challenges and limitations section above, the researcher experienced intense difficulty recruiting participants. There was research fatigue in this population because of the recent surge of attempts to implement health care improvement initiatives. There was great support amongst higher level health care leadership, but this eagerness seemed to diminish when looking at front line workers. Due to this recruitment difficulty, the data collection occurred over a lengthy period of time (8 months). During

this time, there were several changes in the landscape of the health care system and government support for EMR use. These conditions may have reduced the inter-respondent consistency of the data collected.

The method of using a personalized link proved to be cumbersome, and significantly reduced the ease of recruitment. The idea of a temporarily identifying link caused apprehension for potential participants, despite assurances that this identification would be removed from the data set. The intended benefit of making comparisons between clinics and offering personalized suggestions for process improvement was not realized due to small numbers of participants per clinic. Perhaps a study initiated at a program level, such as a PCN, could generate a bigger data set and allow for this type of analysis to be conducted.

Directions for future research. Future study assessing the Innovation Implementation scale or other measures could bring to light additional factors that contribute to meaningful EMR use. This information would be useful in applying strategies at both the clinic level and at the health care system level.

Going forward, more research is also needed to further assess the validity of the Meaningful EMR Use scale. Adjustments in some scale items may be required to increase the reliability of this recent measure. The scale has the potential to compare Meaningful EMR Use among and between groups. This suggests that there may be beneficial ways to utilize the tool in future research.

Further investigation into which factors motivate clinic employees to increase their meaningful EMR use could help guide long-term strategic planning for future

programs and training attempting to increase meaningful EMR use. Also, research into this area on a larger scale with more participants would further solidify the scale.

As the number of clinics adopting EMRs continues to climb, the need for creating a climate in which the meaningful use of that EMR will also climb. As with any project, there will need to be a baseline measurement of meaningful EMR usage, along with measurements of

Implementation Climate amongst employees. With the validation of the Klein and Sorra's (1996) model in the context of EMR implementations, as well as the introduction of the Meaningful EMR Use scale, clinics have access to some preliminary tools. They will have the ability to assess their current state and workflows, set specific goals in order to improve different aspects affecting Implementation Climate in their own clinic, and ultimately improve their overall level of meaningful EMR use.

In closing, in order for Canada to develop a nation-wide electronic health record, the foundational building blocks must first be in place. The spark to ignite this movement and innovation must begin within individual physician clinics in order to support the scaffolding for higher-level functionality. Government level programs such as POSP that provide financial means to facilitate these sweeping changes are absolutely necessary. All of those individuals involved in this change process have to welcome a new perspective. Everyone needs to freely release traditional authority structures and embrace new ways of doing things. We are on the precipice of a revolution in health care informatics, and we have much catching up to do …

The time is now, not tomorrow.

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Appendices

Appendix A: Complete Survey for Meaningful Electronic Medical Record Use

University of Lethbridge

Demographic Questions: About You

In responding to the following questions, please choose (click on) the response the most applies to you. The responses to the following questions will be used for comparison purposes between the respondents.

1. **Understanding that you may have more than just one role, what title below best describes your MAIN role in the clinic?**
    a. Billing Clerk
    b. Booking Clerk
    c. Change Management Advisor
    d. Data Entry Staff
    e. Educator (Dietician, Weight loss, Exercise, etc.)
    f. Information Technology (IT) Specialist
    g. Licensed Practical Nurse (LPN)
    h. Clinic Manager
    i. Medical Office Assistant (MOA)
    j. Nurse Practitioner (NP)
    k. Pharmacist
    l. Physician (general practitioners only)
    m. Receptionist
    n. Registered Nurse (RN)
    o. Supervisor
    p. Other: _____

2. **How long have you worked at this clinic, in the role indicated above?**
    a. <1 year
    b. 1-5 years
    c. 6-9 years
    d. 10+ years

3. **How long have you worked at this clinic in any role?**
    a. <1 year
    b. 1-5 years
    c. 6-9 years
    d. 10+ years

4. **What is your age?**
    a. <18 years
    b. 18-25 years
    c. 26-35 years
    d. 36-45 years
    e. 46-55 years
    f. 56+ years

5. **What is your gender?** M / F

Demographic Questions: About Your Clinic

The responses to the following questions will be used for comparison purposes between the clinics.

1. **In which zone is your clinic located?**
    a. North
    b. Edmonton
    c. Central
    d. Calgary
    e. South

2. **Which EMR does your clinic use?**
    a. Accuro
    b. Emis
    c. Health Quest
    d. Jonoke
    e. Optimed
    f. Oscar
    g. Practice Solutions
    h. Telus Med-Access
    i. National Medical Systems (NMS)
    j. Nightingale
    k. Telin
    l. Telus Wolf
    m. Other: _____

3. **How long has your clinic been using this EMR?**
    a. <1 year
    b. 1-2 years
    c. 3-4 years
    d. 5+ years

4. **Is your clinic part of a Primary Care Network (PCN)?** (Yes / No / I don't know)

5. **Is your clinic a Family Care Centre (FCC)?** (Yes / No / I don't know)

6. **Does your clinic receive funding through Physician Office Systems Program (POSP)?** (Yes / No / I don't know)

7. **How many *general practice physicians* work at your clinic** (NOT COUNTING SPECIALISTS)**?**
    a. 0
    b. 1
    c. 2-5
    d. 6-10
    e. 11-15
    f. 16+

8. **How many non-physician employees work at your clinic?**
    a. 1 to 5 employees
    b. 6 to 10 employees
    c. 11 to 20 employees
    d. 21 to 30 employees
    e. Greater than 30 employees

	The following items assess the support and learning that you receive on an ongoing basis with regard to the EMR system currently in use at your clinic. The items will be assessed on a five point scale whereby 1=strongly disagree and 5= strongly agree. Please choose (click on) the response that best applies to your experience.	Not Applicable	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
	IMPLEMENTATION CLIMATE						
	Mean Emphasis						
1	Employees are told about the new work procedures for using the system.						
2	Employees are told about the changes in the work procedures due to the implementation of the system, and any subsequent upgrades or changes in workflow.						
3	Employees are told about the methods for using the system.						
	Goal Emphasis						
4	Employees are told that what they need to accomplish in using the system.						
5	Employees are told the standards they have to meet in using the system.						
6	Employees are told the types of outcomes that they need to accomplish in using the system.						

	The following items assess the support and learning that you receive on an ongoing basis with regard to the EMR system currently in use at your clinic. The items will be assessed on a five point scale whereby 1=strongly disagree and 5= strongly agree. Please choose (click on) the response that best applies to your experience.	Not Applicable	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
	Task Support						
7	Employees are provided with all computer technology (e.g., hardware and software) necessary to perform their tasks with the system.						
8	Helpful books, manuals, and online documents are available when employees have problems with the system.						
9	Employees were given sufficient time to learn the system before they had to use it.						
10	A "Help Desk" is available whenever people need help with the system.						
11	Additional training for the system is available on request.						
12	Money is readily available to support activities related to the ongoing training of the system.						
	Reward Emphasis						
13	Employees are told the potential risk if they do not use the system.						
14	Employees perceive that the more they know about the system, the better their chances are of getting a job promotion.						
15	Employees perceive that the better they are at using the system, the more likely they are to get a bonus or a raise.						
16	Employees know how their individual performance in using the system is evaluated.						
17	Employees perceive that they are going to be recognized for time and effort they spent in learning the system.						
	INNOVATION-VALUES FIT						
	Quality						
18	The system keeps data up-to-date for my task.						
19	The system is missing critical data that would be very useful to my task. ***(reverse score)***						
20	The system helps me to get data that is current enough to meet my needs.						
21	The system maintains data I need to carry out my task.						
22	Sufficiently detailed data are maintained by the system.						
23	The system keeps data at an appropriate level of details so that I can complete my tasks.						

	The following items assess the support and learning that you receive on an ongoing basis with regard to the EMR system currently in use at your clinic. The items will be assessed on a five point scale whereby 1=strongly disagree and 5= strongly agree. Please choose (click on) the response that best applies to your experience.	Not Applicable	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
	Locatibility						
24	The definition of data fields relating to my task is easy to find out in the system.						
25	The system helps me locate patient data very easily.						
26	It is easy to find out what data the system maintains on a given subject.						
27	The system helps me understand the meaning of data very easily.						
	Flexibility and cooperation						
28	The system supports the repetitive and predictable work processes.						
29	The system supports cooperation between work groups.						
30	The system assists me in developing diverse abilities and capabilities that are required to do my job.						
	SKILLS						
31	I am very knowledgeable about how the system works.						
32	I understand all of the special features of the system.						
33	I can enter into the system whenever I need to.						
34	I know how data in my work group links to data in other work groups.						
35	I know which work groups receive the information I input into the system.						
36	I can interpret the data shown in the system without problems.						
	ABSENCE OF OBSTACLES						
37	Due to the lack of organizational resources (e.g., time, training), I have faced a lot of difficulties in learning to use the system. ***(reverse score)***						
38	Due to the lack of technical support, I have found the system difficult to use. ***(reverse score)***						
39	There are a lot of organizational barriers that prevent me from using the system effectively (e.g., Clinic procedures or rules, rules, either written or unwritten) ***(reverse score)***						
	INCENTIVES						
40	I am discouraged from using the system. ***(reverse score)***						
41	I am motivated to use the system.						
	COMMITMENT						
42	Using the system is personally meaningful to me.						
43	I enjoy discussing my experiences in using the system with my colleagues.						
44	I really feel as if the system is my system.						
45	I like to spend time mastering the system.						

	The following items assess the support and learning that you receive on an ongoing basis with regard to the EMR system currently in use at your clinic. The items will be assessed on a five point scale whereby 1=strongly disagree and 5= strongly agree. Please choose (click on) the response that best applies to your experience.	Not Applicable	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
	IMPLEMENTATION EFFECTIVENESS						
46	I think the system is a waste of time and money for our organization. ***(reverse score)***						
47	If I had my way, this clinic would go back to the old way and forget the system. ***(reverse score)***						
48	If I can avoid using the system, I do. ***(reverse score)***						
49	When I can do a task using either the system or not using the system, I usually choose not to use it. ***(reverse score)***						
50	Even when I can do a task using the system, I sometimes use other ways to complete the task. ***(reverse score)***						

EMR Usage

When answering the following questions, please think about the extent to which your EMR is currently being used where you work. Please choose (click on) the response that best applies to your work situation. If you do not use a particular feature, or if you are not sure, please select N/A.

EMR = Electronic Medical Record (Local system); EHR = Electronic Health Record (Provincial system like Netcare); RX = Prescription

a. Health Information

21 **How do you keep track of the patient demographics in your practice?**

Not applicable to my work.	7
In the **patient chart** and/or in my **billing program.**	1
Mainly in the patient chart and **billing program**. I may have **some files** on my **computer** also, such as a spreadsheet for some patients	2
In the billing program. I also duplicate (manually) patient information in my EMR or other electronic tools I use.	3
Exclusively in my **EMR** (which does **NOT** have an integrated billing system)	4
Exclusively in my **EMR** (which has an integrated billing system).	5
Exclusively in my **EMR** which can be **synchronized** with a **provincial EHR.**	6

22 **Where do you keep a patient's medical summary?**

Not applicable to my work.	7
I maintain a **separate (face) sheet** in the **paper chart** that I **manually update** or I **do not maintain a patient medical summary.**	1
I use my electronic system, (**NOT** an EMR) which include(s) free-text information on some patients	2
I use my EMR, which contains free-text or structured information for ***some*** patients.	3
I use my EMR, which stores nearly all or all my patient records, but mainly as free text.	4
I use my EMR, which stores all my patient information in a **structured** form. (e.g., **coded problem lists, drop-downs, pick lists, etc.)**	5
As described above, but the EMR also syncs summary data with the **provincial EHR**.	6

23 **How do you record your patient visit or encounter notes?**

Not applicable to my work.	7
They are **hand-written** as entries in the **paper chart.**	1
They are **dictated, transcribed** and inserted in the paper chart.	2
I use an electronic tool for a **subset of patients** (e.g., for patients with chronic disease).	3
In my **EMR** as **text** that I enter in a **SOAP note or equivalent** for **all patient** visits. Most of my findings and plans are typed as free text.	4
In my **EMR** using **multiple structure templates to enter data. (I capture findings as structured elements where feasible).**	5
In my **EMR** using **multiple fields and templates** with selected data that can be **synchronized** with a **provincial EHR.**	6

b. Medications

24 **How do you write new drug prescriptions?**

Not applicable to my work.	7
I **write** them on my **RX pad** and record them in the **patient's paper chart.**	1
I **write** them on my **RX pad** and **dictate / transcribe** them as **part of my note entry** in the patient's paper chart.	2
I write them using my **EMR some of the time or document them in another electronic system.** They are handwritten or **printed and given to the patient.**	3
I write them for **all patients** using my **EMR**, which has an **updated formulary**. I **print the RX** to **give to the patient.**	4
I write them for **all patients** using my **EMR**, which has an advanced RX module with **clinical decision supports** such as alerts for **drug** interactions. Prescriptions are **printed** or faxed.	5
I write them for **all patients** using my **EMR** which has an advanced RX module and is **linked to a province wide ePrescription system** that is linked to pharmacies.	6

25 **How do you write renewal drug prescriptions during office visits?**

Not applicable to my work.	7
I review my paper chart. Then I **write** them on my **RX pad** and **record** them in the **patient's paper chart.**	1
I review my transcribed notes. I **write** them on my **RX pad** and **dictate / transcribe** them as **part of my note entry** in the patient's paper chart.	2
When needed, I check a standalone system (e.g., Netcare or by calling a pharmacist) to confirm dose and when the prescription might be due, before writing the prescription.	3
I write them for **all patients** using my **EMR** and can review previous notes to see what was prescribed.	4
My EMR tracks medication prescriptions and I can pick from a list of "current" or "ongoing" medications and renew them quickly. I can also see when they are expected to be up for renewal as that is locally tracked in my EMR.	5
As described above, but the EMR also syncs with the provincial system to confirm if / when the patient had medications prescribed / dispensed.	6

26 **Describe your process for managing medication prescription renewals outside of a visit.**

Not applicable to my work.	7
Requests are **processed manually by fax or phone** and **recorded** in the patient's **paper chart.**	1
As above, but an **external electronic tool** such as an **Excel spreadsheet** is used to keep track of when patients are due for refills. **Handwritten RX.**	2
Requests are **processed manually by fax or phone**. The fax is scanned into the EMR, or a note is created in the EMR. **Handwritten RX.**	3
Requests are **processed manually by fax or phone. The fax is scanned into the EMR, or a note is created in the EMR. Electronic RX.**	4
Requests received by **fax or phone are registered and sent by staff as an electronic request within my EMR for approval and responses are sent back by fax or phone.**	5
Requests are **received, processed and approved electronically** from a **province-wide ePrescribe system, linked to my EMR.**	6

27 **How are you supported in making decisions about prescriptions? (e.g., alerts when writing or renewing a prescription)**

Not applicable to my work.	7
Only by **reading a medication's drug profile** (e.g., in the CPS) **or phoning a pharmacist.**	1
I use a **standalone PC** or a handheld device (smartphone, PDA) to manually check drug: drug interactions (which I enter manually for a patient).	2
I use an **EMR** that provides **basic recommendations** such as **drug dose** and **frequency**	3
I use an **EMR** that **automatically** provides **drug:drug** and **drug:allergy** alerts	4
I use an **EMR** with more **comprehensive** drug alerts including **drug:disease, drug:lab** to check against the local medication list in the EMR.	5
I use an **EMR** with an **integrated clinical decision support system** (CDSS) that is **linked** to **updated provincial** as well as **local medication lists.**	6

c. Laboratory

28 **How do you order lab tests?**

Not applicable to my work.	7
I use the standard **pre-printed lab requisition form** and (may) **re-write** what I ordered in the **paper chart**.	1
I may use an **electronic version of the standard requisition** (e.g., a PDF) which I print out then **re-write** what I ordered in the **paper chart** (or photocopy).	2
I keep electronic copies of all requisitions on my office computer as standalone files (e.g., PDFs).	3
I use my **EMR's** electronic **version** of the **standard, free-text lab requisition** which **automatically records** what I ordered in the patient's file, and then print out the requisition.	4
My **EMR** has a **lab requisition manager** that lets me **order tests, print out the form**, gives me some **clinical decision support** prompts, and **automatically records** and **reconciles** tests and results.	5
As described above, but my **EMR** can also send orders and reconciles tests electronically. **No paper requisitions are generated.**	6

29 **How do you receive, review and process lab results?**

Not applicable to my work.	7
Lab reports of tests I ordered (or were copied to me) are received **in paper form by mail and/or fax** and filed in the patient chart.	1
I also **view and print <u>some</u> lab reports electronically through software from the laboratories or a web interface** and file them in the patient chart in the same way as paper reports.	2
I also **view and print <u>all</u> lab reports electronically through software from the laboratories or a web interface** and file them in the patient chart the same way as paper reports.	3
Most lab results are **downloaded** into a **structured database** in my **EMR** to allow **viewing in tabular and graphic formats**. **Some lab reports** are still only **stored as scanned documents** (non-structured).	4
ALL lab reports of tests I ordered (or were copied to me) are **downloaded into a structured database in my EMR** for viewing and processing.	5
ALL lab results of tests I ordered (or were copied to me) are **downloaded into my EMR**, which also **has a viewer** to **integrate** and display all available lab data on a patient from **multiple lab databases and hospitals.**	6

d. Medical Imaging

30 **How do you order diagnostic tests?** (e.g., X-rays, U/S, CT, MRI, PFT, stress tests, etc.)

Not applicable to my role.	7
I complete a **paper requisition** specific to each diagnostic centre.	1
I may use an **electronic version** of the diagnostic centre specific requisition (e.g., a PDF from the web) which I **print out, complete** and store in patient chart.	2
I scan / copy in the requisition and / or document that I ordered the test in my EMR for **some patients.**	3
I scan / copy in the requisition and / or document that I ordered the test in my EMR for **all patients**	4
My **EMR** has a **diagnostic requisition manager** that lets me **order most tests** and **prints the order form.**	5
I use an **advanced diagnostic test requisition manager** in my **EMR** that is **securely linked** to **diagnostic test sites** so that I can **order, record and reconcile** tests **electronically**. No paper requisitions are generated.	6

31 **How do you receive, review, and process Diagnostic Imaging reports?**

Not applicable to my work.	7
They are **received in paper form** by mail and/or fax and filed in the patient chart after written follow-up instructions are given to my MOA if needed.	1
I **print** the reports from a **CD** and file them in the patient chart in the same way as paper records.	2
I **print** the reports from a **web interface or diagnostic imaging viewer** and file them in the patient chart in the same way as paper reports.	3
Most or all of my paper X-ray reports are scanned (or copied from CD) and **linked to the patient's record in my EMR.**	4
Most of my X-ray reports are **digitally downloaded** into a **structured database in my EMR**, but we still need to scan some of them.	5
All of my X-ray reports are **digitally downloaded** into a **structured database in my EMR.**	6

32 **How do you view the images (e.g., X-rays, CT, MRI)?**

Not applicable to my work.	7
I do not view the images.	1
I view images **at the hospital** or I receive a **CD** with the images that I can look at on a computer (not part of an EMR).	2
I view images using a remote viewer provided by the hospital or diagnostics imaging clinic. The system is standalone and **I have to log into it separately** from any office applications I might be running.	3
I view images using a remote viewer provided by the hospital or diagnostics imaging clinic. **There is a link (e.g., a button) in my EMR** that allows me to connect to the remote viewer for **some of my image needs**.	4
I view images using a remote viewer provided by the hospital or diagnostics imaging clinic. There is a link (e.g., a button) in my EMR that allows me to connect to the remote viewer for most of my image needs.	5
The image viewer is part of my EMR. Images are automatically tagged and linked (e.g., downloaded) to my patient's EMR record.	6

e. Referrals

33 **How do you make a referral?**

Not applicable to my work.	7
I **hand-write** the referral letter. My **MOA arranges** the appointment.	1
I use a **computer** / word processor to generate the referral letter. My **MOA arranges** the appointment.	2
I use a **computer** / word processor to generate the referral letter. My **MOA arranges** the appointment. **The office tracks referrals in a computer application (not an EMR)**	3
I type the referral letter directly into the EMR. I **rely on my memory** for which specialists are available and enter the **specialist's name as free text** into the letter. My MOA arranges the appointment.	4
I use my **EMR's referral manager**, which has an **updated database of consultants** and the ability to **generate and fax a referral letter using selectable data from the patient record.** My **MOA arranges** the appointment.	5
I use my EMR's referral manager, which is linked on a secure network with consultant located in private offices and / or hospitals. The consultant can view referral data when an electronic request is sent. Referral appointments can be made online within the network.	6

34 **How do you receive and process consultation reports (e.g. the letter back from the consultant?**

Not applicable to my work.	7
They are received in paper form by mail and/or faxed and filed in the patient chart.	1
I can also scan paper consult reports into a standalone PC for electronic access	2
I receive at least some referrals electronically through a standalone system (e.g. secure email). All consult reports are manually linked to patient records in my EMR (e.g. they may be scanned or received through secure email).	3
All consult reports are manually linked to patient records in my EMR. (e.g. they may be scanned or received through secure email.	4
SOME or ALL consult reports I receive are automatically downloaded into my EMr as letters, reviewed and signed off from my inbox.	5
MOST or ALL consult reports are digitally downloaded into a structured database in my EMR and this can update my problem lists, medications and other summary data in my EMR.	6

35 **How do you keep track of which providers a patient sees (e.g., specialists, home care nurses, physiotherapist)?**

Not applicable to my work.	7
I look through the **paper chart** for old referrals and letters.	1
I keep a **paper list** in the chart (e.g., on a patient summary page) with current specialists and care providers.	2
I use my **billing program** to view a list of who I have referred to in the past for that patient.	3
I can look through my EMR to find who I have referred to and review names on consult letters, etc.	4
My EMR has a specific list of providers that my patient sees. I maintain this and it is updated when I make referrals in my EMR.	5
My EMR maintains a list and it synchronizes with a provincial EHR.	6

f. Decision Support

36 **How do you store and access reference materials (excluding patient handouts)?**

Not applicable to my work.	7
I use only **paper (textbooks and journals)** and keep copies in the office on the shelf or in filing cabinets.	1
I also use the **web** to search free sites like google.com	2
I have access to a specific reference site, or I **use standalone software on a PC or a handheld** device to look up medical reference material.	3
Website links and/or **reference databases are accessible from within my EMR**, from its user interface (e.g., the menu bar) but are not patient-specific).	4
Website links and/or reference databases can also be **accessed from a patient's file based on specified data elements** such as diagnoses, problems, lab results, meds, specific templates, etc.	5
Information available from updated **reference databases** that also **reflect local (health authority or provincial) expertise and policies is accessible from general** and **patient-specific user interfaces in my EMR.**	6

37 **How are clinical practice guidelines accessed and used in providing patient care in your practice?**

Not applicable to my work.	7
I use **paper-based guidelines** and review them when I need to.	1
I also use a **handheld device** to look up guidelines when I need to.	2
I use a **standalone PC** to look up guidelines when I need to.	3
I use an **EMR** with access to guidelines that I can read (e.g., there are links to guidelines in the EMR).	4
I use an **EMR** that **has templates and reminders built from evidence.** The **Flowsheets / templates have embedded guidelines** / evidence.	5
I use an **EMR** that has **embedded guidelines updated from external sources** to **automatically adjust** best recommendations (e.g., if evidence changes).	6

38 **How are patient reminders (for follow-up and prevention) generated in your office?**

Not applicable to my work.	7
Manually: when I see a patient I record a follow-up in the patient's chart or I rely on my memory.	1
I also use a **personally set-up, standalone reminder system (i.e., Excel spreadsheet) or my office's billing program,** which has reminders for things like mammograms and pap tests.	2
I use an **EMR** that allows **me to set up** recall reminders for an individual or groups of patients.	3
I use an **EMR** that also has **built-in automated reminders** for prevention (that I cannot add to).	4
I use an **EMR** with a **customizable rule-based reminder** system that searches a **structured database** allowing **me to set up multiple reminders** using different parameters and reminds me of overdue reviews based on common conditions. It only uses information from within the EMR.	5
I use an **EMR** with a **rule-based reminder** system that also **leverages** information on **provincial and other external repositories** to adjust rules (e.g., will confirm if patients have had immunizations from public health).	6

39 **Do you use any tools such as flow sheets, recall lists or reminders to manage your patients with chronic disease (e.g., diabetes, hypertension, COPD, etc)?**

Not applicable to my work.	7
There is **no** formal chronic disease management **system.**	1
I use **flow sheets** on paper which are part of the **paper chart.**	2
I use an electronic tool, but data must still be **entered manually** on a regular basis.	3
I use an **EMR** that **has flow sheets**, but it **does not have recall lists, etc.**	4
I use an **EMR** that **has flow sheets** and I then can generate **reminders and recall lists.**	5
As described above, but my EMR also pulls in additional data from multiple providers across the care team (e.g., if immunizations have been completed elsewhere if would not remind me to complete this).	6

g. Electronic Communication and Connectivity

40 **How do you communicate about patient issues in your office (e.g., between providers or between providers and staff?)**

Not applicable to my work.	7
We **talk** in my office / on the phone. **Paper notes** are stuck to the front of the chart and left on my desk or in an inbox for review.	1
We use **pape**r and **sometimes a secure tool like email.** (NOTE: NOT part of the patient chart but can be printed to put in the paper chart).	2
A **standalone secure communication tool (e.g., secure email)** is used for the majority of communication. It is **not part of the paper chart.**	3
A **secure electronic communication tool as part of the EMR** is used by **some providers** and the **messages** are **tagged** to the patient's **EMR record**.	4
A **secure electronic communication tool as part of the EMR** is used frequently by all providers in the office and the **messages** are **tagged** to the patient's **EMR record.**	5
Note: A level 6 is not applicable for this item	~~6~~

41 **How do you access your records while you are out of the office?**

Not applicable to my work.	7
I cannot access information in my records while I am out of the office.	1
I phone in and ask someone to review / fax information to me.	2
I access other tools remotely (e.g., hospital systems) but not my own records.	3
I occasionally access my EMR through a secure connection (e.g., by Remote Desktop, Citrix, or a secure website).	4
I regularly access my EMR through a secure connection (e.g., by Remote Desktop, Citrix, or a secure website).	5
As described above, but I can **also access my EMR from the hospital.**	6

42 **How do you communicate about patient issues with providers OUTSIDE your office (e.g., specialists, hospital), NOT including formal referrals?**

Not applicable to my work.	7
For the majority of communication, it is by **phone / fax.** It is kept **documented** in the **paper chart.**	1
Standalone, secure email is used for most of the external communication. We **print out these emails** and put them in the paper chart.	2
Standalone, secure email is used for most of the external communication. These **emails are stored electronically** outside of the paper chart.	3
Any external communication is generated outside my EMR but **copied / scanned into the EMR for all patients.**	4
I use my **EMR to generate outgoing notes**, which are **printed and faxed. All notes** are stored in my **EMR.**	5
We have an **electronic communication network** for much of the communication that is **connected to my EMR. Messages arrive** in my inbox from others **electronically**. (e.g., are not scanned).	6

h. Patient Support

43 **How do you store and access patient handouts?**

Not applicable to my work.	7
I use only **paper handouts** and keep copies in the office on the shelf or in filing cabinets.	1
I also use the **web** or other **standalone software on a PC or handheld** device to look up handouts and print them.	2
Our **practice** / group **has** a **website** with patient handouts and / or links to good resources for our patients.	3
Website links and/or reference databases are **accessible from within my EMR**, from its user interface, but are not patient specific.	4
Website links and/or reference databases can also be **accessed from a patient's file based on specified data elements** such as diagnoses, problems, lab results, meds, specified templates, etc.	5
Information available from updated **reference databases** that also **reflect local (Health Authority or Provincial) expertise and policies** is **accessible from general** and **patient specific user interfaces in my EMR.**	6

44 **How do you share the patient's own information with them?**

Not applicable to my work.	7
I do not provide patients copies of results.	1
I provide **paper copies of results** when asked.	2
I routinely provide paper copies of results for some patients.	3
Our practice uses **secure email** with patients for some activities, such as scheduling appointments or requesting refills.	4
Our **EMR** has a **patient portal**. Patients can **view some** of their **data** online and / or they can communicate with us to request appointments, etc.	5
Our **EMR** can **send data** to our **patients' PHR (Personal Health Record)**. This is used by at least 10% of patients in the practice.	6

i. Administrative Processes

45 **How do you schedule appointments in the practice?**

Not applicable to my work.	7
We have a paper scheduling system for the practice.	1
We have an electronic standalone scheduling system for the practice (NOTE: may / may not be part of the billing program).	2
We have an EMR with scheduling, but the electronic day sheet is visible only to office staff. Clinicians (e.g., physicians) review a paper print-out of the schedule.	3
We schedule in the EMR and both front staff and clinicians see the status of patients in the electronic schedule.	4
We use our EMR scheduler for complex scheduling, including documenting visit types and / or reason for visit. This is linked to the patient's electronic record.	5
Other people outside of our office can request or schedule appointments electronically into our EMR for at least some visits (e.g., patients schedule directly or family physicians can book referrals directly).	6

46 **How do you bill in the practice?**

Not applicable to my work.	7
I write my billings on paper and send them to a billing service OR I submit on paper.	1
I write my billings on paper and the office staff (or I directly) use an electronic billing system to submit and manage the bills.	2
I write my billings on paper and the office staff uses our EMR to submit and manage the bills.	3
I use the billing module in my EMR directly to add codes for visits. My office staff or I review and manage payment through the EMR.	4
I use billing templates in my EMR to generate most of the billing and diagnostic codes automatically when a visit is created. These can be edited and managed within the EMR.	5
I use my EMR and it auto-populates the billing codes based on my notes in the patient chart. These can be edited and managed within the EMR.	6

47 **How do you keep a list of other providers that you regularly refer to (i.e., specialists)?**

Not applicable to my role.	7
My lists are **kept on paper** (e.g., in a printed directory, on a rolodex or other).	1
I have some other electronic list of providers that I refer to (e.g., electronic address book, excel spreadsheet, or database)	2
I use my billing program to view a list of providers I have used in the past.	3
I use my **EMR** that has a list of providers that **can be searched or selected** as part of the referral process.	4
As described above, plus I can have lists of **favorite or common providers** or the EMR automatically ranks my provider list based on who I have referred to.	5
As described above, plus my **EMR is synchronized** and updated using a **provincial electronic provider registry**.	6

48 **How do you manage paper in the office?**

Not applicable to my work.	7
All patient information is processed and filed in the **paper charts**.	1
We scan old records into files on a computer (e.g., as PDF files) that are not connected to any electronic information system.	2
We are **scanning in some paper to an EMR** – either for select patients or select pieces of information.	3
After any incoming results / reports are reviewed they are scanned into the EMR.	4
Most / nearly all paper is scanned into the EMR and tagged (e.g., as an X-ray or consult) once it is received and then it is reviewed electronically in the EMR.	5
We have almost no paper coming into the office anymore, all or nearly all patient information is received electronically into the EMR.	6

j. Reporting and Population Health Management

49 **Do you have any disease registries? If yes, how are they managed?**

Not applicable to my work.	7
No, we do not have any disease registries.	1
We maintain paper lists for some key conditions OR we run reports out of our billing program.	2
We have our own **spreadsheet or database** to track some of our chronic disease patients or we use **another standalone tool** that is **not linked to our EMR**.	3
Our **EMR** can run reports of patients with specific diagnoses from our billing data. **The reports are built in** (we do not create our own).	4
We use our **EMR** and create our own registries from patient problem lists, not from billing data.	5
As described above, but the EMR also uses additional information from the provincial EHR.	6

50 **How do you run reports or create recall lists in your practice?**

Not applicable to my work.	7
We do not. OR We have **paper lists and calendars** where we put recalls for mammograms etc. OR we **rely** on the **provincial programs** for recalls.	1
We use our **billing program** to run reports for patients who are overdue for chronic disease visits / immunizations.	2
We have our own **spreadsheet or database** to track some of our chronic disease patients OR we use **another standalone tool** that is **NOT linked to our EMR**.	3
Our **EMR** can run reports of patients with specific diagnoses. The **reports are built in** (we do not create our own).	4
We have **complex reports** in our **EMR** that we use (e.g., diabetics with A1C over 8% who haven't been seen in 3 months) and **we create our own reports.**	5
As described above, but the **report queries** used **also include additional data from regional / provincial systems** in some way.	6

Thank you for your time and participation.

Note. EMR = Electronic Medical Record.

Appendix B: Letter of Informed Consent

Dear research participant:

Invitation: You are being invited to participate in a research study on family physician clinics and their level of meaningful use of their Electronic Medical Record (EMR) systems. We are also interested in psychological empowerment within the clinic for all employees, and in seeing if this empowerment creates a positive climate for more meaningful EMR use.

Participant Inclusions: Any employee who regularly uses whatever EMR system your physician clinic currently uses. This may include, (but is not limited to): billing clerks, booking clerks, change management advisors, data entry staff, educators, information technology specialists, LPNs, managers, MOAs, NPs, pharmacists, physicians (general practitioners only), receptionists, RNs, supervisors, or others not already listed.

Participant Exclusions: Specialist physicians and their support staff are **NOT** included in this research study.

Commitment: This research will require between 25-30 minutes of your time. During this time, you will complete an electronic survey. Paper surveys will be available on request for those who prefer this method.

Risks: There are no anticipated risks or discomforts related to this research.

Information Gathered: Several steps will be taken to protect your anonymity and identity. Your name will never be recorded at any point in the data gathering process. Potentially identifying information such as which profession replied in which manner will not be revealed to the reports given to the individual clinics, as such information could be traced back to individuals.

The information from the individual electronic surveys will be uploaded to Survey Monkey, and then downloaded to the main researcher's personal computer, which is password protected. Any paper surveys will be mailed or faxed to the one main researcher, then manually entered into the personal computer mentioned above. The information will be kept for the purposes of secondary analysis and potential future publications.

Clinic Deliverable: The identity of your clinic will be gathered in a coded format as part of the questionnaire. This will be done in order to provide an anonymized and de-identified compiled report back to your clinic at the end of the research process. This is intended to be for the purposes of business self-evaluation and future growth.

Volunteerism: Your participation in this research is completely voluntary. However, you may withdraw from the study at any time for any reason. If you do this, all information from you will be destroyed.

Results of Study: The results from this study will be presented in the Master's Thesis of Bekki Tagg, and may also be presented in writing in journals read by other professionals to help them better understand physician clinics and their meaningful use of Electronic Medical Records (EMRs) and the role of psychological empowerment in achieving a climate for their use.

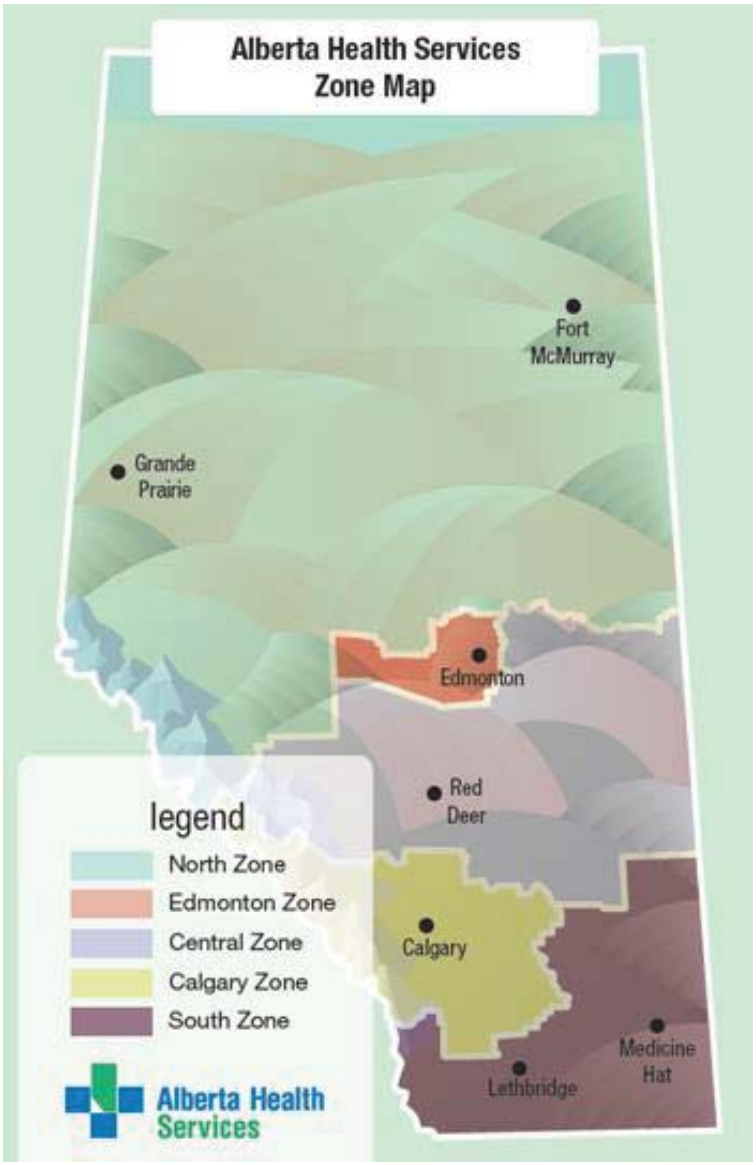
If you require any information about this study, or would like to speak to the researcher, please call Bekki Tagg at [telephone number], or email her at [email address]. If you have any other

questions regarding your rights as a participant in this research, you may also contact the Office of Research Ethics at the University of Lethbridge at [telephone number] or [email address].

I have read the above information regarding this research study on Electronic Medical Records. By completing and submitting this survey, I am giving my consent to participate in this study.

Bekki Tagg BA, RN, BN, MSc (Candidate)
Faculty of Health Sciences
University of Lethbridge
[Mailing address]
[Telephone number]
[Email address]

Appendix C: Alberta Health Services Zone Map



Note. From *Alberta Health Services Zone Map* (p. 1), by Alberta Health Services, 2015, Edmonton, AB, Canada: Alberta Health Services. Copyright 2014 by Holder. Reprinted with permission. Retrieved from http://www.albertahealthservices.ca/1532.asp

Appendix D: Call for Participants

Call for Research Participants: **Meaningful EMR Use in Family Practice Clinics**

Bekki Tagg, a registered nurse and graduate student of the Faculty of Health Sciences at the University of Lethbridge, is in the process of conducting research for her Master's degree, which explores the level of **Meaningful EMR Use in Family Practice Clinics.** This is important and timely research in today's health care landscape, as providers in family practice clinics are striving for high quality use of their EMRs. This helps health care teams collaborate to better manage their patient panels, make use of chronic disease registries, and to enable patient engagement in their own care.

Bekki is currently looking to recruit study participants from family practice clinics, including **family physicians, RNs, MOAs, receptionists, and anyone else who uses EMRs as a part of their daily work.** Participants will be asked to complete a 25-minute online survey. This project has received ethical approval from both the University of Lethbridge and the Community Research Ethics Board of Alberta (CREBA).

If your clinic is interested in taking part, please have EACH INDIVIDUAL PARTICIPANT email [email address] along with the name of their clinic and the city or town it is located. Each participant will receive an email with a "Description of Research Study" document which will provide detailed information on the project.

Each participant will also receive a separate email with a link to the survey. The benefit for participating is that you will learn specific information about your clinic's level of **Meaningful EMR Use** in comparison with other clinics in your zone and the province, and recommendations for ways to increase the meaningful usage of EMRs. The findings will be presented in summary/aggregated form. In addition a customized summary report, specific to each individual clinic will be produced.

Thank you for your time and consideration. I look forward to engaging in this exciting opportunity with you!

Bekki Tagg BA, RN, BN, MSc (Candidate)
Faculty of Health Sciences
University of Lethbridge
[Mailing address]
[Telephone number]
[Email address]

Appendix E: Description of Research Study

Description of Research Study: **Meaningful EMR Use: A Survey of Family Practice Clinics**

Invitation: You are being invited to participate in a research study. The purpose of this study is to study the interaction of a family physician clinic's climate for EMR implementation, and the level of meaningful use of its existing Electronic Medical Record (EMR) system.

Participant Inclusions: Any employee who regularly uses an EMR system within their clinic. This may include but is not limited to: billing clerks, booking clerks, change management advisors, data entry staff, educators, information technology specialists, LPNs, managers, MOAs, NPs, pharmacists, physicians (general practitioners only), receptionists, RNs, supervisors, or others not already listed. Also, interdisciplinary clinics with no physicians on staff ARE INCLUDED in this study.

Participant Exclusions: Specialist physicians and their support staff are **NOT** included in the study at this time.

Commitment: This study will require approximately 25 minutes of your time. Participation involves the completion of an online survey. Paper surveys will be made available upon request. We ask participants to complete the survey within two weeks of receiving the survey link. A reminder email will be distributed after week one of survey distribution.

Risks: There are no anticipated risks or discomforts related to this research. Individual responses will **NOT** be shared with the clinics. The choice to participate or not, or to withdraw, will **NOT** have any impact in participants' employment or with services received from the clinic.

Voluntary Participation, Anonymity and Confidentiality: Participation in the study is voluntary and participants may withdraw from the study up until the completion of data collection, before data amalgamation without explanation or consequence. Once responses have been submitted, anyone wishing to withdraw from participation may email the researcher at [email address] with the email subject line stating "Please withdraw me from your study." I will be able to identify the specific results of the person making the request, and can then delete their set of responses.

As with any electronic survey, privacy cannot be absolutely guaranteed. However, several steps will be taken to protect participant anonymity and the confidentiality of the data collected. For example, the name of each participating clinic will be replaced with a clinic code and this information will be kept on a master list, which will be stored and protected in a secured location known only to the researcher and her supervisor. This clinic code will later be replaced with a pseudonym in the published report of the findings.

Because of the need to keep track of participants' email addresses and names during the participant recruitment phase, personally identifying information will temporarily be collected. There is also an email customized link that will link responses to the participant. Once the data

collection phase has concluded, the data will be aggregated, and this link will be broken. The data will then no longer be connected to the individual participants.

All data gathered from the survey will be housed in a secured database, which will be password protected and accessible only to the researcher. Data will be kept on file in a secured location for five years post study completion and will be discarded appropriately at that time.

All data in the final thesis write-up will be presented in such a way that the identity of individual clinics will not be revealed, rather pseudonyms will be used. Participating clinics will receive a customized report of their clinic specific data. Given the small number of participants per clinic, identifying information such as how specific professions responded will not be revealed in this clinic report.

Clinic Deliverables: Clinics who participate will be given an anonymized aggregate report of their clinic's responses for Klein & Sorra's Innovation Implementation scores as well as level of Meaningful EMR usage scores. These scores will also be given in comparison with the other responses in their health zone and province. The provision of this information is intended for the purposes of business self-evaluation, future planning and growth. The report will be provided to clinic owners/management with the understanding that it is to be shared with all staff at the clinic.

Results of Study: In addition to being put forth as a final thesis, the researcher will seek publication of the final results in scholarly and industry publications and presentations to inform and add to the literature on meaningful EMR use within health care in general, and family practice clinics in particular. However, all findings will be presented in summary/aggregated form. The names of the individual clinics will never be identified in any of these end-result publications, rather pseudonyms will be used.

Further Information: Further information about the study may be attained by contacting the researcher Bekki Tagg by telephone at: [telephone number] or email at: [email address]. The Office of Research Services at the University of Lethbridge may also be contacted for information concerning the ethics approval of this research. Their contact information is as follows: telephone: [telephone number]; email: [email address].

Consent to Participate: The first page of the online survey will be a brief Letter of Informed Consent. Consent will be indicated by each participant by continuing past this page and on to the rest of the survey.

Thank you for your time and participation,

Sincerely,

Bekki Tagg BA, RN, BN, MSc (Candidate)
Faculty of Health Sciences
University of Lethbridge
[Mailing address]

Appendix F: Demographics Tables

Table F1

Demographics of Role

Question	Responses	Number	Percentage
1. Role	Billing Clerk	4	2.9%
	Booking Clerk	5	3.6%
	Change Management Advisor	1	0.7%
	Data Entry Staff	2	1.4%
	Interdisciplinary Educator	4	2.9%
	IT Specialist	4	2.9%
	Licensed Practical Nurse (LPN)	5	3.6%
	Manager	17	12.2%
	Medical Office Assistant (MOA)	29	20.9%
	Physician (GP)	30	21.6%
	Physician's Assistant (PA)	3	2.2%
	Receptionist	4	2.9%
	Registered Nurse	18	12.9%
	Supervisor	5	3.6%
	Other	8	5.8%
	No Response	0	0.0%

Table F2

Demographics of Years in Role and Clinic

Question	Responses	Number	Percentage
2. Years in Role	< 1 Year	25	18.0%
	1-5 Years	73	52.5%
	6-9 Years	22	15.8%
	10+ Years	19	13.7%
	No Response	0	0.0%
3. Years in Clinic	< 1 Year	19	13.7%
	1-5 Years	70	50.4%
	6-9 Years	28	20.1%
	10+ Years	22	15.8%
	No Response	0	0.0%

Table F3

Demographics of Age and Gender

Question	Responses	Number	Percentage
4. Age	18-25	16	11.5%
	26-35	35	25.2%
	36-45	34	24.5%
	46-55	29	20.9%
	56+	23	16.5%
	No Response	2	1.4%
5. Gender	Female	119	85.6%
	Male	20	14.4%
	No Response	0	0.0%

Table F4

Demographics of Zone

Question	Responses	Number	Percentage
6. Zone	Calgary	24	17.3%
	Central	46	33.1%
	Edmonton	23	16.5%
	North	8	5.8%
	South	38	27.3%
	No Response	0	0.0%

Table F5

Demographics of EMR

Question	Responses	Number	Percentage
7. EMR	Accuro	1	0.7%
	Health Quest	16	11.5%
	Jonoke	12	8.6%
	Oscar	2	1.4%
	MDPS (Practice Solutions)	9	6.5%
	Telus Med-Access	52	37.4%
	Telin	1	0.7%
	Telus Wolf	42	30.2%
	JET	4	2.9%
	No Response	0	0.0%

Note. EMR = Electronic Medical Record.

Table F6

Demographics of Clinic's Number of Years on EMR

Question	Responses	Number	Percentage
8. Years on EMR	< 1 Year	3	2.2%
	1-2 Years	21	15.1%
	3-4 Years	52	37.4%
	5+ Years	59	42.4%
	No Response	4	2.9%

Note. EMR = Electronic Medical Record.

Table F7

Demographics of Clinic Type

Question	Responses	Number	Percentage
9. Primary Care Network	No	13	9.4%
	Yes	116	83.5%
	I don't know	9	6.5%
	No Response	1	0.7%
10. Family Care Clinic	No	117	84.2%
	Yes	3	2.2%
	I don't know	19	13.7%
	No Response	0	0.0%

Table F8

Demographics of Whether POSP Funded or Not

Question	Responses	Number	Percentage
11. Physician Office Systems Program (POSP)	No	8	5.8%
	Yes	80	57.6%
	I don't know	48	34.5%
	No Response	3	2.2%

Table F9

Demographics of Clinic Staffing Levels

Question	Responses	Number	Percentage
12. # of Physicians (GPs)	0	1	0.7%
	1 doc	5	3.6%
	2-5 docs	50	36.0%
	6-10 docs	39	28.1%
	11-15 docs	31	22.3%
	16+ docs	13	9.4%
	No Response	0	0.0%
13. # of Non-Physician Employees	1-5 employees	22	15.8%
	6-10 employees	30	21.6%
	11-20 employees	46	33.1%
	21-30 employees	16	11.5%
	31+ employees	24	17.3%
	No Response	1	0.7%

Appendix G: Innovation Implementation Model

Descriptive Statistics & Frequencies

Table G1

Descriptive Statistics and Frequencies for Implementation Climate

	Strongly Disagree (1)		Disagree (2)		Neither Disagree Nor Agree (3)		Agree (4)		Strongly Agree (5)	
Item	No.	%	No.	%	No.	%	No.	%	No.	%
14a	1	0.7%	7	5.1%	7	5.1%	71	52.2%	50	36.8%
14b	0	0.0%	9	6.6%	11	8.0%	66	48.2%	51	37.2%
14c	1	0.7%	5	3.6%	11	8.0%	74	53.6%	47	34.1%
14d	1	0.7%	6	4.4%	15	11.1%	71	52.6%	42	31.1%
14e	2	1.5%	14	10.4%	27	20.1%	53	39.6%	38	28.4%
14f	2	1.5%	12	9.1%	31	23.5%	55	41.7%	32	24.2%
14g	1	0.7%	3	2.2%	8	5.9%	59	43.4%	65	47.8%
14h	5	3.6%	23	16.8%	31	22.6%	54	39.4%	24	17.5%
14i	6	4.4%	22	16.2%	29	21.3%	57	41.9%	22	16.2%
14j	2	1.5%	5	3.8%	21	15.1%	59	44.4%	46	34.6%
14k	1	0.7%	14	10.4%	33	24.6%	54	40.3%	32	23.9%
14l	8	6.5%	14	11.3%	55	44.4%	29	23.4%	18	14.5%
14m	3	2.6%	13	11.4%	55	48.2%	24	21.1%	19	16.7%
14n	23	20.9%	24	21.8%	36	32.7%	17	15.5%	10	9.1%
14o	28	25.5%	27	24.5%	32	29.1%	13	11.8%	10	9.1%
14p	13	10.5%	26	21.0%	46	37.1%	24	19.4%	15	12.1%
14q	12	9.8%	26	21.1%	46	37.4%	28	22.8%	11	8.9%

Table G1

Descriptive Statistics and Frequencies for Implementation Climate (Continued)

Item		N/A		Missing			
	Total	No.	%	No.	%	*M*	*SD*
14a	136	2	1.4%	1	0.7%	4.19	0.81
14b	137	1	0.7%	1	0.7%	4.16	0.83
14c	138	0	0.0%	1	0.7%	4.17	0.78
14d	135	3	2.2%	1	0.7%	4.09	0.81
14e	134	3	2.2%	2	1.4%	3.83	1.01
14f	132	2	1.4%	5	3.6%	3.78	0.97
14g	136	0	0.0%	3	2.2%	4.35	0.76
14h	137	1	0.7%	1	0.7%	3.50	1.08
14i	136	2	1.4%	1	0.7%	3.49	1.08
14j	133	4	2.9%	2	1.4%	4.07	0.89
14k	134	2	1.4%	3	2.2%	3.76	0.96
14l	124	12	8.6%	3	2.2%	3.28	1.06
14m	114	23	16.5%	2	1.4%	3.38	0.98
14n	110	26	18.7%	3	2.2%	2.70	1.22
14o	110	27	19.4%	2	1.4%	2.55	1.25
14p	124	14	10.1%	1	0.7%	3.02	1.15
14q	123	14	10.1%	2	1.4%	3.00	1.09

Table G2

Descriptive Statistics and Frequencies for Innovation-Values Fit

	Strongly Disagree (1)		Disagree (2)		Neither Disagree Nor Agree (3)		Agree(4)		Strongly Agree (5)	
Item	No.	%	No.	%	No.	%	No.	%	No.	%
15a	0	0.0%	8	5.8%	19	13.9%	69	50.4%	41	29.9%
15b*	11	8.1%	45	33.3%	33	24.4%	31	23.0%	15	11.1%
15c	0	0.0%	7	5.2%	17	12.6%	81	60.0%	30	22.2%
15d	1	0.7%	6	4.4%	12	8.8%	80	58.8%	37	27.2%
15e	0	0.0%	13	9.6%	18	13.2%	76	55.9%	29	21.3%
15f	1	0.7%	6	4.4%	17	12.5%	78	57.4%	34	25.0%
15g	5	3.6%	14	10.2%	34	24.8%	57	41.6%	27	19.7%
15h	2	1.5%	19	13.9%	13	9.5%	63	46.0%	40	29.2%
15i	2	1.5%	25	18.5%	30	22.2%	55	40.7%	23	17.0%
15j	3	2.2%	23	17.0%	32	23.7%	54	40.0%	23	17.0%
15k	0	0.0%	8	5.9%	22	16.2%	78	57.4%	28	20.6%
15l	1	0.7%	7	5.2%	33	24.4%	66	48.9%	28	20.7%
15m	2	1.5%	16	12.0%	27	20.3%	66	49.6%	22	16.5%

Note. * Indicates a reverse-coded item.

Table G2

Descriptive Statistics and Frequencies for Innovation-Values Fit (Continued)

		N/A		Missing			
Item	Total	No.	%	No.	%	*M*	*SD*
15a	137	0	0.0%	2	1.4%	4.04	0.82
15b*	135	1	0.7%	3	2.2%	3.04	1.16
15c	135	0	0.0%	4	2.9%	3.99	0.75
15d	136	0	0.0%	3	2.2%	4.07	0.78
15e	136	0	0.0%	3	2.2%	3.89	0.85
15f	136	0	0.0%	3	2.2%	4.01	0.79
15g	137	0	0.0%	2	1.4%	3.64	1.03
15h	137	0	0.0%	2	1.4%	3.88	1.03
15i	135	1	0.7%	3	2.2%	3.53	1.03
15j	135	2	1.4%	2	1.4%	3.53	1.03
15k	136	1	0.7%	2	1.4%	3.93	0.78
15l	135	2	1.4%	2	1.4%	3.84	0.84
15m	133	4	2.9%	2	1.4%	3.68	0.94

Table G3

Descriptive Statistics and Frequencies for Skills

	Strongly Disagree (1)		Disagree (2)		Neither Disagree Nor Agree (3)		Agree (4)		Strongly Agree (5)	
Item	No.	%	No.	%	No.	%	No.	%	No.	%
16a	1	0.7%	14	10.4%	19	14.1%	66	48.9%	35	25.9%
16b	3	2.2%	50	37.3%	26	19.4%	41	30.6%	14	10.4%
16c	2	1.5%	7	5.2%	10	7.5%	68	50.7%	47	35.1%
16d	2	1.6%	23	18.0%	30	23.4%	51	39.8%	22	17.2%
16e	2	1.6%	13	10.1%	20	15.5%	61	47.3%	33	25.6%
16f	0	0.0%	6	4.5%	28	21.1%	76	57.1%	23	17.3%

Table G3

Descriptive Statistics and Frequencies for Skills (Continued)

	N/A		Missing			
Total	No.	%	No.	%	*M*	*SD*
135	0	0.0%	4	2.9%	3.89	0.94
134	1	0.7	4	2.9%	3.10	1.09
134	0	0.0%	5	3.6%	4.13	0.87
128	6	4.3%	5	3.6%	3.53	1.03
129	5	3.6%	5	3.6%	3.85	0.97
133	2	1.4%	4	2.9%	3.87	0.74

Table G4

Descriptive Statistics and Frequencies for Absence of Obstacles

	Strongly Disagree (1)		Disagree (2)		Neither Disagree Nor Agree (3)		Agree (4)		Strongly Agree (5)	
Item	No.	%	No.	%	No.	%	No.	%	No.	%
17a*	22	16.7%	61	46.2%	27	20.5	18	13.6	4	3.0%
17b*	26	19.4%	70	52.2%	22	16.4%	11	8.2%	5	3.7%
17c*	31	23.3%	71	53.4%	21	15.8%	9	6.8%	1	0.8%

Note. * Indicates a reverse-coded item.

Table G4

Descriptive Statistics and Frequencies for Absence of Obstacles (Continued)

	N/A		Missing			
Item	No.	%	No.	%	*M*	*SD*
132	3	2.2%	4	2.9%	3.60	1.02
134	0	0.0%	5	3.6%	3.75	0.98
133	1	0.7%	5	3.6%	3.92	0.85

Table G5

Descriptive Statistics and Frequencies for Incentives

	Strongly Disagree (1)		Disagree (2)		Neither Disagree Nor Agree (3)		Agree (4)		Strongly Agree (5)	
Item	No.	%	No.	%	No.	%	No.	%	No.	%
18a*	78	58.2%	52	38.8%	3	2.2%	1	0.7%	0	0.0%
18b	2	1.5%	3	2.2%	11	8.2%	58	43.3%	60	44.8%

Note. * Indicates a reverse-coded item.

Table G5

Descriptive Statistics and Frequencies for Incentives (Continued)

	N/A		Missing			
Total	No.	%	No.	%	*M*	*SD*
134	0	0.0%	5	3.6%	4.54	0.58
134	1	0.7%	4	2.9%	4.28	0.83

Table G6

Descriptive Statistics and Frequencies for Commitment

	Strongly Disagree (1)		Disagree (2)		Neither Disagree Nor Agree (3)		Agree (4)		Strongly Agree (5)	
Item	No.	%	No.	%	No.	%	No.	%	No.	%
19a	1	0.7%	8	6.0%	37	27.6%	54	40.3%	34	25.4%
19b	4	3.0%	7	5.2%	40	29.9%	46	34.3%	37	27.6%
19c	3	2.2%	30	22.2%	47	34.8%	34	25.2%	21	15.6%
19d	3	2.2%	21	15.7%	35	26.1%	49	36.6%	26	19.4%

Table G6

Descriptive Statistics and Frequencies for Commitment (Continued)

		N/A		Missing			
Item	Total	No.	%	No.	%	*M*	*SD*
19a	134	0	0.0%	5	3.6%	3.84	0.90
19b	134	0	0.0%	5	3.6%	3.78	1.01
19c	135	0	0.0%	4	2.9%	3.30	1.05
19d	134	0	0.0%	5	3.6%	3.55	1.04

Table G7

Descriptive Statistics and Frequencies for Implementation Effectiveness

	Strongly Disagree (1)		Disagree (2)		Neither Disagree Nor Agree (3)		Agree (4)		Strongly Agree (5)	
Item	No.	%	No.	%	No.	%	No.	%	No.	%
20a*	63	46.7%	54	40.0%	13	9.6	5	3.7%	0	0.0%
20b*	85	64.9%	35	26.7%	7	5.3%	4	3.1%	0	0.0%
20c*	89	66.4%	41	30.6%	4	3.0%	0	0.0%	0	0.0%
20d*	81	61.4%	45	34.1%	4	3.0%	2	1.5%	0	0.0%
20e*	69	51.9%	48	36.1%	6	4.5%	10	7.5%	0	0.0%

Note. * Indicates a reverse-coded item.

Table G7

Descriptive Statistics and Frequencies for Implementation Effectiveness (Continued)

		N/A		Missing			
Item	Total	No.	%	No.	%	*M*	*SD*
20a*	135	0	0.0%	4	2.9%	4.30	0.79
20b*	131	4	2.9%	4	2.9%	4.53	0.74
20c*	134	1	0.7%	4	2.9%	4.63	0.54
20d*	132	3	2.2%	4	2.9%	4.55	0.63
20e*	133	2	1.4%	4	2.9%	4.32	0.88

Table G8

Descriptive Statistics for Combined Innovation Implementation Items

Item	*N*	*M*	*SD*
14. Implementation Climate	81	3.59	0.63
14abc. Mean Emphasis	136	4.18	0.74
14def. Goal Emphasis	130	3.89	0.86
14ghijkl. Task Support	117	3.71	0.71
14mnopq. Reward Emphasis	92	2.89	0.95
15. Innovation-Values Fit	126	3.78	0.65
15abcdef. Quality	130	3.86	0.67
15ghij. Locatibility	134	3.66	0.87
15klm. Flexibility & Coordination	133	3.81	0.71
16. Skills	126	3.74	0.71
17. Absence of Obstacles	129	3.77	0.83
18. Incentives	133	4.41	0.63
19. Commitment	132	3.63	0.82
20. Implementation Effectiveness	128	4.48	0.59

Factor Analysis

Table G9

Factor Analysis for Implementation Climate

Item	Component 1	2	3
14e. Employees are told the standards they have to meet in using the system.	.898		
14f. Employees are told the types of outcomes that they need to accomplish in using the system.	.863		
14b. Employees are told about the changes in the work procedures due to the implementation of the system, and any subsequent upgrades or changes in the workflow.	.851		
14c. Employees are told about the methods for using the system.	.851		
14d. Employees are told what they need to accomplish in using the system.	.842		
14a. Employees are told about the new work procedures for using the system.	.797		
14n. Employees perceive that the more they know about the system, the better their chances are of getting a job promotion.		.902	
14o. Employees perceive that the better they are at using the system, the more likely they are to get a bonus or a raise.		.863	
14q. Employees perceive that they are going to be recognized for time and effort they spend in learning the system.		.809	
14p. Employees know how their individual performance in using the system is evaluated.		.782	
14j. A "Help Desk" is available whenever people need help with the system.			.834
14k. Additional training for the system is available on request.			.793
14h. Helpful books, manuals, and online documents are available when employees have problems with the system.			.655
14i. Employees were given sufficient time to learn the system before they had to use it.			.330
Cronbach's α = 0.89	0.93	0.89	0.80
Eigenvalue = 6.23	4.51	2.74	1.24
Variance = 72.63%	44.39	19.50	8.73

Note. Extraction method: Principal component analysis. Rotation method: Varimax with Kaiser normalization. Rotation converged in 5 iterations.

Table G10

Factor Analysis for Innovation Values Fit

Forced Factors – Innovation Values Fit Rotated Component Matrix

Item	Component 1	Component 2
15d. The system maintains data I need to carry out my tasks.	.863	
15f. The system keeps data at an appropriate level of details so that I can complete my tasks.	.794	
15e. Sufficiently detailed data are maintained by the system.	.781	
15c. The system helps me to get data that is current enough to meet my needs.	.771	
15h. The system helps me locate patient data very easily.	.635	
15a. The system keeps data up-to-date for my tasks.	.628	
15j. The system helps me understand the meaning of data very easily.		.798
15l. The system supports cooperation between work groups.		.789
15m. The system assists me in developing diverse abilities and capabilities that are required to do my job.		.777
15i. It is easy to find out what data the system maintains on a given subject.		.693
15k. The system supports the repetitive and predictable work processes.		.610
15g. The definition of data fields relating to my tasks is easy to find.		.586
15b. The system is missing critical data that would be very useful to my tasks.		.556
Cronbach's α = 0.92	0.89	0.88
Eigenvalue	6.75	1.36
Variance = 62.38%	51.96%	10.42 %

Note. Extraction method: Principal component analysis. Rotation method: Varimax with Kaiser normalization. Rotation converged in 3 iterations.

Table G11

Factor Analysis for Skills

Skills – Component Matrix[a]

Item	Component 1
16d. I know how data in my work group links to data in other work groups.	.828
16e. I know which work groups receive the information I input into the system.	.768
16b. I understand all of the special features of the system.	.761
16a. I am very knowledgeable about how the system works.	.752
16f. I can interpret the data shown in the system without problems.	.731
16c. I can enter into the system whenever I need to.	.648

Note. Extraction method: Principal component analysis; 1 component extracted; Cronbach's α = 0.84; Eigenvalue = 3.38; Variance = 56.25%.

Table G12

Factor Analysis for Absence of Obstacles

Absence of Obstacles – Component Matrix

Item	Component 1
17c. There are a lot of organizational barriers that prevent me from using the system effectively (e.g., clinic procedures or rules, either written or unwritten).	.891
17b. Due to the lack of technical support, I have found the system difficult to use.	.876
17a. Due to the lack of organizational resources (e.g., time, training), I have faced a lot of difficulties in learning to use the system.	.831

Note. Extraction method: Principal component analysis; 1 component extracted; Cronbach's α = 0.83; Eigenvalue = 2.25; Variance = 75.05%.

Table G13

Analysis for Incentives

Incentives – Component Matrix

Item	Component 1
18a. I am discouraged from using the system.	.887
18b. I am motivated to use the system.	.887

Note. Extraction method: Principal component analysis; 1 component extracted; Cronbach's α = 0.70; Eigenvalue = 1.57; Variance = 78.64%.

Table G14

Factor Analysis for Implementation Effectiveness

Implementation Effectiveness – Component Matrix[a]

Item	Component 1
20d. When I can do a task using either the system or NOT using the system, I usually choose NOT to use it.	.914
20c. If I can avoid using the system, I do.	.898
20b. If I had my way, this clinic would go back to the old way and forget the system.	.859
20a. I think the system is a waste of time and money for our organization.	.797
20e Even when I can do a task using the system, I sometimes use other ways to complete the task.	.714

Note. Extraction method: Principal component analysis; 1 component extracted Cronbach's α = 0.88; Eigenvalue = 3.52; Variance = 70.47%.

Table G15

Correlations Between Innovation Implementation Items and Sub-Items

Item		*M*	*SD*	*n*	*α*	14	14a	14b	14c	14d
14	Implementation Climate	3.59	.63	81	.91	1.00				
	a. Mean Emphasis	4.18	.74	136	.90	.70**	1.00			
	b. Goal Emphasis	3.90	.86	130	.91	.79**	.78**	1.00		
	c. Task Support	3.71	.71	117	.84	.85**	.58**	.60**	1.00	
	d. Reward Emphasis	2.89	.95	92	.87	.81**	.25*	.39**	.56**	1.00
15	Innovation-Values Fit	3.77	.65	126	.92	.59**	.42**	.40**	.65**	.34**
	a. Quality	3.86	.67	130	.86	.49**	.38**	.33**	.58**	.22*
	b. Locatibility	3.66	.87	134	.86	.45**	.32**	.30**	.56**	.33**
	c. Flexibility & Coordination	3.81	.71	133	.77	.57**	.41**	.46**	.53**	.39**
16	Skills	3.74	.71	126	.84	.45**	.35**	.34**	.49**	.33**
17	Absence of Obstacles	3.77	.83	129	.83	.62**	.44**	.34**	.68**	.30**
18	Incentives	4.41	.63	133	.70	.32**	.37**	.31**	.30**	.10
19	Commitment	3.63	.82	132	.84	.56**	.43**	.36**	.55**	.43**
20	Implementation Effectiveness	4.48	.59	128	.88	.35**	.35**	.34**	.40**	.14

Table G15

Correlations Between Innovation Implementation Items and Sub-Items (Continued)

Item		15	15a	15b	15c	16	17	18	19	20
14	Implementation Climate									
	a. Mean Emphasis									
	b. Goal Emphasis									
	c. Task Support									
	d. Reward Emphasis									
15	Innovation-Values Fit	1.00								
	a. Quality	.91**	1.00							
	b. Locatibility	.92**	.73**	1.00						
	c. Flexibility & Coordination	.80**	.60**	.68**	1.00					
16	Skills	.46**	.49**	.37**	.38**	1.00				
17	Absence of Obstacles	.67**	.60**	.59**	.51**	.58**	1.00			
18	Incentives	.31**	.28**	.27**	.32**	.27**	.38**	1.00		
19	Commitment	.44**	.37**	.40**	.46**	.46**	.49**	.44**	1.00	
20	Implementation Effectiveness	.45**	.47**	.37**	.41**	.42**	.43**	.59**	.53**	1.00

Appendix H: Meaningful Electronic Medical Record Use

Descriptive Statistics & Frequencies

Table H1

Health Information

	1		2		3		4		5		6	
Item	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
21	11	9.5%	3	2.6%	0	0.0%	1	0.9%	85	73.3%	16	13.8%
22	0	0.0%	0	0.0%	4	3.7%	23	21.1%	75	68.8%	7	6.4%
23	0	0.0%	0	0.0%	0	0.0%	57	54.3%	41	39.0%	7	6.7%

Table H1

Health Information (Continued)

		N/A		Missing			
Item	Total	No.	%	No.	%	*M*	*SD*
21	116	16	11.5%	7	5.0%	4.67	1.34
22	109	23	1.5%	7	5.0%	4.78	0.61
23	105	28	20.1%	6	4.3%	4.52	0.62

Table H2

Medications

	1		2		3		4		5		6	
Item	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
24	0	0.0%	0	0.0%	0	0.0%	29	69.0%	11	26.2%	2	4.8%
25	0	0.0%	0	0.0%	0	0.0%	10	24.4%	27	65.9%	4	9.8%
26	2	4.2%	0	0.0%	1	2.1%	24	50.0%	21	43.8%	0	0.0%
27	2	5.0%	15	37.5%	11	27.5%	9	22.5%	2	5.0%	1	2.5%

Table H2

Medications (Continued)

		N/A		Missing			
Item	Total	No.	%	No.	%	*M*	*SD*
24	42	92	66.2%	5	3.6%	4.36	0.58
25	41	93	66.9%	5	3.6%	4.85	0.57
26	48	86	61.9%	5	3.6%	4.29	0.87
27	40	94	67.6%	5	3.6%	2.93	1.12

Table H3

Laboratory

	1		2		3		4		5		6	
Item	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
28	8	10.4%	1	1.3%	2	2.6%	54	70.1%	10	13.0%	2	2.6%
29	0	0.0%	1	1.4%	3	4.1%	42	57.5%	20	27.4%	7	9.6%

Table H3

Laboratory (Continued)

		N/A		Missing			
Item	Total	No.	%	No.	%	*M*	*SD*
28	77	57	41.0%	5	3.6%	3.82	1.11
29	73	62	44.6%	4	2.9%	4.40	0.78

Table H4

Medical Imaging

	1		2		3		4		5		6	
Item	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
30	12	17.1%	3	4.3%	1	1.4%	2	2.9%	48	68.6%	4	5.7%
31	5	7.0%	0	0.0%	1	1.4%	32	45.1%	23	32.4%	10	14.1%
32	13	26.0%	12	24.0%	12	24.0%	3	6.0%	6	12.0%	4	8.0%

Table H4

Medical Imaging (Continued)

		N/A		Missing			
Item	Total	No.	%	No.	%	*M*	*SD*
30	70	65	46.8%	4	2.9%	4.19	1.63
31	71	63	45.3%	5	3.6%	4.38	1.19
32	50	83	59.7%	6	4.3	2.78	1.59

Table H5

Referrals

	1		2		3		4		5		6	
Item	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
33	2	3.2%	1	1.6%	1	1.6%	19	30.6%	38	61.3%	1	1.6%
34	12	16.2%	1	1.4%	1	1.4%	43	58.1%	15	20.3%	2	2.7%
35	0	0.0%	0	0.0%	1	1.2%	67	81.7%	11	13.4%	3	3.7%

Table H5

Referrals (Continued)

		N/A		Missing			
Item	Total	No.	%	No.	%	*M*	*SD*
33	62	72	51.8%	5	3.6%	4.50	0.90
34	74	60	43.2%	5	3.6%	3.73	1.34
35	82	52	37.4%	5	3.6%	4.20	0.51

Table H6

Decision Support

	1		2		3		4		5		6	
Item	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
36	8	10.4%	16	20.8%	23	29.9%	24	31.2%	1	1.3%	5	6.5%
37	16	22.5%	6	8.5%	26	36.6%	10	14.1%	12	16.9%	1	1.4%
38	12	12.9%	2	2.2%	46	49.5%	0	0.0%	31	33.3%	2	2.2%
39	7	10.3%	2	2.9%	18	26.5%	15	22.1%	25	36.8%	1	1.5%

Table H6

Decision Support (Continued)

		N/A		Missing			
Item	Total	No.	%	No.	%	*M*	*SD*
36	77	57	41.0%	5	3.6%	3.12	1.26
37	71	63	45.3%	5	3.6%	2.99	1.40
38	93	40	28.8%	6	4.3%	3.45	1.37
39	68	66	47.5%	5	3.6%	3.76	1.31

Table H7

Electronic Communication and Connectivity

	1		2		3		4		5		6	
Item	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
40	7	6.1%	4	3.5%	5	4.4%	30	26.3%	68	59.6%	N/A	N/A
41	13	17.8%	1	1.4%	1	1.4%	19	26.0%	35	47.9%	4	5.5%
42	31	40.8%	1	1.3%	0	0.0%	12	15.8%	29	38.2%	3	3.9%

Note. There is no level 5 usage for question 40.

Table H7

Electronic Communication and Connectivity (Continued)

		N/A		Missing			
Item	Total	No.	%	No.	%	*M*	*SD*
40	114	19	13.7%	6	4.3%	4.30	1.12
41	73	60	43.2%	6	4.3%	4.01	1.55
42	76	57	41.0%	6	4.3%	3.21	1.92

Table H8

Patient Support

	1		2		3		4		5		6	
Item	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
43	31	33.7%	30	32.6%	8	8.7%	15	16.3%	2	2.2%	6	6.5%
44	3	3.3%	70	76.1%	12	13.0%	3	3.3%	0	0.0%	4	4.3%

Table H8

Patient Support (Continued)

		N/A		Missing			
Item	Total	No.	%	No.	%	*M*	*SD*
43	92	40	28.8%	7	5.0%	2.40	1.48
44	92	40	28.8%	7	5.0%	2.34	0.94

Table H9

Administrative Process

	1		2		3		4		5		6	
Item	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
45	0	0.0%	2	1.7%	7	5.8%	40	33.1%	70	57.9%	2	1.7%
46	3	5.4%	0	0.0%	4	7.1%	23	41.1%	17	30.4%	9	16.1%
47	7	7.8%	7	7.8%	1	1.1%	57	63.3%	14	15.6%	4	4.4%
48	0	0.0%	5	4.0%	9	7.3%	17	13.7%	77	62.1%	16	12.9%

Table H9

Administrative Process (Continued)

		N/A		Missing			
Item	Total	No.	%	No.	%	*M*	*SD*
45	121	12	8.6%	6	4.3%	4.52	0.71
46	56	77	55.4%	6	4.3%	4.39	1.17
47	90	43	30.9%	6	4.3%	3.84	1.16
48	124	8	5.8%	7	5.8%	4.73	0.92

Table H10

Reporting and Population Health Management

	1		2		3		4		5		6	
Item	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
49	24	37.5%	1	1.6%	2	3.1%	9	14.1%	23	35.9%	5	7.8%
50	15	19.5%	0	0.0%	1	1.3%	20	26.0%	40	51.9%	1	1.3%

Table H10

Reporting and Population Health Management (Continued)

		N/A		Missing			
Item	Total	No.	%	No.	%	*M*	*SD*
49	64	68	48.9%	7	5.0%	3.33	1.94
50	77	55	39.6%	7	5.0%	3.95	1.54

Table H11

Descriptive Statistics for Combined Meaningful Electronic Medical Record Use Items

Question No.	*N*	*M*	*SD*
21–23. Health Information	96	4.68	0.61
24–27. Medications	37	4.13	0.56
28–29. Laboratory	67	4.10	0.79
30–32. Medical Imaging	44	3.75	0.93
33-35. Referrals	53	4.18	0.57
36–39. Decision Support	50	3.45	0.88
40–42. Electronic Communication & Connectivity	55	3.87	1.10
43–44. Patient Support	82	2.45	0.96
45–48. Administrative Process	48	4.39	0.67
49–50. Reporting & Population Health Management	56	3.58	1.56

Factor Analysis

Table H12

Factor Analysis for Health Information

Health Information – Component Matrix

Item	Component 1
22. Where do you keep a patient's medical summary?	.847
23. How do you record your patient visit or encounter notes?	.697
21. How do you keep track of the patient demographics in your practice?	.617

Note. Extraction method: Principal component analysis; 1 component extracted. Cronbach's α = 0.45; Eigenvalue = 1.58; Variance = 52.78%.

Table H13

Factor Analysis for Medications

Item	Component 1
24. How do you write new drug prescriptions?	.874
27. How are you supported in making decisions about prescriptions (e.g., alerts when writing or renewing a prescription).	.823
25 How do you write renewal drug prescriptions DURING office visits?	.667
26. Describe your process for managing medication prescription renewals OUTSIDE of a visit.	.477

Note. Extraction method: Principal component analysis; 1 component extracted. Cronbach's α = 0.64; Eigenvalue = 2.11; Variance = 52.86%.

Table H14

Factor Analysis for Laboratory

Laboratory – Component Matrix

Item	Component 1
28. How do you order lab tests?	.830
29. How do you receive, review and process lab results?	.830

Note. Extraction method: Principal component analysis; 1 component extracted. Cronbach's α = 0.53; Eigenvalue = 1.38; Variance = 68.95%.

Table H15

Factor Analysis for Medical Imaging

Medical Imaging – Component Matrix

Item	Component 1
32. How do you view the images (e.g., X-rays, CT, MRI)?	.734
30. How do you order diagnostic tests? (e.g., X-rays, U/S, CT, MRI, PFT, stress tests, etc.)	.571
31. How do you receive, review, and process diagnostic imaging reports?	.556

Note. Extraction method: Principal component analysis; 1 component extracted. Cronbach's α = 0.22; Eigenvalue = 1.17; Variance = 39.14%.

Table H16

Factor Analysis for Referrals

Referrals – Rotated Component Matrix

	Component	
Item	1	2
34. How do you receive and process consultation reports (e.g., the letter back from the consultant)?	.802	
35. How do you keep track of which providers a patient sees (e.g., specialists, home care nurses, physiotherapist)?	.734	
33. How do you make a referral?		0.955
Cronbach's α = 0.09	0.08	N/A
Eigenvalue = 1.20	1.20	1.01
Variance = 39.40%	39.40%	34.24%

Note. Extraction method: Principal component analysis; 2 components extracted.

Table H17

Factor Analysis for Decision Support

Decision Support – Rotated Component Matrix

	Component	
Item	1	2
38. How are patient reminders (for follow-up and prevention) generated in your office?	.867	
39. Do you use tools such as flow sheets, recall lists, or reminders to manage your patients with chronic disease (e.	.809	
36. How do you store and access reference materials (EXCLUDING patient handouts)?		0.908
Cronbach's α = 0.09	0.68	0.24
Eigenvalue = 1.20	1.83	1.07
Variance = 39.40%	45.62%	26.83%

Note. Extraction method: Principal component analysis; 2 components extracted.

Table H18

Factor Analysis of Electronic Communication & Connectivity

Electronic Communication & Connectivity – Component Matrix

Item	Component 1
41. How do you access your records while you are out of the office?	.748
40. How do you communicate about patient issues in your office (e.g., between providers or between providers and staff	.694
42. How do you communicate about patient issues with providers OUTSIDE your office (e.g., specialists, hospital), NOT including formal referrals?	.675

Note. Extraction Method: Principal Component Analysis; 1 component extracted. Cronbach's α = 0.48; Eigenvalue = 1.50; Variance = 49.89%.

Table H19

Factor Analysis of Patient Support

Patient Support – Component Matrix

Item	Component 1
44. How do you share the patient's own information with them?	.769
43. How do you store and access patient handouts?	.769

Note. Extraction Method: Principal Component Analysis; 1 component extracted. Cronbach's α = 0.29; Eigenvalue = 1.18; Variance = 59.14%.

Table H20

Factor Analysis for Administrative Processes

Administrative Processes – Component Matrix

Item	Component 1
45. How do you schedule appointments in the practice?	.728
48. How do you manage paper in the office?	.717
46. How do you bill in the practice?	.712
47. How do you keep a list of other providers that you regularly refer to (e.g., specialists)?	.546

Note. Extraction Method: Principal Component Analysis; 1 component extracted. Cronbach's α = 0.58; Eigenvalue = 1.847; Variance = 46.19%.

Table H21

Factor Analysis for Administrative Processes

Reporting & Population Health Management – Component Matrix

Item	Component 1
49. Do you have any disease registries? If yes, how are they managed?	.891
50. How do you run reports or create recall lists in your practice?	.891

Note. Extraction Method: Principal Component Analysis; 1 component extracted. Cronbach's α = 0.74; Eigenvalue = 1.59 Variance = 79.45%.

Table H22

Correlations Between Meaningful Electronic Medical Record Use Items

Item	*M*	*SD*	*n*	α	1	2	3	4	5	6	7	8	9	10
1 Health Information	4.68	0.61	96	.45	1.00									
2 Medications	4.13	0.56	37	.64	.30	1.00								
3 Laboratory	4.10	0.80	67	.53	.03	.45**	1.00							
4 Medical Imaging	3.75	0.93	44	.22	.08	.42*	.49**	1.00						
5 Referrals	4.18	0.57	53	.09	.33*	.14	.40**	.37*	1.00					
6 Decision Support	3.45	0.88	50	.59	.47**	.49**	.41**	.44*	.30	1.00				
7 E-Communication & Connectivity	3.87	1.10	55	.48	.40**	.29	.33*	-.06	.29	.33*	1.00			
8 Patient Support	2.45	0.96	82	.29	.45**	.28	.38**	.46**	.33*	.60**	.43**	1.00		
9 Administrative Process	4.39	0.67	48	.58	.20	.33	.40*	.23	.39*	.37**	.70**	.49**	1.00	
10 Reporting & Pop. Health Management	3.58	1.56	56	.74	-0.01	.21	.16	.16	-.04	.185	.22	.25	.25	1.00

Note. * Correlation significant at the 0.05 level; ** Correlation significant at the 0.01 level; Pop. = Population.