CANADIAN FORCES CARE PROVIDER ACCEPTANCE OF THE ELECTRONIC MEDICAL RECORD: A QUALITATIVE DELPHI STUDY

by

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ABSTRACT

Low adoption of the electronic medical record persists despite obvious benefits of centralized medical record management. A survey of Canadian care providers provided several reasons not to adopt the electronic medical record (EMR). An understanding of the problems leading to low EMR adoption was key, as solutions can only be found when problems of low adoption are clearly defined. Canadian healthcare spending on ostensibly interoperable medical records has failed to provide a viable and encompassing care provision system. Canadian government healthcare spending exceeded $1 Billion in the last decade, while less than 30% of care providers have adopted an EMR. A Delphi method study processed three surveys seeking final concurrence on the greatest barriers and facilitators to EMR adoption among care providers. Important variables such as care provider location, experience, age, computer literacy, and prior exposure to EMRs were measured. Results showed the greatest care provider barrier to be resistance to the EMR as concept. The implications of these findings might suggest revisiting EMR implementation, financing, user training, and help-desk practices that collectively influence current care provider adoption patterns. Benefits may include targeted healthcare spending, increased EMR adoption, interoperable medical records, fewer lost records, and improved patient assessment based on congregated and comprehensive medical data.
DEDICATION

This research dedicated to future healthcare researchers, who will hopefully take bold strides toward an interoperable EMR system providing care to all. I would also like to dedicate this academic journey to Joe and Laura Power of Esquimalt, who channeled me into furthering my education. Your support and direction led me to this doctorate – heartfelt thanks to both of you.
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CHAPTER 1: INTRODUCTION

Care provider adoption and acceptance of an electronic medical record (EMR) remains an elusive goal in pursuit of a pan-Canadian interoperable electronic health record, or EHR. In short, an EMR is a local collection of patient data whereas an EHR is a national collection of patient data from many providers (Canadian Medical Protective Association, 2010). Research has been completed on the factors that influence EMR adoption (Brookstone, 2010; Ludwick, Manca, & Doucette, 2010; Rich, 2009); however, the solution to overcoming resistance to change among Canadian care providers requires further research. Care provider adoption of the EMR is a prerequisite for increased and eventual complete implementation of an EHR for Canadian citizens. Significant progress in interoperability of an EHR can only be achieved once care providers willingly espouse the EMR.

A series of questionnaires were proposed in order to collect information on EMR adoption barriers as well as EMR facilitation measures. Questionnaires posed open-ended questions to EMR users in Canada. The theoretical framework of resistance to change formed the basis of an enquiry into low EMR adoption among Canada’s care providers. EMR users were assumed to be information technology enabled care providers in good standing within the medical community. Chapter 1 includes an examination of the problem statement along with definitions and assumptions specific to answering two research questions. Scope, limitations, and delimitations were followed a chapter summary and an introduction to Chapter 2.

Background

To avoid confusion between terminologies such as Electronic Health Record, or EHR, and Electronic Medical Record, or EMR, a brief description is provided. The Electronic Medical Record is considered the legal health record created by care providers in a hospital or clinic.
The Electronic Health Record provides a repository of information among patients, healthcare providers, government organizations, employers, and insurance agencies (Canadian Medical Association, 2008). In short, the EHR is more national and encompassing in scope than the EMR. The EMR essentially contains localized information of patients within distinct care provider networks.

A National Physician Survey on the use of Information Technology was conducted with The Royal College of Physicians and Surgeons of Canada, the Canadian Medical Association, and the College of Family Physicians of Canada (Canadian Medical Association, 2008), to which nearly 20,000 physicians responded. The literature (CMA, 2008) highlighted some factors that detracted from increasing care provider adoption: a desire for improved EMR quality and efficiency in practice, proof of records in the EMR being secure, and acquiring the EMR system from a proven, credible software manufacturer. Factors that influenced EMR adoption among Canadian physicians included receiving training in the use of the EMR system when purchasing, comprehensive installation support, and testimonials from other doctors with high EMR satisfaction levels (CMA, 2008).

A further survey of primary care physicians in 11 countries found that “only 37% of Canadian family physician respondents used electronic medical records in medical practices, the lowest rate among the countries surveyed” (Canadian Medical Association Journal, February 2010, p. E103). Countries compared to Canada included Netherlands, Australia, Italy, New Zealand, Norway, Sweden, United Kingdom, Germany, France, and the United States. Near universal EMR take-up in countries such as the Netherlands has been supported by financial incentives, standards, and technical support at the national level (Canadian Medical Association,
Canadian physicians unable to integrate patient records across multiple care providers saw little reason to implement a system with negligible benefit. Further areas of concern for Canadian physicians included the need for service guarantees from the EMR vendor, assistance with influencing decision-makers within a primary practice setting, and receiving a subsidy to help cover costs associated with implementing EMRs. EMR adoption barriers included time and effort involved in implementation, cost, security, lack of information, lack of administrative staff skills to use the EMR, and the lack of internal champions to lead the EMR integration (Canadian Medical Association Submission to the House Committee, 2008). Webster (2010) noted that profit-driven motives of EMR vendors did little to improve patient outcomes at the physician level.

Providers required a complete history of patient medical data to provide effective patient care. Many electronic medical records encapsulate partial patient histories. Providers who purchased EMRs could only manipulate patient records held within that vendor’s database; little interoperability existed between distinct vendor EMRs. Providers should be able to access distinct patient information held in all electronic medical records, to ensure patient care based on complete information. Striving toward a pan-Canadian interoperable EHR before ensuring basic interoperability between individual EMR ‘cells’ would not seem prudent.

A comprehensive and rapid analysis of patient data required an overall knowledge of interventions, medications, conditions, and drug interactions (Bates & Gawande, 2003). The detailed analysis of paper-based data required costly and time-consuming compilation of relevant material from the patient’s medical file. An absence of EMR interoperability and poor physician adoption of EMRs posed a serious threat to patient safety, as partial medical patient information
among a small percentage of EMR adopters complicated efforts aimed at greater EMR integration.

The concept of an EMR is relatively new, where the beginnings of the internet may serve as a precursor for electronic information exchange. To appreciate the progress made within the medical community regarding adoption of the EMR, an understanding of factors affecting adoption was relevant. Existing literature defined a variety of issues affecting EMR adoption, chief among all being the cost of implementing and sustaining the EMR (Keshavjee, 2007; Ludwick & Doucette, 2009; Terry et al., 2008).

Comparisons with other countries’ EMR adoption rates showed successes and failures achieved within respective healthcare financing and remuneration systems. Current literature showed American EMR adoption influenced by physician age, practice size, gender, information technology budget allocations within the practice, privacy, quality of care, and interoperability among various ‘flavors’ of EMR (Menachemi, Van Durme, & Brooks, 2007). Key to care provider adoption were the ease of operation of the EMR. Little information was available on issues affecting Canadian physicians’ adoption of EMRs, indicating a need for further study. One study showed that only 23% of Canadian primary care doctors used electronic patient medical records (Schoen et al., 2006). The same study cited only eight percent of doctors using at least 7 of 14 key functions available within the EMR.

EMRs may be seen as precursors to an EHR. Canada Health Infoway was deemed to be Canada’s primary EHR implementation organization. The health division of the Information Technology Association of Canada, the Association of Health Technology Industry, and Infoway have collaborated to accelerate the transition to a new set of pan-Canadian health information standards (Koff, 2005). Pan-Canadian interoperability profiles were supported by industry
standards such as Health Level 7 (HL7). HL7’s Clinical Document Architecture provided healthcare related documentation standards. Digital Imaging and Communications in Medicine prescribed messaging standards, while the Systematized Nomenclature of Medicine-Clinical Terms or SNOMED-CT provided terminology standards (Giokas, 2005).

Interoperability was one of the key concerns among organizations determined to standardize nomenclature, architecture, and EHR implementation. Interoperability, however, should refocus on standardization within smaller, granular physician EMRs within care provider offices, before a grand effort is made to standardize nomenclature, messaging standards, and architecture in pursuit of a nationally interoperable EHR. Building a brick house without ensuring suitable bricks and mortar may serve as an apt analogy. An EMR should ideally be implemented in component blocks as opposed to an all-encompassing roll out. Multispecialty and larger practices would more likely adopt an EMR as opposed to single specialty and solo practitioners, “probably attributable to the economies of scale that larger practices have in terms of increased access to both financial and human resources” (Menachemi et al., 2006, p. 84).

Of the 70,000 physicians within the Canadian Medical Association’s database, 63,632 were licensed and practicing (Canadian Medical Association, 2009). The remainder were retired, military physicians, completing residencies, or non-licenced. A snapshot of the province of Alberta’s physicians indicated physicians seeing roughly 30 patients per day at 10 minutes per visit (Ludwick & Doucette, 2009). Ontario’s fee-for-service physicians averaged 149 weekly patient visits spread across 39.42 hours devoted to direct patient care. The data translated to 15.87 minutes per visit. Fee for service physicians in group practices devoted 35 hours to seeing 140.9 patients, or 14.9 minutes per patient (Sarma, Devlin, & Hogg, 20094). An EMR that positively influenced patient visit duration and quality might be considered by physicians.
Problem Statement

The general problem of low EMR adoption among Canada’s care providers required understanding from a user perspective (Keshavjee et al., 2006). The general problem of low EMR adoption persisted despite Canadian provincial funding and programs aimed at addressing stubbornly low adoption rates. The specific problem was low adoption of the EMR concept within Canada due to an absence of EMR interoperability (Keshavjee et al., 2006).

Interoperability inferred an ability to communicate on agreed-upon media, with standardized nomenclature used to describe patient conditions. In Canada’s largest province Ontario, low adoption of the EMR occurred due to a lack of health information technology integration among Ontario’s medical practices and organizations (Aprile, 2010). Poor technology integration influenced the success and failure of health informatics systems (Brender, Ammenwerth, Nykanen, & Talmon, 2006).

The specific problem was addressed by a qualitative Delphi study aimed at Canadian Armed Forces care providers. The Delphi methodology encompassed three Rounds of questionnaires that sought respondent concurrence regarding barriers to and facilitation of EMR implementation. The questionnaires determined which barriers and facilitators were most influential in preventing or enticing care providers to further adopt the EMR. Low EMR adoption presented a concern for pan-Canadian efforts at greater EMR interoperability among care providers, healthcare institutions, and the medical community at large. The impact of non-implementation affected the quality of care, wait times, and the ability to collect patient information centrally.
Purpose

The purpose of the qualitative Delphi study was to study factors that influenced care provider acceptance of the EMR. The EHR as concept was too broad, as the EHR is an unfulfilled idea of the future. Acceptance of the EMR must precede realization of the EHR, which can only be realized once EMRs have been fully utilized. The audience to which the problem was significant included Canada’s care providers. A narrowly defined subset of care providers within Canada’s 13 provinces and territories was chosen due to ease of access, as the sample was chosen from the Canadian military health services group.

Emails were sent to 467 care providers employed in the Canadian military (called the Canadian Forces), as the purpose of polling approximately 70,000 licenced and unlicenced Canadian care providers was deemed too broad. Respondent feedback was requested on the EMR as concept, while reminding Canadian Forces care providers of possible bias resulting from the Canadian Forces Health Information Systems (CFHIS) software suite already in use. Respondents from the initial 467 invitees were considered as the prime interest group. Initial questionnaire respondents provided data for Rounds 2 and 3.

The purpose of EMR feedback was stated in a cover letter sent to care providers working for the Canadian Forces. Even though care providers working within the Canadian Forces were spread across Canada, the providers were collectively accessible through the Canadian Defence Wide Area Network (DWAN). The research design was structured to collect questionnaire responses to questions of EMR adoption and facilitation factors. The research design structured group opinion and discussion around EMR adoption issues.

The data collection strategy ensured anonymity of respondent interaction, with feedback compiled into grouped responses showing dominant themes. The purpose behind using the
eListen® survey collection software was to remove respondent identification before data were forwarded to the researcher. eListen® used a Defence intranet only accessible from military computer terminals, which increased safety and integrity of data. Once the grouped responses tended toward agreement on common barriers and facilitators of EMR adoption, data were analyzed for content. Mean and median values were determined to show the level of agreement among respondents. A final third Round list of the most influential barriers and facilitators required respondent concurrence.

The purpose of overcoming impediments to greater EMR adoption extended into areas of population health. Increased EMR adoption might afford an increased capacity of healthcare providers to assess trends in population health (Gagnon et al., 2009). Results could assist Canadian decision-makers and leadership with vested interests in pursuing greater EMR adoption among Canadian care providers. National electronic databases for morbidity, mortality, disease incidence, and prevalence could be created to aid government in disease control outbreak monitoring (Kamhuka, 2008). Improved adoption would provide opportunities to link Canadian care providers to international EMRs and EHRs. The Canadian Forces has shown an interest in the results of the study, and requested to publish study results on the Canadian Forces Health Services Science and Technology Defence Strategy website.

Significance of the Study

Current literature showed persistently low EMR adoption despite concerted efforts to broaden the appeal of an EMR among Canadian care providers. Significant reasons for low adoption included EMRs that did not meet care provider expectations, time and training required to train care providers in EMR usage, and the absence of a champion for increased EMR adoption (Terry et al., 2008). The significance of an EMR study related to the need for smaller
and more manageable electronic medical records being implemented, before considering national or international EHRs.

New data sought to add material to augment guidelines for EMR adoption initiatives aimed at wait times reduction, chronic disease management, information integration, and interoperability among EMRs (Canada Health Infoway, 2009). Few Delphi studies have addressed physician adoption of an electronic health record or electronic medical record (England & Stewart, 2007; Terry et al., 2008; Williams & Whittier, 2007). Once key barriers to adoption have been identified and acted upon through applied EMR implementation redesign, future studies may build upon redesign developments to improve EMR adoption.

Significance to Leadership

Electronic media adoption issues might be of interest to pan-Canadian organizations such as Canada Health Infoway, the Canadian Institute for Health Information, the Canadian Medical Association, and the Canadian Forces Health Services leadership. The Canadian Medical Association (2008) recorded only 23% adoption rates for Electronic Health Records across Canada. “Eighty-eight percent of Canadians believed electronic health records will improve delivery of health care” (Canada Health Infoway Annual Report 2007-2008, p. 4). Few studies existed to determine what Canadian care providers thought of efforts aimed at increasing adoption (CMA, 2009; Hally, 2007; Korn, 2007; Leonard, 2007). Data sharing on national and international infectious episodes such as Severe Acute Respiratory Syndrome and the Swine Flu would demand coordinated communication among care providers. An effective health assessment database would therefore require an interoperable health record system.
Nature of the Study

A qualitative research method examined care provider adoption issues. The nature of the problem statement determined that a qualitative research method would be more suited than mixed method or quantitative methods. Qualitative research required an interpretive approach toward understanding how barriers and facilitators were perceived. Qualitative responses were analyzed to determine repetitive patterns in responses; the research methodology remained qualitative in nature as recommendations and conclusions were based on qualitative data. Klein and Myers (1999) offered a useful set of principles for qualitative research on information systems. Contextualized responses offered feedback influenced by care provider experiences with EMRs, where the interaction with an EMR entrenched or ameliorated respondent resistance to change (Klein & Myers, 1999).

Questionnaire responses were likely influenced by respondent experiences with an EMR within the greater sphere of information technology. Aggregated respondent feedback was coded and listed under themes of care provider adoption barriers and facilitators. Once qualitative barrier and facilitators themes were identified, correlation values exceeding 0.7 were identified for further analysis. The 0.7 value was not known a priori, but was chosen based on literature research (Berman, 2011). The Delphi research technique was an appropriate consensus method (Hsu & Sandford, 2007) for synthesizing qualitative feedback from questionnaire respondents. A lack of scientific evidence for low EMR adoption was complicated by contradictory evidence linking EMRs to improved patient safety (Chaudry et al., 2006). The Delphi method sought to overcome the lack of scientific evidence by using three Rounds of consensus development questionnaires.
Round 1 invited respondents to provide opinions on low EMR adoption among Canadian care providers. Bias may have resulted from care provider experiences with the Canadian Forces Health Information System (or CFHIS). Consequently, a notice was sent to care providers urging feedback on the EMR as concept. If care providers had only ever used CFHIS, then feedback was deemed to be biased due to an absence of experience with other EMRs. A question within the first Round survey determined respondent familiarity to health information systems other than CFHIS.

Respondents were grouped under case and variable headings as used in the Statistical Package for the Social Sciences (or SPSS) research syntax. An example of cases, variables, and values might be case (care provider), variable (sex), variable label (respondent sex), value (1 or 0), and value label (male or female). Respondent feedback was collated and returned to respondents for further consensus deliberations in Round 2. Round 2 requested respondents to rank EMR adoption issues by assigning a value of 1 for least and 5 for most important barriers and facilitators to care provider adoption. Rankings were summarized and included within the third questionnaire. The third questionnaire asked respondents to agree upon EMR barriers and facilitators that had the greatest impact on Canadian care provider’s EMR adoption.

*Research Method Discussion*

Qualitative data obtained from respondent questionnaire feedback included EMR knowledge, opinion, and anecdotal evidence (Gagnon et al., 2009). Qualitative data were preferred, as quantitative data would not effectively capture opinions, anecdotes, and unstructured commentary. Quantitative methods were not suited to develop qualitatively based consensus. Qualitative consensus at the conclusion of three questionnaires sought resolution of
conflicting information not supported by evidence-based decision-making literature. Qualitative research may produce solutions to EMR adoption issues (Jones & Hunter, 1995).

Qualitative research was undertaken based on criteria that enhanced ethical research, clarity, coherence of study design, the use of appropriate and rigorous research methodology, minimal researcher bias, and the importance of establishing and sustaining the validity of results through verified research methods (Cohen & Crabtree, 2008). The goal of EMR adoption measurement was attained through non-linear reasoning based on subjective assessment.

Research Design Discussion

The Delphi method overcame decision-making constraints found in other research methods. Group-based decision-making may have dominant individuals or coalitions representing vested interests, where individuals may not readily submit opinions regarding EMR adoption. Agreement on barrier and facilitator importance was set at 65% or more final Round respondent concurrence on listed barriers and facilitators. An interpretive approach was adopted to make sense of questionnaire responses (Taber, 2006).

Other possible research methods included a mixed approach that used qualitative as well as quantitative methods (Creswell, 2008). A mixed approach may determine quantitative trends within the data collected (Creswell, 2008), but was not found to be suitable. The purpose of the Delphi study was to understand care provider acceptance of the EMR, supported by qualitative experiences of EMR users. A mixed approach may have diluted the results by showing trends as opposed to contextualized feedback regarding EMR adoption issues.

EMR acceptance was not readily quantified as a discrete number or value. Abstract issues may benefit from repeated discussion supported by qualitative respondent experiences. The essence of the Delphi technique was to achieve the goal of consensus based on qualitative
experiences shared and agreed upon by EMR users. Deliberative consensus among respondents with differing knowledge levels and opinions required a qualitative approach. Research design allowed feedback from a broad spectrum of respondent EMR familiarity.

Research Questions

Research was carried out to understand why a persistently low EMR adoption rate occurred among Canadian as well as international care providers. Incentives aimed at increasing the low adoption rate seemed sound and logically feasible, however incentive measures have produced only marginal results (Nagle & Catford, 2008). Existing research cited Canadian examples of incentives aimed at increasing EMR adoption among care providers not entirely convinced of the feasibility of an innovation (Alvarez, 2004). Forcing care providers to adopt the EMR was one method of increasing uptake of an innovation, but was not ideal as users needed to willingly embrace technology for maximum effect. The research questions provided the groundwork for further research.

Question One: “What barriers exist to increasing Electronic Medical Record (EMR) adoption among care providers?”

Question Two: “What solutions might increase care provider adoption of the EMR?”

In order to advance knowledge of EMR adoption, research should reflect the state of knowledge of EMRs among care providers. Factors such as age, gender, location, size of clinic or hospital, and IT helpdesk support influenced EMR adoption in differing degrees. A questionnaire with only limited factors would inhibit the questionnaire’s ability to produce value-added research (Morton, 2008). Both research questions sought to provide information in support of or contrary to current literature, as well as the creation of new information.
If feedback obtained from an EMR adoption study supported the contention that age, gender, location, size of facility, IT help-desk support, and governmental initiatives were material in influencing EMR adoption, then further research would be required to overcome adoption themes. However, if current wisdom was refuted by new findings produced from the survey, then the contribution of knowledge may provide insight and guidance to increasing adoption rates.

Both research questions provided useful data (subjective, anecdotal, and unstructured responses were encouraged for the qualitative study). Government and other healthcare leadership agencies engaged in EMR implementation may benefit from current feedback on effective initiatives. The Delphi study gathered feedback on efforts that seemed ineffective to increasing physician adoption (Halamka, 2008; Menachemi et al., 2006; Weinstock, 2008). Information was aggregated into one coherent body of knowledge, so that comparisons could be made and inferences drawn regarding the cause and effect of low adoption rates.

The research questions addressed formal evidence that refuted, supported, and added data to published research. Existing literature acted as a baseline for further research. Scott, Rundall, Vogt and Hsu (2005) applied the Delphi method to study 20 respondents of an insurance company EMR implementation. In another study, Haggerty et al. (2007) sought expert testimony from 20 respondents discussing salient attributes of healthcare. A minimum of 20 third Round respondents from an initial pool of 467 Canadian military care providers was deemed statistically significant. The assumption was held that a fraction of the 467 care providers would actually respond, as the initial pool included the spectrum of all medical trades. As presumed, the research questions were answered from respondents actively employed in clinics, headquarters,
field ambulances, field hospitals, health services training centres, naval healthcare facilities, on board ship, and special operations personnel.

Factors that influenced past healthcare information technology adoption in related fields and disciplines were assessed for relevance. New indices and strategies for data measurement were formulated as new research findings became available. While new data were of particular interest to the Canadian Forces, the data should not be readily applied when drawing parallels to pan-Canadian EMR implementation efforts elsewhere. Care should be taken when generalizing from reported results, as the Delphi study population sample was delimited by narrowly defined parameters.

Round 1 questionnaire responses were analyzed for prevalent themes that required further analysis in second and third Round questionnaires. A transparent methodology was used to show how evidence-based inferences were made. Transparency was important for purposes of verifiability, trustworthiness, and repetition (Punch, 2005). A logic roadmap allowed for third-party assessment of credibility through repetition of study method, design, and process. Credibility was strengthened as research produced varied field experiences, sampled over time to create a reflexive respondent response (Hsu & Sandford, 2007). Respondents verified assumptions as new data emerged – in short, a peer examination of results led second Round respondents to revisit feedback from the first Round. The third questionnaire required a simple yes or no response to listed barriers and facilitators.

Research questions permitting a transfer of knowledge from the specific to the general were useful when assessing broader questions of technology adoption, as opposed to just barriers to EMRs. The dependability of a research method may be validated when a stepwise replication is possible, so that results may be verified through peer examination. Medical information
technology did not compare favorably to other fields of information technology. Banking, aerospace, automotive, and retail have applied information technology to positive advantage, whereas the medical field has been slow to embrace the electronic age (Empey, 2004).

Conceptual Framework

The broad theoretical framework used for the study on low EMR adoption was resistance to change. Coch and French (1948) produced germinal literature that discussed resistance to change resulting from new work methods introduced in factories. The authors asked two questions: “Why do people resist change so strongly? What can be done to overcome resistance?” (p. 512). Both questions influenced the Delphi study research question design.

Lawrence (1968) maintained that resistance to change might be overcome once employees became involved in change management. Resistance to change was managed if the change was gradual, and those most affected by change had input into change management. Rogers (1995) refined his original Diffusion of Innovation Process (1962) to show how innovations occurred in five phases.

Innovation phases included knowledge, persuasion, decision, implementation, and confirmation. The Delphi study framework assumed that care providers were in stage three of the five stage process, namely the decision to adopt or reject technology (Rogers, 1995). Once barriers and facilitators were properly addressed, implementation (stage four) and confirmation of the decision (stage five) could occur (Rogers, 1995).

The framework was supported by the Technology Adoption Model (TAM) as adapted by Davis, Bagozzi and Warshaw (1989) from the Theory of Reasoned Action (Fishbein & Ajzen, 1975). According to Davis et al. (1989) the positive perception of technology’s ease of use, usefulness, and user attitudes towards technology were important determinants for the intention
to use a given technology. Technology adoption could be determined or measured by the care provider’s willingness to embrace new or adapt to existing technologies (Davis et al., 1989).

Innovators, early adopters, and early majority were terms used in Rogers’ Diffusion of Innovations (1995) discussion. According to Rogers (1995), innovators were typically described as venturesome with a greater propensity to take risk. Early adopters were typically social leaders and well respected among peers. Rogers (1995) went on to say that those in the early majority were often deliberate and had many informal social contacts. The Delphi study’s respondents were not categorized according to Rogers’ theory, as respondents were not adopting or rejecting an innovation; rather, overall adoption and facilitation themes were sought.

If new technology were readily accessible, easily comprehended and obviously beneficial to patient care, the technology might well be adopted notwithstanding barriers such as cost, implementation time constraints, training requirements, and a perceived lack of relevance. Rogers (1995) maintained that adoption was influenced by perceived attributes of innovations, social norms and individual characteristics of users. The Delphi study’s respondents may have worked with the Canadian Forces Health Information System, which was funded and implemented by the Department of National Defence. Factors such as implementation costs did not affect Canadian Forces care providers working solely for the military, whereas costs might have affected private care providers paying out of pocket.

Exploratory research of the past focused on the willingness of physicians to adopt telemedicine technology. A study by Chau and Hu (2002) showed physician adoption based on technology usefulness rather than the technology’s ease of use. Compatibility of software to medical practice raised considerable concerns, whereas less emphasis focused on the need to
control the actual technology or user opinion about the technology (Chau & Hu, 2002).

Physicians were concerned when disruptive influences altered tested methods of care delivery.

Disruptive technology models “have the potential to drastically change a given industry by shifting competition and shattering existing business models” (Williams & Whittier, 2007, p. 27). Disruptive technology rarely occurred as a planned event – sporadic technological innovations such as the EMR were a known entity, yet adoption of the tool was slow (Grove, 2005). Traditional Diffusion of Innovation (Rogers, 1995) attributes such as relative advantage, compatibility, complexity, observability, and trialability partially explained the variance in rate of new technology adoption. However, the role of perceived attributes was the most powerful predictor of innovation (Rogers, 1995).

Rogers (1995) noticed that after an organization adopted an information technology, individuals made “contingent innovation decisions” to adopt or reject that innovation (p. 30). As new information technology tools increased the reach and possibility of a continuum of care (Dick, Steen, & Detmer, 1997), contingent innovation decisions translated into firm adoption of technological tools. Adoption of an electronic medical record remained low, as care providers were unsure and hesitant to adopt an immature technology. In essence, being unsure and hesitant resulted in resistance to change from accepted methods of healthcare practice.

Resistance to change may result from physicians failing to balance efforts to develop an EMR, while maintaining and further developing an EMRs current capabilities. An organization would usually encourage, facilitate, or even force (Zhou, 2008) staff to use an innovation the organization had adopted. Subsequent diffusion of innovation might be less effective when forced upon users unsure or apprehensive of an innovation’s impact. Rogers (1995) defined
diffusion as “the process by which an innovation was communicated through certain channels over time among the members of a social system” (p. 5).

The reasons for slow adoption have been mentioned above (cost, location, gender, age, IT fluency, business profitability, and more), even as core competencies of the EMR might suggest greater adoption. Core competencies may include the EMR’s capacity to increase financial value, interoperability that widened the reach of patient data retrieval, and the lack of competing capacity inherent within truly interoperable EMRs (Urowitz et al., 2008). Canadian physicians were often more motivated to increase investments in areas that sustained current operations, as opposed to investing in capabilities associated with new technologies destined to dominate the healthcare market of the future (Gagnon et al., 2009). Traditional diffusion research focused on individuals’ decision-making per se, but failed to examine the interaction between individuals and social or institutional contexts (Rogers, 1995). Technological innovations may impact current business practices as well as projected value-added capabilities of the future.

As physicians did not want to destroy known modus operandi through irrational adoption of untested technology, a dynamic capability of change had to exist to create the right conditions for change. The structure and culture of physician practices determined the extent of absorptive capacity for change; innovations needed to fit, be easy to use, and present a readily apparent benefit as discussed in the Technology Adoption Model (Davis et al., 1989). Change management inferred a capacity to install personnel and structures required to bring about business transformation.

Change normally involved investments in staff and change management champions to usher in new technologies in a phased manner (Nagle & Catford, 2008). Rogers (1995) referred to ‘change agents’ within the diffusion process. Healthcare organizations and paying care
providers would want to assure themselves of the shelf life of a technology, and might wait longer before implementing an EMR that had been through iterations and revisions. Military care providers were informed of the CFHIS implementation in 2001, and subsequent training commenced to ensure a phased approach to pan-Canadian Forces EMR adoption.

Care providers who invested time and effort in proprietary and restrictive EMR systems were wary of new EMRs promising greater interoperability. Patient loyalty fostered through proprietary EMR systems was not easily surrendered in favor of nationwide EMR systems, further complicating and retarding progress toward EMR interoperability. Organizations that were inherently decentralized were more amenable toward the eventual adoption of a large interoperable EHR, if the reward system made business sense.

EMR implementation experts with global oversight viewed barriers, facilitators, change, and strategies from a dispassionate distance. Equity and time invested by individual physicians clouded individual judgments regarding changes in business processes. A circumspect viewpoint of EMR adoption barriers and facilitators may have included factors of cost, gender, age, location, and financial support that did not materially influence respondent objectivity. A Canadian Forces mandate urged Canadian Forces care providers to use the CFHIS. Consequently, a level of resentment may have formed toward electronic medical records as an invasion into known business processes.

The conceptual framework addressed the question of why barriers persisted when the reasons for adoption were sound. The Delphi study framework addressed the solution to dismal EMR adoption rates by seeking qualified opinions from people keenly aware of EMR adoption issues. Military care providers offered insights regarding EMR adoption outside the strictly military healthcare domain, seeing as most care providers had concurrent civilian practices.
Improving upon a theory was more important than testing a theory – the facts showed a low EMR adoption rate among Canadian physicians (Webster, 2010). The theory sought to understand the low adoption rate beyond the data already published. The Delphi results sustained the assumption that current actions to increase EMR adoption were ineffective. An assumption was made regarding respondent awareness of EMR adoption issues outside of the military healthcare domain.

The definition of an EMR remained open to interpretation (Linder, Ma, Bates, Middleton, & Stafford, 2007). Seeing as the EMR was a relatively new concept (the early 1980s was used as the beginnings of the electronic medical record), patients older than the inception date of EMRs would likely not have the entire health record electronically stored. EMRs once implemented did not normally collect and incorporate historical paper records, but rather set a timeline for current and future medical information storage. If required, historical data were copied, digitized, and incorporated into the electronic database.

The need and benefits of the EMR should be weighed against the challenges of successful implementation. Care provider self-review was required before an EMR was installed into care provider practices, hospitals, community networks, or any other care provision facility (Badger, Bosch, & Toteja, 2005). Care providers may actually have been satisfied with the level and nature of patient data exchange mechanisms used, and might have been reticent in adopting new and expensive technology which had few proven business case reasons for doing so. Biased respondent questionnaire feedback may have occurred when CFHIS users compared experiences with other (better) medical records. The cover letter did however request respondent impartiality in support of unbiased data collection.
Information about patients was stored in a variety of registries, unable to communicate due to an absence of universally agreed-upon storage and transmission media. Lai, Lau and Shaw (2009) mentioned the need for comprehensive implementation assistance when installing EMRs into physician offices. The nature of the EMR often precluded the patient from interacting with the physician, as the software program prompted the physician to extract patient information. The EMR may have acted as a barrier – both virtual and real – where the physician prompted the patient for EMR-generated, template driven data. Templates could diminish traditional face-to-face communication, and negatively influence patient-care provider contact.

Ventres et al. (2006) showed the presence of an EMR to have influenced physician-patient encounters. If the care provider had the chance to review the file of a patient prior to the visit, the care provider might spend more face-to-face time with the patient. Research showed that EMR-using physicians (Ventres et al., 2006) might briefly greet the patient, before reviewing the electronic patient file while the patient sat by idly. Concurrent patient discourse detracted from the physician’s ability to concentrate on the electronic record. Alternatively, physicians might overreact to the pervasive nature of the EMR, thus purposefully avoiding any efforts at increased EMR adoption.

**Definition of Terms**

*Canadian Forces Health Information System (CFHIS):* An electronic health record that served 117,000 members of the Canadian Forces (Doggett, 2008).

*Digital Imaging and Communications in Medicine (DICOM):* A standard for handling, storing, printing, and transmitting information in medical imaging (National Manufacturers Association, 2007).

*Electronic Health Record (EHR):* A longitudinal electronic record of patient health
information generated by one or more encounters in any care delivery setting (Jha, Ferris, & Donelan, 2006).

*Electronic Medical Record (EMR):* The Electronic Medical Record system allowed family doctors and other health care providers to chart patient health information using a computer. The software tool allowed health care providers to link to other health care professions (CMA, 2008).

*Health Level 7 (HL7):* An international community of healthcare subject matter experts and information scientists collaborating to create standards for the exchange, management and integration of electronic healthcare information (Health Level 7 website, 2009).

*Organization for Economic Cooperation and Development (OECD):* A membership of 30 countries that shared common visions of democracy and market economic principles. Canada is a member (OECD, 2010)

*Personal Health Record (PHR):* “Combine data, knowledge, and software tools that help patients to become active participants in their own care” (Tang, Ash, Bates, Overhage, & Sands, 2006, p. 121).

*Systematized Nomenclature of Medicine Clinical Terms (SNOMED CT):* A systematically organized computer processable collection of medical terminology covering most areas of clinical information such as diseases, findings, procedures, microorganisms, and pharmaceuticals (Health Level 7 website, 2009).

*Technology Acceptance Model (TAM):* An information system theory that modeled how users came to accept and use a technology (Fishbein & Ajzen, 1975).
Assumptions

Assumptions were made that current efforts at increasing EMR adoption were ineffective (Canadian Medical Association, 2010). Areas such as safety, effectiveness, patient-centered care, timely delivery, efficiency, and equity in healthcare access were not improved by the current state of Canadian EMR implementation (Robinson, 2007). Despite administrative executive’s roles in promoting adoption, as well as physician involvement in the process, the demonstrated benefits to physicians did not translate into greater adoption rates. The ease-of-use and alignment with workflow were similarly ineffective even as technical support was available to bridge adoption issues (Robinson, 2007). Education and support were essential elements of care provider adoption of an EMR.

An assumption was made that EMR users had an appreciation of care provider’s barriers and facilitators to EMR adoption. Demographic questions determined a minimum set of qualifications necessary to be a qualified EMR user. The ability to do systematic reviews of technology interventions assumed that users were technologically aware. Users possessing ‘hands-on’ experience with patients formed the basis for managerial decision-making, policy-making, and benefit analysis regarding innovations in healthcare. A knowledge of innovation costs assisted user capacity for a comprehensive evaluation of barriers and facilitators, both perceived and real. Respondents may not have had actual knowledge of EMR implementation costs; respondents did, however, have informed or evidence-based opinions.

The goal of providing an electronic health record for all Canadians rested upon the presumption that all care providers would fully use an electronic medical record – the precursor of the electronic health record. The office of the Canadian Auditor General (2009) generated a report that noted less than 1% of an $800 million EHR network was being used, “with peak
usage averaging only about 16% of available bandwidth” (Auditor General Report, 2009, p. 28). Full use of an EMR would benefit Canadian patients if all had some form of electronic medical record – yet only 17% of Canadians had a core electronic medical record (Canada Health Infoway, 2009).

Every audited jurisdiction in Canada had at least one EHR system in place (Office of the Auditor General, 2010), necessary for the diffusion of innovation process as mentioned by Rogers (1995). Canadian provinces and territories did not collectively adhere to a national standard of certification, complicating issues of vendor recognition from one province or territory to the next (Webster, 2010). Government assumed that financial initiatives aimed at increased adoption would suffice to spur physician EMR adoption.

Current literature showed that less than 30% of Canadian physicians were adopting EMRs, despite all efforts at increasing adoption (Urowitz et al., 2008). A linear increase of physician adoption assumed constant adoption progress. As an indication of adoption progress, a baseline figure of 100 EMR adopters in 2001 grew to 160 adopters by 2005, and 195 adopters by 2007. Despite the increases, only 54% of all Canadian physicians had at least partially adopted the EMR by mid-2008 (Urowitz et al., 2008).

Certified and licenced Canadian physicians numbered 66,992 in 2009, according to the Canadian Medical Association (2009). While scientific rigor and factual research remained the best adoption indicator (Hing, Burt, & Woodwell, 2007), the 2001 baseline trend showed an EMR adoption increase of 95% from 2001 to 2007. If the trend continues, the number of Canadian physicians adopting an EMR will double every 6 years. If 36,000 EMR adopters represented roughly 54% of all Canadian physicians in 2009, the trend should show all physicians accessing an EMR by 2015. The progression assumed that the number of Canadian
physicians remained steady at approximately 67,000; current Canadian Medical Association membership stood at 74,000 (CMA, 2010).

Both U.S. and Canadian governments have been aware of the slow rate of adoption, resulting in further government efforts aimed at augmenting adoption initiatives (Protti, 2008). The US healthcare market differed from the socialized Canadian model of healthcare, so an assumption of differences in adoption patterns was warranted. However, both U.S. and Canadian governments were actively seeking ways to increase EMR use among respective nation’s physicians (Nagle & Catford, 2008).

While feedback from respondents was drawn from the Canadian Forces, the issues faced by Canadian Forces care providers was global and therefore relevant to the North American market. Issues such as resistance to change, time needed for retraining, age, gender, rural or urban location, size of practice, and IT fluency may apply throughout. The Delphi technique offered a non-threatening process of information gathering (Hasson, Keeney, & McKenna, 2000) where respondents could revise earlier statements without concerns of position consistency. The absence of personal information allowed respondents to honestly report on feelings, perceptions, and attitudes without fear of ridicule or admonishment. The ability to converge after three Rounds of questionnaire was assumed; concordance was reached after the third Round, so the need for a fourth Round of questionnaire deliberation was unnecessary.

Scope, Limitations, and Delimitations

The scope of the EMR adoption research encompassed adoption barriers as well as adoption facilitators among care providers working for the Canadian Forces. The data collected encompassed the findings collected from a three Round Delphi study questionnaire sent to respondents at 37 Canadian Forces healthcare facilities. The opinions and feedback obtained
from regular force, reservists, and contracted care providers represented an overview of EMR adoption. The scope of care providers included a range of ages, experience, gender, location, and electronic media familiarity; consequently, caution was required when generalizing results to Canadian care providers at large. Respondents had to have a Defence Wide Area Network (DWAN) address, as the survey was hosted on a secure military intranet accessible only by military email.

One of the limitations of the EMR study was the lack of first-hand anecdotal, ‘lived-experience’ feedback from care providers (Keshavjee et al., 2006). The limitation in part formed the reason for further research. There was a need to broaden the field of inquiry beyond the known data of current barriers and facilitators. The pilot study engaged 10 EMR users from the province of Ontario, whereas the full-scale questionnaire sought to engage providers from an initial email sent to more than 400 care providers. A minimum of 20 final Round responses would provide a statistically significant set of responses. Statistical significance, according to Akins, Tolson and Cole (2005) generally inferred a high probability of respondents concurring, where respondent concurrence was not due to chance. As insufficient agreement existed on the number of minimum responses required to provide a statistically significant result (Akins et al., 2005), 20 responses was deemed sufficient.

The initial pilot study requested feedback from 10 EMR users within military hospitals and care provision facilities. Although this may have seemed a limitation, the small pilot study served the purpose of guiding the subsequent large-scale study. The respondent population was limited to personnel familiar with EMRs. The number of purposefully selected respondents might have seemed limiting and unlikely to provide a truly representative cross-section of Canadian EMR users, yet Canadian Forces care provider concerns, perceived barriers and
facilitators to adoption may provide insights for Canadian care providers at large. Only prevalent barrier and facilitator themes were resubmitted for further discussion and eventual respondent concordance in Rounds 2 and 3.

Delphi study data presented a microcosm of pan-Canadian EMR adoption, which remained consistently low (Giokas, 2005; Nagle, White, & Pringle, 2007; Protti, 2008). EMR adoption issues among Canadian Forces care providers paralleled adoption issues among U.S. care providers in similar practice conditions (Bristol, 2005; Protti, 2008; Schoen et al., 2006). A complex case-mix among North American populations, ethical practices based on licensure requirements, and an established electronic infrastructure were found in both Canada and the U.S. While the method of care provision in the U.S. and Canada were different, the actual EMR implementation issues were similar. Similarities allowed for guarded generalizations, even as the incentives, payment structures, government intervention rationale, and number of EMRs differed between the U.S. and Canada.

Researcher bias may have influenced objectivity if material other than that obtained from respondent feedback was used. Subsequent research should be able to validate results using similar methodology and data gathering practices. Potential researcher bias may have existed when questions elicited a desired response from respondents. The questionnaires encouraged respondent feedback to be open and honest. Due to the official Canadian national languages requirement, questionnaires were in both official languages (English and French). Senior healthcare personnel as well as personnel from the Official Languages Bureau graciously offered time and input to ensure accurate survey renditions in French and English.

Delimitations differed from limitations in that limitations were factors one could control, whereas delimitations were the boundaries set for the study. Delimitations included selection
criteria imposed on EMR users; respondents returning questionnaires that indicated limited EMR knowledge or usage during everyday care did not provide meaningful comment on barriers and facilitators to greater EMR adoption. Canadian Forces EMR users other than those selected may have been knowledgeable or even more suited to offer insights on EMR adoption issues; however, delimitations were set to include care providers most likely to have used an EMR.

The reason for the exclusivity of respondent selection was one of convenience and support obtained from military management. Delimitations included time spent in information technology related work, positions held at work, familiarity with electronic health media, insight and comprehension of care provider barriers and facilitators to EMR adoption, and the place of work for EMR users across Canada’s provinces and territories. Delimitations encouraged a degree of data origin diversity, even as respondents were drawn only from Canadian Forces healthcare facilities.

Summary

The problem statement addressed barriers and facilitators of EMR adoption among Canadian Forces care providers. The purpose was to elicit feedback from EMR users in order to address the problems of EMR barriers and facilitators. The study was significant due to an increased care provider reliance on electronic media; only 10% of Canadian physicians fully engaged an electronic medical record system, while 23% of all Canadian physicians had adopted some form of EMR (CMA, 2008). The Delphi study method addressed issues of time required for lengthy surveys, and expedited consensus within three Rounds of respondent interaction.

Research questions placed the problem and solution statements in focus, while the conceptual framework relied on resistance to change as explained by Rogers’ (1995) Diffusion of Innovations concept. The concept suggested five stages of innovation adoption, which
included awareness, interest, evaluation, trial, and adoption. Care providers were assumed to be at the EMR adoption and decision-making stage. Adoption among military care providers was essentially mandated by virtue of edict.

The decision stage of adoption was a key factor in understanding barriers and facilitators of EMR adoption. Limitations and delimitations narrowed the availability of respondent resources, as care providers were subject to periodic absences, inter-base postings, reservist status, and annual leave. The survey was translated by the Official Languages Bureau to ensure an accurate rendition in English and French. A literature review follows in Chapter 2.
CHAPTER 2: LITERATURE REVIEW

A review of the available literature provided Delphi method applications, discussions of international EMR and EHR usage, care provider opinions on EMRs and EHRs, factors influencing successful and failed EMR and EHR adoptions, surveys, government reports, and information technology developments in general. Social, organizational, and contextual factors influenced the care provider’s decision whether or not to adopt electronic media. When the reasons or causes of low EMR adoption were unknown, further study sought to understand and solve the issues of low EMR adoption.

Chapter 2 is divided into three sections: (a) title searches, articles, research documents, and journals researched; (b) historical literature overview; and (c) current literature overview. The intent of the historical overview was to show the evolution of the electronic health and medical record, and the impact the evolution had on care providers. The intent of the current findings was to examine literature published on electronic medical and health record research within the last 2 years, both in Canada and worldwide. A summary concluded the chapter.

Title Searches, Articles, Research Documents, and Journals Researched

Title searches yielded 177 sources of information at JSTOR, Medline, Ovid, EBSCOhost, ProQuest, Gale database, ACM Portal, Elsevier, Emerald Fulltext, PubMed Central, BioMed Central, Sage, Questia, Science Direct, Pare Online, University of Phoenix Theses and Dissertations, CINAHL, Ingenta Connect, Health and Wellness Resource Center, Wiley Periodicals database, Wolters Kluwer Health database, and the Internet. Factual content came from peer-reviewed journals. Table 1 lists the dominant topics found among the sources listed.
Table 1

*Title Searches, Articles, Research Documents, and Journals Researched*

<table>
<thead>
<tr>
<th>Topics</th>
<th>Journals</th>
<th>Books</th>
<th>Articles</th>
<th>Reports and Theses</th>
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<td>6</td>
<td>3</td>
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<td>Health Information Technology and Systems</td>
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<td>1</td>
</tr>
<tr>
<td>Care provider concerns</td>
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</tr>
<tr>
<td>Barriers and facilitators to adoption</td>
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<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
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<td>128</td>
<td>11</td>
<td>19</td>
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The literature review provided a 17 percent incidence of articles, journals, books and other references that were 5 years and older (31 of 177 references). The available literature review provided explanations regarding low EMR adoption among care providers, with an emphasis on subjects such as EMR and EHR innovation, health information technology and systems, research methodologies, Delphi studies, care provider concerns regarding EMR adoption, and barriers to adoption.
Historical Literature Overview

Resistance to Change

Numerous theories have evolved to examine and explain resistance to change. The foundational theory was resistance to change. Germinal theorists included *Overcoming Resistance To Change* (Coch & French, 1948), *Belief, attitude, intention, and behavior: An introduction to theory and research* (Fishbein & Ajzen, 1975), *Learned behavior: The key to understanding and preventing employee resistance to change* (Mealiea, 1978), *User acceptance of computer technology: A comparison of two theoretical models* (Davis, Bagozzi, & Warshaw, 1989), and Rogers’ (1995) *Diffusions of Innovations*. Germinal theorists provided overall direction for an historical literature overview of the general concept of resistance to change.

Coch and French (1948) highlighted the motivational problems of people encountering new learning techniques, modes of production, and decision-making. Learning new skills with the aid of group decision-making compared favorably to new skills acquired without the benefit of group dynamics. Modern care provider EMR adoption should be facilitated by participative engagement. Imposing unevaluated technologies on care providers without participative feedback may result in low adoption rates.

Fishbein and Ajzen (1975) observed how attitude affected the intention to change, and thus the level of resistance to change. Care providers would evaluate an intervention that affected business practices, reacting according to beliefs on how interventions might affect them. The theory of reasoned action proposed by Fishbein and Ajzen (1975) related to the reasons given by care providers for exhibiting low adoption rates of the EMR. As the name inferred, care providers might reason and react according to individual perceptions of EMR utility.
Mealiea (1978) construed the link between employee resistance to change programs and the likelihood of change programs failing. If employees did not perceive identified needs met after organizational changes occurred, employees would resist the changes that affected specific needs. Needs were interpreted within the context of care provider engagement in determining what impact an EMR might have on daily practice. Low adoption of EMRs were indicative of unmet or partially fulfilled needs among care providers.

Davis, Bagozzi and Warshaw (1989) relied on the Technology Acceptance Model, or TAM, to measure perceived usefulness of an innovation. Expectations of an innovation’s productivity, performance, and effectiveness gains were material factors in determining resistance to change from accepted ways of doing business. The TAM (Davis, Bagozzi, & Warshaw, 1989) predicated a positive user outcome, while resistance to change produced negative outcomes. Care providers should ideally perceive greater positive than negative outcomes from innovation introductions.

Diffusion of innovations as considered by Rogers (1995) dealt with new ideas introduced (over a period of time) to members of a social system. Communication involved the exchange of information between individuals. An iterative and cyclic information transfer relied on shared decision-making. If care provider expectations, concerns, and desired benefits of an innovation were not communicated to change agents, resistance to change might prevent an innovation from succeeding.

Germinal research on EHR implementation in Canada commenced in 2001, when the government of Canada established Canada Health Infoway (Neville et al., 2004). Canada Health Infoway was launched in 2001 as an independent, not-for-profit organization comprising federal, provincial, and territorial Ministers of Health (Alvarez, 2004). Infoway was tasked to “support
and accelerate the adoption of interoperable electronic health registries across Canada” (Neville et al., 2004, p. 1). Four components formed the core elements of the proposed EHR. The components were a unique personal identifier client record, a pharmacy network, a laboratory network, and a diagnostic network (Neville, Keough, et al., 2004). The need to install modular healthcare components was not addressed within the core components.

Change management had been an inherent aspect of EMR implementation, as care providers had to be co-opted and convinced of the benefits of the nascent EMR (Neville et al., 2004). Lapointe and Rivard (2006) discussed resistance to change as physicians accepted or resisted new implementations of computer information systems. Once an innovation involved new work methods and influenced time required to enter data into a computerized system, stakeholder resistance would unfold if changes were not agreed upon a priori. Insufficient tutorials or time to learn new electronic record systems increased resistance to change (Lapointe & Rivard, 2006). If complaints by end-users were not heeded and implementation staff persisted in realizing the system, end-users might refuse to use the system altogether.

General resistance to change presupposed an unwillingness to alter the status quo, whether for reasons of fear, reluctance to change, or care provider complacency to innovate. Resistance to change included care provider reticence to adopt an innovation perceived as ineffective and not adaptable to suit care provider needs. Resistance to change would persist if the reasons for change did not make sense from a business point of view. Specific resistance to change in the Canadian context should factor in cost, a lack of interoperability, a lack of implementation ‘champions’, and security concerns to name but a few. Once a common vision emerges, resistance to the concept of change might be addressed on a national level (Wedel, Kalischuk, Patterson, & Brown, 2007). Even though the Canadian Forces mandated acceptance
of the Canadian Forces Health Information System, the mandate did not translate into automatic adoption and acceptance among care providers. Resistance to change may seriously delay or impact care delivery in the Canadian Forces.

*Development of the EMR*

The earliest recorded mention of a medical record referred to Hippocrates in the fifth Century B.C. Modern-day Hippocratic confidentiality and patient-care provider interaction within the confines of the care provider’s office seemed to undermine the movement toward empowerment of patient-held data repositories (Lunshof, Chadwick, & Church, 2008). The first ‘modern’ EMRs began appearing in the 1960s, and by 1965, at least 73 clinical information projects as well as 28 projects for storage and medical document retrieval were underway in the United States (Dick, Steen, & Detmer, 1997). Information on the origins of the EMR in Canada was sparse.

The province of British Columbia recognized the legal impediments faced by physicians not sure of the impact an EMR might have on practices. Consequently, British Columbia became the first Canadian province to legislate access to electronic medical records (B.C. Law, 2008). The initial 2003 project was a collaborative convergence strategy. The project’s three-phased strategy contained 21 building blocks that would form a comprehensive EMR, based on Canada Health Infoway’s Pan Canadian EHR concept (Alvarez, 2004). A phased approach was preferable when addressing eHealth governance, provincial evaluation frameworks, and change management strategies for eHealth vendor management (Neville et al., 2004).

Variant EHRs that were developed in the U.S. included the Harvard-developed public domain COSTAR, or Computer Stored Ambulatory Record. The Latter-Day Saints Hospital developed HELP or Health Evaluation through Logical Processing, noted for decision support
features. Duke University Medical Center’s TMR or The Medical Record, and Emory
University’s Grady Memorial Hospital THERESA system were both well-known for direct
physician entry capabilities (Dick et al., 1997). The U.S. Department of Defense developed the
clinical patient record system CHCS or Composite Health Care System. The United States
Veteran’s Administration DHCP or De-Centralized Hospital Computer Program was another
innovative EMR (Dick et al., 1997). Technical as well as programmatic EHR implementation
problems such as non-standard vocabulary and differing system interfaces have to be overcome
(Wang, Patrick, Miller, & O’Hallaran, 2008).

Traditional paper-based record keeping was widely practiced because care providers were
content with current methods of patient data collection. The complexity of medical record data
collection increased as the spectrum of modern day care expanded. The advent of the electronic
age brought about advances in data accumulation, aggregation, and data mining. A logical listing
of specialty procedures within an electronically updated database allowed for an accurate
compilation of related events, procedures, and interventions. The traditional ‘pulling of files’
became too laborious, hence instantaneous file retrieval made more sense.

EMRs should not be implemented without due diligence involving research, pilot
programs, cooperative teamwork, and dedicated resources. In 1997, the Canadian Forces
employed contractors to coordinate the Canadian Forces Health Information Systems
implementation at two trial sites (Doggett, 2008). The Canadian military EMR deliverables,
financing, and user training were primary aspects of the EMR roll out plan. The implementation
included a feedback system, problem resolution guidelines, subject matter expert availability,
helpdesk staffing, and the publication of best practices.
The need for a Canadian Forces EMR arose due to an uncoordinated healthcare delivery model that did not have standardized procedures. Security and confidentiality requirements entailed the use of public key infrastructure cards (PKI) that offered a protected environment. A phased implementation commenced with patient scheduling and registration, followed by results review (laboratory, diagnostic imaging, scanning, dental charting, chart tracking, and pharmacy), clinical notes, and order entry that enabled clinical and executive decision support (Doggett, 2008).

*Cost as a Factor in Care Provider Adoption*

Two studies conducted in 2005 by the strategy and consulting firm Booz Allen Hamilton placed the estimated cost of ownership for a pan-Canadian EHR at approximately $10 billion, with a return of $6 to $7 billion a year in efficiencies when fully implemented. “An estimated investment of $350 per person, spread over 10 years, was needed” (Protti, 2008, p. 31). Canadian physicians who bought health registries seemed disillusioned by an imbalance of benefits accrual. While the initial outlay for EMR implementation was borne by physicians, the beneficiaries such as health plans, insurance companies, patients, colleagues, and liability carriers seemed less than forthcoming in sharing savings with physicians (Deber, 2005).

*The Impact of Health Information Technology*

Poissant, Pereira, Tamblyn and Kawasumi (2005) examined the impact of electronic health registries on documentation time for physicians and nurses in Canadian hospitals. The study noted that bedside terminals and central desktop stations saved nurses approximately 25% time spent documenting during a shift. Using bedside or central desktop stations however increased documentation time by 17.5% for physicians (Poissant et al., 2005). The apparent
disparity in time saved for nurses as opposed to time added for physicians was attributed to the level and nature of data entry required by respective care providers.

Poissant, Tamblyn, and Huang (2005) noted that computerized provider order entry, or CPOE functions increased physician work time by a factor of three, from 98.1% to 328.6%. Medical problem lists created within EHRs added documentation time for physicians, as the medical problem lists required manual data entry. Common medical conditions generated by an EHR were helpful, but the validity of electronically generated conditions required physician follow-up for verification. The process of verification presented additional time constraints on physician workdays.

**Workflow Disruptions and Improvements**

Lapointe and Rivard (2006) studied the workflow disruptions caused by an EMR. Three distinct hospital settings provided three case studies offering greater insight on physician resistance to computerized information systems. Implementer responses to physician opposition regarding new business processes played a critical role. Where responses were supportive of physician concerns, the severity of resistance decreased and the “implementation was ultimately successful” (Lapointe & Rivard, 2006, p. 1573).

In the first of Lapointe and Rivard’s (2006) cases, responses to physician concerns merely reinforced physician resistance behavior. Nursing staff would not cooperate with physicians unless physicians provided instructions via the newly implemented EMR. The object of resistance changed from the EMRs features to the EMRs significance as a disruptor of established work patterns. In the second case, inefficient methods of data entry and unresponsive software choices were a threat to patient safety and the ability to deliver quality care. Physicians requested certain modules held back to allow greater time for implementers to address physician
concerns. Four years after the start of the implementation process, “all parties were using the system, and the project was considered a success” (Lapointe and Rivard, 2006, p. 1575).

The Absence of Clear Business Case Benefits

Clear business case benefits should not be studied in a vacuum (Neville et al., 2004), as “health information systems were built to replace or complement existing systems” (Neville et al., 2004, p. 2). Physicians had difficulty in assigning monetary value to health information systems that had few measurement metrics. Business case benefits included increased patient safety, better care, improved workflow, and easing the time constraints of physicians in busy practices. An electronic system that ‘promised’ improvements without evidence-based facts would not be adopted, according to Neville et al. (2004).

When Canada Health Infoway commenced operations in 2001 (Canada Health Infoway, 2009), physicians did not know whether the federal government would effectively accelerate and support the envisioned EHR. Coordinated Infoway investment and support programs were not available in 2001, and technology standards could not provide an interoperable EHR platform. Anticipated outcomes and practice benefits accruing to EHR adopters were concepts at best. Physicians would not invest in an untried, new development even if the development promised great improvements in patient care. The concept of an EHR implementation should rather have involved distinct EMR implementations, to permit an interoperable EHR assembly from functional EMR components.

Low Adoption Rates Among Care Providers

At inception, Canada Health Infoway, as Canada’s prime financial supporter of EHR implementation, provided a gated approach to funding. Gated funding meant that funds would flow once project milestones and clinical adoption levels were achieved (Canada Health
Infoway, 2009). Funds were available once adoption goals as well as EHR benefit utilization levels were reached (Canada Health Infoway, 2009). Risks included upfront investment that could fail, while losses could not be recouped if predetermined goals were not attained. Funding constraints may have been instrumental in low EHR adoption among care providers. The failure of an EHR may have been avoided if a modular EMR implementation were adopted.

_Innovation Diffusion as Model_

Cain and Mittman (2002) remarked on how government could induce or delay innovation diffusion within the sphere of healthcare. The Canadian government through Canada Health Infoway provided restricted funds to implement innovations. Extensive cost-benefit analyses were performed to assess the amount of investment Infoway would allocate to qualifying projects. Rationed funds inferred rationed amounts of new technology, which created the conditions for slow adoption of innovations in healthcare (Cain & Mittman, 2002).

The original diffusion of innovation model (Rogers, 1995) discussed innovation attributes and guidelines that influenced adoption. Historically, care providers would assess an innovation’s relative advantage to see whether the innovation was superior to current processes. An evaluation of new clinical practice guidelines of an innovation included compatibility with “existing beliefs and values” (Davis & Taylor-Vaisey, 1997, p. 408). The complexity of incorporating an innovation into current practice, the ability to trial discrete aspects of the innovation before full-scale adoption, and the ability to observe others’ experiences with the innovation were key factors affecting innovation diffusion (Rogers, 1995). The ability to evaluate innovations before diffusing them into practice made business sense overall.
Governmental Mandates and Inducements Toward Conformity

The Federal Canadian government established Canada Health Infoway in 2001 to “support and accelerate the development and adoption of interoperable electronic health records solutions across Canada” (Neville et al., 2004). Infoway identified core EHR components to include client registries, pharmacy networks in each Canadian region, a laboratory network, and a network of diagnostic services. Traditional evaluations included technical and systems features, cost-benefit analyses, user acceptance, and patient outcomes. Initiatives that were more recent included aspects of change and innovation diffusion theories as part of an EHR project evaluation (Neville et al., 2004).

Infoway had 10 peer-to-peer networks in Canada’s 10 provinces. Provincial networks were designed to integrate with each province’s EMR programs, which were clinician peer-support networks based on the EMR concept (Canada Health Infoway, 2010). The integration of Infoway EHR doctrine with provincial EMR systems was an important and progressive step toward eventual EHR realization across Canada.

International EHR Considerations

A historical perspective was possible by comparing EHR implementations of Canada, Europe, and Australia (Cornwall, 2002). Privacy frameworks and privacy commissioners often influenced EHR projects. Distinct government policies influenced each country’s EHR administration, funding, and method of implementation. The Australian Health Privacy Code sought one common EHR standard for all Australian governments to adopt. Canada’s PIPEDA or Personal Information Protection and Electronic Documents Act of 2001, introduced privacy and protection laws. The European Union Data Protection Directive (Cornwall, 2002) mandated common European privacy and data protection requirements.
Privacy and information commissioners in Europe and Canada provided independent expert advice on EHR privacy and security aspects (Cornwall, 2002). Australian counterparts had a limited role in privacy and security aspects of EHRs. Random audits and assessments of EHR agencies in Canada and Europe assisted in policy formation. Information and Privacy Commissioners were involved in the development of EHRs, as access to information balanced the rights of personal privacy with the public interest in freedom of speech (Cornwall, 2002).

Current Literature Review Findings

Resistance to Change

Germinal change management theorists such as Kurt Lewin and Coch and French provided insight to low EMR adoption. The general concept of resistance to change among care providers also applied to countries other than Canada. Factors that increased or decreased resistance to change included organizational and technological aspects such as management support, existing infrastructure, and the level of care provider exposure to EMRs.

Resistance to change may have outweighed the risk of not doing anything at all, or even leaving the status quo intact. Care providers may have felt connected to a social system that operated according to known, tried, and trusted ways of doing business. An absence of role models to show the way forward for innovations may similarly have entrenched resistance to change. Care providers unsure of an innovation may have lacked the ability to master and successfully employ innovations. An overwhelmed care provider workforce was not ready to contemplate additional stressors in an already hectic schedule.

Skepticism and conservatism among care providers presented with innovations or unsound changes to business practices prolonged the eventual acceptance of an innovation. An absence of a clear agenda among reformers may have deterred care providers from adopting an
EMR. The Canadian healthcare provider in general was slow to embrace patient-accessible electronic health records (Urowitz et al., 2008). Perhaps patient access inferred a shift in the locus of control from care provider to electronic record, where care providers were skeptical regarding patient-generated data populating an EMR. A perceived loss of status may therefore have delayed acceptance of an EMR. Novice users of the EMR did not appreciate the scope of change required to implement an EMR, as well as the change in patient and care provider relationships brought about by an EMR (Terry et al., 2008).

Resistance to healthcare related information technology change among Canadian care providers influenced Canada’s healthcare lagging behind the Organization of Economic Co-operation and Development (OECD) countries (Ouellet, 2009). Low adoption by care providers resulted from a combination of factors. Adoption rates were affected by the lack of evidence on the best manner of using an EMR, the need to improve upon return on investment for physicians, an absence of value-added benefits such as greater laboratory connectivity to laboratory results, improved drug data, and increased communications among colleagues (Ouellet, 2009). Historically, the time taken to implement an EMR system and a lack of funds to buy new technology have kept EMR adoption rates low (Ouellet, 2009).

Overcoming resistance to change differed between paper-based and EMR-based care providers (Zandieh et al., 2008). In a study on challenges to EMR implementation in paper-based versus EMR-based office practices (Zandieh et al., 2008), traditional paper-based physician leaders did not rate overcoming resistance to change as a top priority. Paper-based physicians insisted on sufficient workstations, information technology champions, sufficient workflow education, and high comfort levels in information technology. EMR-based leaders prioritized improved technical training, improved patient privacy, and an open recognition of physician
resistance (Zandieh et al., 2008). Differing priorities perpetuated historic care provider resistance that prevented greater EMR adoption among Canadian care providers.

Terry et al. (2008) suggested overcoming resistance to change by making EMR end-users such as nurses and physicians aware of what to expect of an EMR. Care providers should prepare for an implementation process that might take longer than anticipated, and might require “more of a commitment than initially expected” (Terry et al., 2008, p. 735). Resistance to change amelioration through sufficient training time, having a champion to usher the project into the realm of care provider practice, and sufficient computer literacy could result in care providers incorporating the full benefit of an EMR.

Current Development of the EMR

In general, electronic medical record adoption and healthcare related information technology adoption lagged behind technological capabilities of global businesses such as banking, telecommunications, and the media (HIMSS, 2008). Common threads that affected EMR implementation efforts in industrialized countries of the world include funding, governance, standardization, interoperability, and communication (HIMSS, 2008). Effective progress of national EMRs (then called EHRs) were contingent on large-scale, sustained, coordinated, and financed support of governments; if any of the abovementioned variables were absent, physicians were reticent to commit personal funds.

Specifically, an electronic medical record was essentially a compilation of data stored centrally at an off-site location. An authorized user or care provider was able to access a patient’s health record, add information to a health record, modify and transmit data, and request data from others using the same variant of electronic medical record. Considerations of confidentiality, data monitoring, rights and permission monitoring, redundancy of data or backup
servers, and system-wide application upgrades or updates required off-site data storage (Canadian Medical Association, 2008).

Internationally, government agencies were committing funds toward EMRs designed to modernize healthcare delivery (Ouellet, 2009). Countries were applying the concept of incremental additions to an electronic medium that achieved milestones of interoperability and security. Once localized EMRs competed for patients and services, centralized governance became an issue. The U.S. model relied on financial support to private businesses interested in implementing EMRs, so that isolated EMRs could move toward a national concept of an interoperable EMR, called an EHR. All countries suffered from a lack of information technology standards, creating interoperability barriers for EMR adoption on a national level (HIMSS, 2008).

Gagnon et al. (2009) highlighted a lack of EMR integration into practices and organizations. Perceptions of the EMR varied among end-user groups, adding to the complex nature of implementation. A report on the Canada Health Infoway (2009) Public Health Surveillance Program (‘the Program’) showed the need for integration of current EMR infrastructure and architecture with the Program. The Program was an Infoway initiative aimed at a collaborative approach to combating disease outbreaks in Canada (Canada Health Infoway, 2009). Existing EMR registries would ideally feed data into the Program’s data repositories, creating an immunization data exchange.

Canada Health Infoway (2009) forecasted, that by end 2010, 50% of all Canadian health records would be electronically available to healthcare providers. As at March 31, 2010, 38% of Canadian patients across Canada’s provinces and territories had some form of electronic client registry, provider registry, diagnostic imaging, drug information system, laboratory information
system, or clinical report (Canada Health Infoway, 2010). Infoway (2010) projected that by 2016, all Canadian health records would be available electronically. At the conclusion of the 2008-2009 financial year, 96% of Infoway’s $1.6 billion budget had been allocated to 283 healthcare related projects (Infoway, 2009). During the 2008-2009 financial year, Infoway developed e-Health support networks, electronic medical record demonstration sites and case studies, knowledge sharing and toolkits, innovation projects, benefits frameworks, and benefits evaluations (Infoway, 2009).

Cost as a Factor in Care Provider Adoption

In general, current literature indicated that healthcare systems did not function more efficiently when more money was spent on the system (Auditor General Report, 2009). Canadian government spending of $1 billion (2009) on an electronic healthcare network resulted in less than 1% use of system capacity (Auditor General Report, 2009). Cost as a factor of healthcare delivery transcended national boundaries, as few sound proposals were implemented to arrest the spiraling increase of healthcare delivery in Canada, the U.S. and worldwide. Hillestad, Bigelow & Bower (2005) suggested ameliorating healthcare costs through increased utilization of EMRs. EMR adoption costs influenced non-adopters, as a maturing EMR market conversely required greater outlays to include new structures and advancements in electronic exchange media (Erdil & Emerson, 2009). Traditionally, maturing markets required less capital outlay as an innovation saturated the market and decreased costs resulted for each new instance of the innovation.

In order to appreciate EMR adoption progress within the medical community, an understanding of factors affecting EMR adoption was relevant. The cost of implementing and sustaining an EMR were the greatest barrier to adoption, even if the stated and evident benefits were readily apparent to the physician (Canadian Medical Association, 2008). Costs were
especially relevant for independent physicians not supported by large organizations with dedicated budgets supporting EMR implementations.

The specific cost of implementation through widespread adoption among Canadian physicians would likely be in the billions of dollars (Auditor General of Canada, 2010; Hillestad et al., 2005; Miller & West, 2007; Miller, West, Brown, Sim, & Ganchoff, 2005). Guidance to investors as well as fresh allocation of dollars to support ongoing EMR implementation efforts were required. A 2009 fiscal stimulus signed into law by Canadian Prime Minister Stephen Harper had a direct effect upon the Canadian government’s healthcare (EMR) stimulus, with $40 billion allocated to the Canadian economy (Holland et al., 2009).

**The Impact of Health Information Technology**

Health information technology influenced most aspects of care. Paper records that were digitally stored aided physicians by centralizing patient data in one repository. Patients in remote areas had access to physicians through telemedicine, allowing health monitoring by means of electronic devices connected to providers far away (Canada Health Infoway Annual Report, 2007-2008). Wait times reduction was possible through electronic scheduling applications. Internationally dispersed physicians collaborated on case studies; however, transmission of sensitive data required secure and reliable media. The concept of health information technology was sound, whereas the implementation and standardization remained as barriers to full-scale usage (Canada Health Infoway Annual Report, 2007-2008).

In the main, most EMRs were unable to share data about the same patient. Patients could theoretically have medical information co-located in three distinct repositories. Data might have resided in care provider data banks, the patient’s health plan, or with the patient. Three different versions of health records could have existed – the Patient Health Record known to the patient,
the electronic medical record containing healthcare provider data, and the record containing data known to the patient’s health plan (Halamka, 2008). Patients treated at various facilities generated data that often did not travel with them to the next point of care.

Overriding concerns of cost, insufficient knowledge of transfer procedures from paper to EMR, and disruptions to office life were themes that repeated themselves within EMR adoption literature (Mitchell, 2008; Persel & Bufalino, 2008). The legal implications of EMR use remained unclear due to the relatively new nature of the EMR as a medium of patient data transmission and storage (Burton, Anderson, & Kues, 2004). Barriers to acceptance included legal considerations for care providers when moving data from one care provider network to another, and the ‘back door’ requirement for audits on access to files (CMPA, 2010).

One of the aspects of an EMR that added to dissatisfaction among physicians was fragmentation and confusion of data (Valdes, Kibbe, Tolleson, Kunik, & Petersen, 2004). Generally, physicians claimed too many steps were required to arrive at patient information. A lack of intuitive data location left physicians frustrated when searching for specific information. Medication lists that were undifferentiated increased the chance for error; ambiguous dosing information such as 1 (dose of) 100 mg could be read as 1100 mg. Software designers were slow to consult physicians for guidance on grouping medications by organ or problem.

An unstructured and confusing layout of data led to frustration and even error in decision-making, especially if the physician had little time to decide. Pre-structured texts within an EMR interface made anecdotal inclusion difficult. Anecdotes were a vital addition to an otherwise sterile and unimaginative data entry template (Poissant et al., 2005). Physicians tended not to harvest maximum benefit from IT investments because of insufficient due diligence in
researching the EMR. Frustrated physicians at times found technical personnel unable to address user concerns.

Physicians determined not to implement the full range of an EMR would likely seek partial satisfaction even when paying full price. As an example, physicians would not want value-added benefits such as physician alerts. Physicians might want to view entire laboratory results to gauge subtleties or dependencies, which pre-programmed EMRs might not be able to do. Alerts might be misplaced or out of context, and may therefore lead to an increase in complexity of care. Mechanically plotted trends in laboratory data may trigger false alarms, which a trained physician could dismiss by common sense.

In a specific study by Joos, Chen, Jirjis, and Johnson (2006), 25 physicians practicing in an adult primary care clinic evaluated select features of an electronic medical record. The qualitative study entailed semi-structured private interviews. Of the 99 electronic medical record features singled out, 85 features required further research to establish common themes. Face validity of the restructured survey was tested (Joos et al., 2006), with several respondents acting as representatives of the survey population. The reorganized survey sent to 70 different physicians recorded a 66% response rate (46 responses). Data analysis employed the Statistical Analysis System (SAS), version 8.2.

The restructured survey showed physician anxiety about security and confidentiality, time to enter data, negative impacts on quality of patient care, EMR response time, illogical and inefficient flow of tasks, an inability to complete desired tasks, difficulty of correcting mistakes, a lack of proper training on the EMR, and an absence of follow-up support for post-implementation matters (Joos et al., 2006). Care provider concerns were representative of studies already mentioned.
Workflow Disruptions and Improvements

Physicians would seek applications and innovations that did not disrupt known workflows but offered concrete improvements to patient care and outcomes. EMR adoption would not succeed as long as physicians did not perceive a net-gain result from adoption. The idea of change for the good had to be readily apparent when prompting physicians toward greater adoption. An absence of business case viability, future direction from leading oversight agencies, and the absence of interoperability with current medical care systems perpetuated low adoption among physicians.

Personal health records (PHR) varied from electronic medical records as personal records were populated by the patient, while electronic medical records were more comprehensively populated repositories of information supplied by medical professionals (Tang et al., 2006). An extensively populated EMR should provide an improvement to physician oversight of the patient record. An EMR should contain the medical information of one patient by one physician, whereas an EHR should contain many health related data from a multitude of physicians and care providers. Disruptions caused by verifying patient-entered PHR data with physician-entered EMR data produced more confusion than workflow efficiencies. Inefficiencies added to physician reticence to adopt the EMR as a preferred solution.

The benefits of an EMR increased once users comprehended the functionality and purpose of an EMR. An appreciation of the term ‘fully functional EMR’ was required to assess the structure and purpose of an electronic medical record. Certain key functionalities had to be present for the EMR to qualify as ‘fully functional’. Fully functional EMRs could provide the impetus for fully functional EHRs, yet physician adoption and use of the EMR remained central.
A fully functional EMR should include patient demographics and problems lists, electronic lists of patient drug intakes, and clinical notes with medical history and follow-up notes (Nagle & Catford, 2008). Order entry functionality had to take account of orders for prescriptions, laboratory and radiology tests, as well as prescriptions and orders sent electronically.

Results management functionality should include laboratory and imaging results, as well as electronic image returns. Clinical decision-support functionality could provide drug interaction alerts and out-of-range level highlights (Neville et al., 2004). The difference between a fully and partially functional EMR were, inter alia, the absence of one or more of the characteristics mentioned above.

Increased quality of care, security, decision-making support, universal yet secure access, and customization were some of the benefits of the EMR. Security was paramount in keeping patient information accessible to those authorized to see, alter, transfer, or share data in support of the continuum of care (Bates & Gawande, 2003). Technological sophistication and ease of computer use were prerequisites for obtaining qualified physician responses of EMR assessments. If a physician was not computer literate or did not embrace the full functionality of an EMR, the workflow among physicians partially connected to electronic health record storage increased the gap in pan-Canadian physician EMR adoption.

EMR elements such as patient encounters, laboratory data, e-prescribing with decision-support built in, diagnostic imaging, hospital data, home care, long-term residential care and user access to own records had potential impacts on wait times, primary health care development, safety, quality, and efficiency (Baron, 2007). Laboratory data evaluation were enhanced by an
EMR, effectively addressing wait times in Canada. An improved response time on test results might require physicians to adjust work schedules to react to increased patient data.

The benefits accrued from greater volumes of data might eventually result in time and efficiency gains for the physician. Abnormal results could be flagged to alert physicians to apply recommended interventions – or even an automatic consult query with a specialist, if the physician desired. Spurious alerts would however require physicians to adjust EMR programming, which may further dissuade physicians from embracing the EMR.

The challenge of connecting disparate EMR functionalities into one comprehensively structured EMR remained (Giokas, 2005). Connected physicians benefited through an aggregation of information, readily disseminated within a network of electronic medical records. In addition, networks offered advantages for smaller physician practices when networks formed collectives as far as risk, load sharing of maintenance, costs, and support were concerned. Networks could be supervised through vendor management, thereby freeing time for physicians to concentrate on care provision (Bates, 2005).

The EMR as change agent could increase patient-centered care, where the patient interacted with the provider. Ahmad, Hogg-Johnson, and Skinner (2008) sought to study patient-perceived benefits of family practice electronic consultation. The authors studied female patient concerns concerning privacy of medical information, the interference of electronic media in patient-physician interactions, and the interest expressed by female patients regarding computer-assisted health assessments (Ahmad et al., 2008). Results showed that female immigrants and lower socioeconomic status individuals perceived greater barriers on the subject of computer assisted lifestyle surveys, even as 87% of respondents to the survey indicated computer use at home (Ahmad et al., 2008).
Ahmad et al. (2008) showed how technology was used to advantage by incorporating patient preferences into care giving practices. Illness management by the patient as well as the provider was possible, if guidelines and prompts for preventive care regimens existed within the EMR database. Shared health management would present a significant workflow improvement for the care provider. Decision-support should be a benefit to the patient as well as the care provider.

Gaps in the knowledge of low EMR adoption existed partly due to a lack of due diligence required of EMR implementers. Slow EMR responses to data requests affected EMR adoption. Practical testing of EMR architecture was required to see which overheads affected transmission speeds (Maglogiannis, Delakouridis, & Kazatzopoulos, 2006). Further EMR adoption research included the implementation of EMRs within an efficient knowledge management system (Purves & Robinson, 2004), designed to compensate and adapt to influences that denigrated overall EMR user satisfaction.

Efforts to increase EMR adoption rates prompted Canada Health Infoway to educate physicians on the benefits of electronic media (Alvarez, 2004). Health care delivery system incentives (Steele, 2008) should have involved captains of industry who related progress achieved in the field of EMR interoperability. Quality improvement with an EMR were achievable but not automatic (Baron, 2007). Canada Health Infoway (2010) provided regular updates on pan-Canadian EHR implementation progress, detailing specific areas of functionality by province or territory.

Providing devices that relayed medical information could assist the continuum of care for patients at home or in long-term care facilities. E-registration, or electronic registration, offered convenience by allowing online registration, which reduced staffing loads at hospitals.
Kiosks located in Ontario’s Women’s College hospital foyer offered patient-enabled registration, resulting in faster processing of patient data and decreased wait times (Women’s College Hospital, 2010). E-registration could sound an electronic alert to alleviate the wait for patients with urgent conditions. An immediate response could expedite care that bypassed traditional triage paperwork and long wait times (Dick et al., 1997).

Wait time improvements allowed for greater provider productivity, which positively influenced the spectrum of care. Enhanced communication, safety prompts concerning possible drug interactions, automated reminders for comprehensive care, and division of labor due to electronic scheduling were possible with an EMR (Alvarez, 2004). While physicians were aware of abovementioned benefits, the actual implementation and training did not always deliver the desired results. User satisfaction should align with implementation that ensured follow-up and feedback on resolution of persistent provider-EMR issues.

Canadian urban and rural EMR use stood at respectively 22% urban and 21% rural use (College of Family Physicians of Canada, 2005). Younger physicians identified with a more robust use of the EMR regarding allergies, medication lists, diagnosis, problem lists, patient scheduling, educational materials, preventive services, and access to reference materials. Specific PDA usage included drug referencing, weight based dosing, medication interactions, and dictation (College of Family Physicians of Canada, 2005). Family physicians sought a more comprehensive benefit from an EMR, as family physicians often dealt with the holistic aspect of patient care as opposed to specialist practitioners. In spite of family physician adoption rates, smaller rural practices did not embrace the EMR as readily as urban practices (Menachemi et al., 2006).
A lack of financial and human resources within rural settings acted as a barrier to greater EMR use. Installing a costly electronic medical record that provided little assurance of palpable benefit or positive business returns made little sense. Physicians in small to medium sized primary care practices were justifiably reticent to spend money on a promise of better things to come. Geographically distributed physicians used peer-to-peer networks to collaborate and exchange EMR information (Maglogiannis et al., 2006); however, the interoperability of EMRs in general was not affected. A peer-to-peer network involved users who communicated directly, as opposed to users communicating through a central server.

In contrast to large complex care facilities with entrenched data transfer and sharing mechanisms, regionally dispersed practices that were organizationally independent were not equipped to transfer and share data effectively. To surmount data sharing constraints, the design of health information applications should combine principles of workflow systems, peer-to-peer networking architecture, the Internet, and visual integration concepts such as video-enabled telemedicine. Such comprehensive design might aid the information exchange among geographically distributed personnel (Maglogiannis et al., 2006). The 2009 Canadian stimulus budget allocated governmental support aimed at increased EMR penetration among the physician community (Holland et al., 2009).

*The Absence of Clear Business Case Benefits*

Historically, physicians treated and diagnosed patients according to an algorithmic method of practice. Briefly, algorithms involve logical problem solving steps used in mathematical equations as well as in patient care. The patient presented and the physician listened, analyzed, and reasoned what approach was best suited to the particular symptom(s).
Handwritten notes and anecdotes added volume to the paper file. Retrieval was manual, and patient data updates were normally paper or hard copy imagery. 

Certain time-consuming efforts such as file retrieval, data aggregation and sorting, charting to determine trends, follow-up checks, and appointment telephone calls to patients were common in the paper-based physician’s office (Miller et al., 2005). The advent of the computer age and the need for seamless integration of information from a variety of sources and resources necessitated radical re-engineering of data and physician practice management. The rate of progression from paper to electronic data storage, retrieval, use, and transmission depended on user acceptance of the EMR.

Early EMR variants were brave attempts to produce useful electronic media. As in any new technology, early adopters were required to install, use, and comment on the technology so that upgrades, improvements, and increased functionality resulted from subsequent EMR renditions. The negative side of early EMR versions were (and still are) a lack of standardization in protocol, a lack of interoperability, prohibitive implementation cost, and unknown business-case profitability (Tang et al., 2006).

Organizational effort were required to implement an EMR that effectively changed the modus operandi of paper-based physician practices. Behavioral changes were not easy to implement, especially when physicians were content with current methods of care delivery. A conservative culture within physician offices tended toward working within known parameters that produced requested results. Current literature showed that physicians were not willing to accept electronic medical records if the business case for doing so was unclear (Nagle & Catford, 2008).
Physician reticence to adopt an electronic record may have stemmed from an uncertainty of financial return on IT investments. The political sense of installing an EMR that may not suit the practice or may even need replacing by another EMR created further barriers to increased adoption. There were few sound economic reasons for buying an EMR that could not guarantee interoperability with other EMRs, although select healthcare institutions with sufficient economic resources have already implemented EMRs (Bristol, 2005; Burton et al., 2004; Gans, Kralewski, Hammons, & Dowd, 2005; Jha et al., 2006; Tang et al., 2006). Organizations with dedicated budgets and information technology champions encountered less resistance to change than individual physicians limited in time, resources, and knowledge regarding EMR benefits.

EMR implementation in family practices required extensive customization of off-the-shelf software (Terry, 2006). An EMR structure should accommodate different types of patients, individual patient needs, and data generated; restrictive templates should be easily modified to suit care provider preferences. Application obsolescence, sporadic helpdesk availability, vendor obsolescence, the lack of interoperability among EMR variants, and the time taken to acquaint users with a new manner of doing business all detracted from wholesale EMR adoption.

Change management required an emphasis on the psychology of change, and the impact that change might have on the intended audience. A proper change management plan would require workflow adjustments put into practice by systematically coaching physicians to accept change. Creating benchmarks for adoption in a staged manner may elevate incremental change to transformational change as the level of complexity and benefits increases.

General guidelines that effectively sidestepped potential business process changes involved thorough fieldwork and preparation (Pawola, 2007). Implementation checklists were effective if the implementation team operated from a physician-practice vantage point as
opposed to an EMR-centric approach. Once the EMR implementation aligned with the needs of
the practice, physician resistance to change could be approached in a cooperative implementer-
user atmosphere.

Changing from old ways of ordering and assessment to the new method of e-prescribing,
tele-monitoring, e-registration, patient portals, radio-frequency identification (and electronic
template-driven health assessment) was not always easy (Silber, 2004). Physicians coping with
scheduling constraints and limited hands-on training time would welcome change that offered
seamless integration with current practices. The switch from old to new should be gradual, with
set milestones and achievable goals acting as prompts toward an ultimate paperless practice.
Patients were becoming users of the EMR as well, so physicians should increase the interaction
with patients by sharing medical information while the patient was visiting the clinic.

A clear business benefit had to exist for physicians engaging patients in shared health-
record data entry. Patient access to electronic health information (Wiljer et al., 2008) provided
patient engagement and empowerment. Physicians should however consider the benefits and
risks of patient access when developing EMR adoption strategies. Privacy, security issues, and
the lack of patient understanding of EMR infrastructure would remain as barriers to full-scale
EMR adoption.

Sparse legal precedent on erroneous patient-entered health data leading to harmful care
provision further deterred physicians from EMR adoption. Institutional vicarious liability for
physician negligence (Hardcastle, 2011) may defer care provision facilities from adopting an
EMR. Employees of hospitals may implicate the hospital if the equipment provided (in this case
an EMR) was at fault. In essence, a dated EMR might contain incomplete data leading to errors
in medication or procedures. The hospital may therefore be liable for physician actions based on EMR information.

An inability to customize an EMR to suit an organization did not apply when considering the Canadian Forces Health Information Systems project. The Canadian Forces health information systems implementation deadline for 37 military clinics was end-2010 (Doggett, 2008). Expedited implementation by virtue of military edict avoided physicians electing not to adopt the CFHIS. The business case benefits of the CFHIS project were not readily apparent, as the project required time for implementation costing.

*Low Adoption Rates Among Care Providers*

Low adoption rates among physicians presupposed systemic problems with the concept of an EMR. From a theoretical point of view, the idea of centralized, current, instantly updated, and ubiquitous data on patients was sound and even desirable when providing care. Further research was required when theory did not fit with practice, and ideas did not mesh with the actual EMR implementation. A sustained low adoption rate among physicians therefore required change management that addressed barriers currently overlooked or insufficiently recognized as material obstacles.

Contemporary literature confirmed that physician adoption of the EMR was low (Baxley & Campbell, 2008; Der Gurahian, 2008; England & Stewart, 2007; Tang et al., 2006). Technical features of an EMR were not readily comprehensible to physicians pressed for time and often unwilling to commit resources toward unknown technical innovations. Managerial coaxing was required to induce physicians to adopt a technology that required time and effort to master.

A 2004 National Physician Survey conducted by the College of Family Physicians of Canada (CFPC) indicated EMR adoption rates ranging from 33% in Newfoundland to 6% in
Prince Edward Island, with Canada’s most populous province Ontario showing EMR adoption rates of 24%. Hospital-based adoption was 30% as opposed to 20% office based EMR adoption. Solo practice registered 14% EMR adoption, whereas non-solo practices showed 22% adoption (College of Family Physicians of Canada, 2005). The 2007 CFPC survey showed 47% of Albertan family physicians had entered and retrieved clinical patient notes (lowest reported for Quebec at 9%; N = 30,384). Specialists (non-family physicians) entering data and using electronic patient health records showed Newfoundland at 38% (data entry) and 50% (use of electronic patient health records). A 24% survey response rate should caution against generalization toward national EMR adoption rates (National Physician Survey, 2007).

Health information technology was predominantly used for purposes other than a strict EMR application (College of Family Physicians of Canada, 2005). Billing, printing labels, creating referral letters, validating health insurance cards, patient demographic updates, and laboratory results queries were added functionalities of the EMR. An EMR assessment gained perspective when current adoption studies were compared to past adoption studies. In 2006, 8% of Canadian physicians reported routine use of electronic ordering of tests, 11% reported electronic prescribing of medication, 27% had electronic access to patient’s test results, and 15% had electronic access to patient’s hospital records (Protti, 2008). In essence, electronic media were being used by physicians, yet the EMR as specific tool was not fully utilized.

*Innovation Diffusion as Model*

Primarily, innovation diffusion as suggested by Rogers (1995) studied how, why, and at what rate innovations spread through society’s social systems. The social system mentioned by Rogers (1995) applied to physicians as a group. Key to adoption of innovations were variables such as the type of innovation being introduced into society, the communication media used to
introduce the innovation, the rate of adoption, and the social system that determined the rate of adoption. Consistently low adoption of an innovation across an entire group was the result of collective decision-making processes.

Innovation diffusion progressed through five stages before complete adoption of the innovation was achieved (Rogers, 1995). According to Rogers (1995), awareness, interest, evaluation, trial, and adoption formed the stages of innovation diffusion. If an innovation was not accepted despite awareness and interest, the innovation seemed to be stuck at the trial stage. Trials required time, effort, courage, and financial support to weather disappointment and errors. Once successful trials and reports had been completed, reticent and cautious physicians might trial an innovation themselves.

An ideal EMR implementation process would be aimed at care provision facilities adequately staffed with physicians to enable a return on time and effort invested. Larger facilities of 25 physicians or more with dedicated IT budgets were targeted with solutions specifically tailored to meet the needs of diverse physician practices (Leonard, 2007). The likelihood of positive acceptance of the EMR concept was increased as the number of physicians and the size of dedicated IT budgets increased. Silos of information among larger care provision facilities made business sense, whereas the bulk of smaller physician’s practices were left to either buy individually or wait for government subsidies (Ludwick, Manca, & Doucette, 2010).

Physicians should implement a simpler, robust EMR version capable of producing specific functionality, as opposed to complex EMRs that were sub-optimally employed (Terry, 2006). Pilot testing a large-scale EMR implementation tended to ease the passage of novel electronic tools such as electronic medical records (Bassinder, Bali, & Naguib, 2006). The
benefit of a small scale turnkey EMR implementation was the relative lack of complexity common in large EHR installations.

Large EHR implementations generally had a host of interdependencies, legacy systems and architectures, operating systems, diverse personnel, and tight timelines as added complications. As stated earlier, an EMR was generally smaller and patient-centric, whereas an EHR comprised the entire health status of an individual that was shared among many providers. Healthcare payers who did not share patient information with physicians were partly to blame for further fragmentation of the care continuum.

The ultimate quest for an ideal EMR innovation diffusion would be the widespread if not ubiquitous use of EMRs for all patients. Widespread use would provide a continuum of care comprising the complete record of patient health, interventions, diagnoses, and alerts in one data repository. While adoption patterns were affected by extraneous and seemingly unrelated factors such as geography, age and gender, the factors nevertheless limited adoption rates.

A need existed for formative evaluation before any implementation of an EMR was attempted (McGowan, Cusack, & Poon, 2008), where process rather than outcomes were the focus. A coordinated and concerted effort was required to proceed with electronic patient data management (Burton et al., 2004). Part of EMR implementation functionality concerned the ability of patients to access the EMR for purposes of medical record changes, or to request prescription refills, referrals, or appointments. If patient data were to reside in an EMR that spanned multiple care provision facilities, the ability to aggregate data in one database would ease decision-support for physicians. An innovation could readily diffuse if all components were easily and logically linked.
Differential EMR satisfaction was noted in a study of pediatric and internal medicine residents co-located within the same practice (O’Connell, Cho, Shah, Brown, & Shiffman, 2004). The residents shared the same EMR, practice location, administration, and information technology support. A cross sectional survey measured satisfaction with the installed EMR. Differences in previous exposure to an EMR translated to a variation in the rate of adoption among respective residents.

O’Connell et al. (2004) contended that exposure to ostensibly superior EMRs may have tainted the results of the survey. EMRs generally specialized in certain functionality; if the functionality corresponded to the requirements of residents, the responses were skewed. The lessons learnt were that physician preferences for information technologies could not be predicted without first determining physician needs. An innovation should disperse among a body of users contingent on consensus regarding shared benefit from widespread adoption.

An extrapolation for future EMR capabilities was possible if the current trepidation concerning EMR competence was used as an indication of upcoming developments. Speed and connectivity among physician networks were key characteristics that influenced acceptance of electronic health records. Pilot-version hardware and software could allow physicians to actually send data over probative networks, providing hands-on experience that resulted in frank feedback. The user-friendliness and capability of trial EMR systems provided useful guidelines for large-scale implementations (Maglogiannis et al., 2006).

Simulated communications between physicians using a variety of transmission media, hardware, software, and protocols could provide data for vendors who needed to align EMR products with concepts such as interoperability and user-friendliness. Further research was required on handheld devices such as Personal Digital Assistant (PDA) interoperability with
existing communication media (Menachemi et al., 2006). Low PDA adoption among Canadian physicians was reported in the 2004 National Physician Survey (College of Family Physicians of Canada, 2005). The Canadian prairie provinces showed adoption of 34%, while the rest of Canada did not exceed 25% (College of Family Physicians of Canada, 2005). A survey done among 16 of Canada’s 17 medical schools showed no health information technology in student curricula (CMAJ, July 2010).

Strong administration of the EMR may increase physician EMR adoption if the administrators were champions who were technologically aware of an innovation’s capabilities. While administrators may not be technically proficient in the mechanics of the EMR, administrators could assuage fears of physicians through feedback and support. A Delphi study seemed most suited to deliver an overview of innovation diffusion, as opposed to a collection of individualized innovation adoption descriptions (Fleuren, Wiefferink, & Paulussen, 2004).

The implementation of an EMR should be preceded by due diligence to ensure a proper fit of an electronic medical record to specific healthcare practices. A comparison engine (CMA, 2009) allowed prospective buyers to view accredited Canadian EMRs, showing capabilities and accomplishments in producing a product designed to suit physician needs. An uncertainty of product shelf life and the idea of spending time to become familiar with new and possibly short-lived technology further complicated the case for innovation diffusion. The province of Ontario provided a standardized EMR certification process for EMR vendors, accessible through OntarioMD (eHealth Ontario, 2010). Certification application fees of $2,500 applied, while testing fees ranged from $25,000 for the first and $7,000 for subsequent tests. A total of 21 certification test scenarios were conducted, test data were provided, while certification to the
specification had to be maintained for funding eligibility. Testing was video recorded, and only successful certification candidates were published (eHealth Ontario, 2010).

**Governmental Mandates and Inducements Toward Conformity**

Change that was mandated would rarely succeed if democratic discussion options existed. If the greater good of society were used as an inducement toward conformity, the good needed to be aligned with the reality of implementation and execution of mandated changes. Governments that proposed change had to consider the impacts of change. The notion of national EMRs that benefited the entire population should be correlated with the mechanics of implementation.

Canadian, U.S., and other countries have encouraged greater acceptance of EMRs through various measures, inducements, and pilot trials. Mandates needed to be weighed against the needs of physicians, the physician’s financial capacity to implement an EMR, and installing an innovation across different platforms, infrastructures, and operating systems. Inducements toward conformity may succeed once pilot phases demonstrated success in incremental implementation that did not interfere with or degrade patient care.

Canada Health Infoway, a federally funded independent organization, has been a catalyst for collaborative change to accelerate the use of electronic health information systems and EMRs across Canada (Alvarez, 2004). At last count, 300 distinct projects were being funded by Canada’s prime EMR implementation agency Infoway (Canada Health Infoway, March 2010). Infoway chose to use the term EHR, even though cognizant of the need for EMR adoption preceding EHR realization. Convergent EMRs should form the building blocks for a pan-Canadian EHR. Health records technology will develop haphazardly until national standards formalize the technology, allowing EMR interoperability to form an EHR.
Technological innovations easing the transition for paper-based physician practices could speed the rate of EMR espousal. The architecture to connect geographically dispersed physicians via a client-server system as well as a peer-to-peer scheme existed (Maglogiannis et al., 2006). Data storage should comply with standardized formats such as Digital Imaging and Communications in Medicine, or DICOM. Security concerns were allayed with widely used 1024-bit encryption keys. Encryption keys could be compromised, albeit via dedicated code deciphering using very expensive and time-consuming decryption.

Physicians were averse to data residing in multiple storage locations, and were alarmed when patients accessed and integrated personal medical data into one repository (Tang et al., 2006). The risk of faulty patient diagnosis may increase if physicians routinely accepted patient entered data. The issue of physician culpability may have dissuaded physicians from encouraging patient access to personal files. While physician privacy concerns were traded off against patient access demands, the error rate and legalities of misdiagnosis may well have deterred physicians from EMR adoption.

Once a common interface was developed where patients and physicians entered data discretely, diagnoses could occur without the doubt of data origin and accuracy. Patient-entered data could be highlighted, italicized, or demarcated to create a clear indication of each data entry’s origin. Apprehension and rejection of EMRs, EHRs, and PHRs could be overcome by means of care provider and patient education in electronic media. Government intervention may be required to ensure a consistent data-coding format in support of EMR interoperability.

In order to overcome the dispersion of patient data among a multitude of EMRs, a common language would accurately transmit information among a variety of EMRs on the market. National and international interoperability standards might allow exchanges between
physicians of differing cultures, languages, and disciplines (Begoyan, 2008). Current issues of different architectures, diverse naming conventions, proprietary licensing restraints, and inertia among physicians to adopt an EMR for the sake of adopting an electronic medical record, countered the rate of EMR adoption.

Interoperability allowed more than one EMR system to exchange information across a multitude of architectures, platforms, and operating systems. As an example, an EMR diagnostic imaging element reduced delays caused by redundant imaging, and allowed faster interpretation for remote sites (Alvarez, 2004). Electronic transfers were near instant, allowing for follow-up and treatment as required. However, remote sites in different provinces with unique naming conventions were ill-suited in the quest for greater interoperability.

Reduced referrals resulted when using picture archiving and communication systems, or PACS. The PACS images were expertly interpreted to minimize missed pathology (Alvarez, 2004). The cost of repeated tests, transportation of x-ray images, and loss of x-rays in transit highlighted the benefits of an EMR-based diagnostic imaging system. The ultimate ideal was to have all EMRs linked by a common architecture and language, which would overcome many issues faced by isolated EMRs.

International EHR Considerations

In general, international EHR implementations were adapted to suit countries’ general patient needs. EHR implementation progress within countries were of interest to other countries if similarities existed among them. Comparisons did not easily act as blueprints to be copied from one country to the next. Each country had a unique mix of government, privacy laws, population needs, medical expertise, and care provision infrastructure that formed the ultimate shape of an EHR. While demographic similarities among common cultural facets of the U.S. and
Canada produced similarities in EHR implementation, the essential differences of state-supported versus private financing influenced EHR adoption rates.

Specific EHR adoption rates were placed in context by comparing adoption rates within OECD countries like New Zealand, the U.K., and Australia (Der Gurahian, 2008). EHR adoption rates among physicians in abovementioned countries were 92%, 89% and 79% respectively. 98% of medical practices in the Netherlands were using EHRs, while the U.S. EHR adoption rate of 35% fell far behind (Center for Disease Control, 2009). Once again, the distinction between an EMR and an EHR should be kept in mind, as the scope of implementation and patient data storage differed between the localized EMR system and the nationally implemented EHR.

United States. Of all U.S. physician-patient encounters that took place in 2007, 68% were in physician groups of four or fewer, therefore “improvements in small practices will be necessary to close the well-documented gaps in consistent delivery of high quality care” (Baron, 2007, p. 549). The U.S. Office of the National Coordinator for Health Information Technology, or ONCHIT listed national goals of IT adoption, and offered physicians extra Medicare payments for the "meaningful use of a certified EHR that could exchange data with other parts of the health care system" (Blumenthal, NEJM, p. 1477). Certification would require privacy controls compliant with the U.S. Health Insurance Portability and Accountability Act (HIPAA, 1996).

Adapting technology for use in public health, medical research, quality improvement, and national medical emergency preparedness may spur greater EHR adoption. The U.S. Certification Commission for Healthcare Information Technology or CCHIT formed part of a federal initiative to implement national standards for health information technology (Classen,

The United States Department of Health and Humans Services developed certification criteria and an inspection process for EHRs. An industry-recognized level of interoperability, functionality, and security among certified EHRs was available. The test-script each vendor had to pass was openly available on the CCHIT home page, allowing vendors to test applications before applying for certification (Classen et al., 2007). There was a drawback in the CCHIT testing process, though, as usability and ‘friendliness’ of the application were not tested. Physicians should use the certified vendor lists as guidelines only, after which due diligence was required to test for ‘fit’. CCHIT certified vendors touted EHRs that purported to be interoperable, functional, and secure within the frameworks set by the CCHIT (Leonard, 2007). The degree of complexity in connecting disparate healthcare provider networks should caution vendors who proclaimed a product’s interoperability.

The U.S. Federal government was engaged in a five-year demonstration project that was inclusive of financial incentives prompting individual physicians toward EHR adoption (McKinnon, 2008). The U.S. Department of Health and Human Services (HHS) demonstration project offered 50 U.S. communities financial support toward a funded EHR implementation. Supported communities contained 1200 practices serving 3.6 million patients, and incentives ranged from $58,000 per physician or up to $290,000 per practice (McKinnon, 2008). In the U.S., care providers had to meet usage and reporting requirements to qualify for incentives in the project. The project aimed to reduce medical errors and improve quality of care.

Financial incentives were generally potent inducers of change, while simultaneously spreading EHR adoption. A thoughtful approach was required when enticing physician support
through federally supported financial incentives. Desired end results were not guaranteed, as incentives to adopt an EHR were not necessarily an indication of continued use or improvement in physician productivity. Pay-for-performance incentives could help promote widespread EHR adoption where small practices were especially needy of incentives for adoption (Simon, Rundall, & Shortell, 2005).

A lack of government funding was partly based on a poor payer mix of patients, as well as increased volumes of patients in recent years (Shields et al., 2007). Limited data on health IT adoption in U.S. community health clinics did not deter from recording factors that significantly affected electronic record functionality. Factors included a disproportionate number of Latino patients, the volume of patients served, and the number of full time physicians available per patient load (Shields et al., 2007). Barriers to adoption were a lack of capital, an inability to integrate electronic records with billing systems, and a loss of productivity or income during implementation. Also, uninsured and poor patients produced fragile revenue streams (Shields et al., 2007) and created greater dependence on public funding and Medicare payments.

Physicians who used electronic records as a collaborative tool generally shared the tool with patients (Ventres et al., 2006). Physicians with limited typing skills were hindered in the effective use of electronic records as a timesaving tool. The theme of information technology fluency repeated itself where technologically adept physicians were more attuned and at ease with electronic records. A preponderance of younger physicians routinely used computers. Modern computing software generally satisfied privacy requirements by using encryption and access control mechanisms. One of the disadvantages of electronic records applied to younger physicians not yet schooled in effective communication with patients - the attention required to adequately complete electronic records templates detracted from engaging patients.
Cyprus. Comparisons to EHR implementations in foreign countries highlighted differences in physician practice, remuneration schemes, and the size of physician population. An EHR implementation in Cyprus (Samoutis et al., 2007) required added prescription information, changes to the electronic interface, and interactive features for laboratory testing. As a result, a Cypriot EHR variant was constructed to be more suited to the conditions prevalent in that country. The implementation was performed in a care setting that had relatively little electronic record keeping facilities at the outset. The previously computer-naïve (Samoutis et al., 2007) primary care providers were receptive to EHR implementation, although there was a need for subsidies and performance incentives for care providers.

Major implementation impediments remained among physicians in the Cypriot primary care centre. Barriers included physician perceptions of EHRs negatively influencing workflow, legal concerns with electronic media, the reversion to paper-based practices, a lack of incentives, system breakdowns, software design problems, transition difficulties, and a lack of familiarity with EHRs. While Cyprus was deemed to be lagging in information technology expertise and electronic medical records, the issues there seemed strikingly similar to U.S. electronic medical record issues (Samoutis et al., 2007).

Canada. The EHR in Canada will require bridging of EMR barriers and promotion of EMR adoption measures. A knowledge gap existed in EMR barrier and facilitator literature, even though the literature review cited three reports, two articles and 25 journal entries addressing barriers and EMR adoption among 177 literature searches. The literature review showed an important gap in the literature on Canadian physician adoption and facilitation of electronic health registries. Specifically, despite the large amounts of cash and incentives that were allocated to Canadian EMR implementation, little was known or suggested to improve the rate of
EMR adoption. Research addressing barriers and facilitators may suggest a targeted approach that could better employ Canadian healthcare resources.

Conclusion

The general state of EMR adoption in Canada was below the levels desired by government agencies tasked with implementing an interoperable EHR. In the main, factors such as cost, security concerns, a lack of standards and infrastructure, and reticence to adopt among Canadian physicians added to sustained low EMR adoption. A lack of change management was a key barrier to increased adoption, even as the merits of an EMR seemed evident and accepted by physicians.

The development of a functional EMR required direction, support, and governance aimed at progress through consultation with EMR beneficiaries such as care providers. While the literature showed that cost was the chief barrier to greater adoption (Silversides, 2010), the impact of health information technology showed promise thus far. Workflow disruptions needed to be addressed to create an EMR recognized as innovative and helpful rather than being a hindrance. Once clear business case profitability was proven, physicians could be encouraged to adopt an EMR. While Canadian Forces members were obliged to adopt the military EMR currently in use, forced adoption did not necessarily translate into user-satisfaction.

Innovation diffusion could succeed once proper communication introduced an innovation at an adoption rate suited to physicians (Webster, 2010). Even though governments may mandate adoption of an EMR, the end user would determine whether to adopt an EMR based on common sense decision-making. Comparisons to other EMR implementations across the world showed similarly low adoption rates, however the cause of low adoption among Canadian physicians should be researched within Canadian healthcare circumstances.
Summary

Only eight percent of peer-reviewed references were found to address Canadian care provider EMR adoption and facilitation. A need existed for more research to better understand EMR adoption issues in Canada. Key topics emerged that included EHR and EMR innovations, health information technology and systems designs, EMR adoption research methodologies, applications of the Delphi technique, physician concerns regarding EMR as a concept, and barriers to adoption in general. All references were sourced from peer-reviewed material.

Historical perspectives of individual key factors affecting physicians were presented, so that current developments of key factors could be analyzed for signs of progress. Resistance to change was used as an initial conceptual theory. Resistance to change was discussed from a historical as well as current point of view. Key factors influencing EMR adoption and facilitation included

- cost as a factor in physician adoption (Gagnon et al., 2009; Silversides, 2010);
- the impact of health information technology on physician adoption (Gravel, Légaré, & Graham, 2008);
- workflow disruptions and improvements caused by the EMR (Kazley & Ozcan, 2007);
- the absence of a clear EMR business case (Ludwick et al., 2008);
- persistently low adoption rates among physicians (Canada Health Infoway, 2009);
- innovation diffusion as a model (Rogers, 1995);
- governmental mandates and inducements toward EMR implementation conformity (Webster, 2010);
- foreign EMR implementations.
The literature suggested resource availability to help physicians integrate EMR technology into patient care, as physicians transitioned from paper to electronic communications media (Brender et al., 2006; Chau & Hu, 2002; Coch & French, 1948; England & Stewart, 2007; Gagnon et al., 2009; Gans et al., 2005, Webster, 2010). Best practices and standard procedures should be used to assist physicians being introduced to the EMR. An emphasis on patient-centered models of care should assist international efforts at increasing EMR adoption, so that barriers could be overcome in support of improved patient care. Chapter 3 will discuss methods used to elicit feedback from respondents.
CHAPTER 3: METHOD

The purpose of the qualitative Delphi study was to study factors that influenced care provider acceptance of the EMR. The EHR as concept was too broad, as the EHR was an unfulfilled idea of the future. Acceptance of the EMR should precede realization of the EHR, which can only be realized once EMRs have been fully utilized. A narrowly defined subset of care providers within Canada’s 13 provinces and territories were selected due to ease of access, as the sample was chosen from the Canadian military health services group.

Chapter 3 elaborates on the Delphi research method as well as the study design appropriateness. An explanation of the rationale for choosing a qualitative Delphi method is given, in contrast to other equally valid but less appropriate methods. The population is discussed regarding suitability and ability to offer constructive comment. The sampling technique is discussed, and informed consent requirements by participants is stated. Data collection occurred by means of secure data collection software.

The data collection strategy ensured anonymity of respondent interaction, with feedback compiled into grouped responses showing dominant themes. The eListen® survey collection software removed respondent identification before data were forwarded to the researcher. The Delphi instrument’s reliability and validity were substantiated. Data analysis by successive Rounds of questionnaire responses preceded the chapter summary and a brief transition discussion to Chapter 4.

Research Method Appropriateness

The Delphi technique was the most suited qualitative research method to obtain feedback regarding EMR adoption barriers and facilitation. The character of qualitative responses included personal recollection, insights, and open-ended responses that added to the richness of data.
Quantitative research may be used to determine averages, means, modes, and medians for numerical data (Creswell, 2008). Qualitative analysis allowed for aggregation of data which were unrestrained and open to interpretation based on learned insight. Supporting evidence was produced to substantiate conclusions drawn from new ideas that emerged.

The reason for choosing qualitative as opposed to quantitative EMR adoption research was supported by related medical research also using the Delphi technique. Brender et al. (2006) used a pilot Delphi study to gain information on factors “influencing success and failure for health informatics for a group of medical informaticians” (p. 125), while a Delphi consultation exercise by Snooks et al. (2008) sought further information on priorities for research in pre-hospital care. A Delphi consensus on risk and investigation performed by Essex, Ashworth, and Crichton (2007) evaluated performance concerns in primary care, whereas Skulmoski, Hartman, and Krahn (2007) provided guidelines concerning the Delphi method for graduate research.

A targeted research population may provide simple solutions to complex matters. When numerical data fail to provide answers to persistently low EMR adoption rates, qualitative data may offer insights toward resolving adoption rates. Social systems such as care provider groups cannot be classified as distinct entities, prone to react in certain ways based on defined stimuli. Quantitative data produced low adoption factors that required qualitative resolution. Four key areas of mixed methods were mapped by Creswell (2008) that included: (a) Priority; (b) Implementation; (c) Integration; and (d) Theoretical perspectives. Each key area required further analysis within the Delphi technique employed.

The Delphi method has been used to address research requiring qualitative research methods. Although quantitative data formed a part of the qualitative data provided by respondents, priority had to be assigned to qualitative data as the data formed the basis of
determining barriers and facilitators. Once prioritized, implementation referred to the sequence of qualitative and quantitative data collection, thereby determining which informed the other (Creswell, 2008). Qualitative data provided the initial data from which quantitative data were drawn. Following the sequence, data integration required inferences to be drawn from qualitative respondent feedback.

Collected data allowed for a compilation of concrete quantitative facts, sequences, and trends found within respondent feedback. An appropriate survey collection tool was chosen interface with the SPSS analysis software. The theoretical perspective focused on resistance to change, in line with the theoretical framework of the study. The aim included effecting a change in EMR implementation policy, action, or ideology (Creswell, 2008), by publishing results that may serve future Canadian Forces researchers.

The Delphi method has broad application possibilities, and was used in: (a) Practical assessment research (Hsu & Sandford, 2007); (b) Blended learning in enterprises (Moebs & Weibelzahl, 2006); (c) Determining clinical information system risk factors (Paré, Sicotte, Jaana, & Girouard, 2008); and (d) As a preparatory tool for Canadian pandemic planning (Stalker, Weir, Vessel, & Mikail, 2009) amongst others. While the Delphi method did not necessarily provide ‘correct’ answers, feedback did offer a ‘best-in-class’ set of responses gleaned from respondents deemed to be subject matter experts. The best in class responses were similarly sought when applying the Delphi method to studies of EMR adoption.

Thorough qualitative research should include pilot studies aimed at issue identification, research, questionnaire production, and response gathering. Early research involved a pilot study of 10 EMR users in the province of Ontario, Canada. The pilot study participants provided useful results which were assessed and incorporated into the final rendition of the full-scale survey.
Dalkey, cited in Linstone and Turoff (1978, p. 296) found seven or more pilot study respondents to be suitable. Current and historical literature did not reveal an ideal or minimum number. The 10 EMR users were requested to provide feedback on the general ‘look and feel’ of a pilot questionnaire (see Appendix B). A cover letter was sent to the pilot study respondents, stating the study’s aim, purpose, and assurances of confidentiality.

For the Delphi technique to succeed, the definition of user was qualified earlier to lend credibility to feedback gathered from respondents. Users regularly entered and retrieved data from an EMR. A variety of professional medical specializations exist within the Canadian Forces group of care providers. Some specializations indirectly use an EMR, as a physician may hand paper records to the clerk for data entry. Users who had knowledge of an EMR (but did not actually enter data) may nevertheless have had valuable insight and opinions. Qualitative responses were sought for content validity regarding EMR adoption issues. While research (CMAJ, 2010) showed low EMR adoption rates among Canadian physicians, the reasons for low adoption were not always evident in research.

The Delphi questionnaire solicited qualitative responses to questions addressing causes, reasons, and possible solutions to low EMR adoption. Respondent demographics were included in the first questionnaire. The respondent demographics included medical specialty, level of education, respondent age, EMR experience, gender, and place of work. Cross referencing was possible between demographic and respondent feedback, while maintaining anonymity of users.

The iterative process of the Delphi technique, according to Hasson et al. (2000), allowed each Round of questionnaire to be designed to focus on emerging themes and ideas. Qualitative research tended to study human behavior, habits, and preferences (Creswell, 2008). Meaningful data patterns emerged as respondent feedback was logically arranged according to thematic
headings. Quantitative analysis of themes in behavior, habits, and preferences was possible once qualitative data had been collected.

In order for the Delphi technique to function effectively and produce a definitive outcome, conclusive agreement had to occur among respondents. To attain concordance among respondents, the Delphi method used a three Round iterative feedback process. Three Rounds of questionnaires were sent to the same group of respondents. Qualitative research allowed data to be improved as new ideas emerged, creating a dynamic environment of data refinement as the quality and content of data increased. Data returned from the second questionnaire were collated to list dominant themes, with an option for respondent commentary to supplement or refute the study’s findings. The third Round listed prevalent barriers and facilitators as analyzed from respondent feedback. Respondents were asked to either concur or disagree with the study’s findings; concurrence of 65% or more was deemed to be statistically significant respondent agreement.

The format of the study’s questions included text boxes that allowed anecdotal as well as multiple-choice responses. Careful wording of questions was required to minimize researcher bias; none of the questions were leading. The formal survey data were stored at the eListen® military server facility in Halifax, Nova Scotia. Respondent data were coded – individual respondents could not be identified as respondent data returns were stripped of identifying information. Data were aggregated to determine common themes of EMR barriers and facilitators.

Common themes were returned to the respondents for a second Round analysis, consistent with the Delphi technique of obtaining consensus by consecutive Rounds. Qualitative research allowed for data aggregation in pursuit of emergent themes, as opposed to the structured
and rigid quantitative research methods employed for numbers analysis. The third Round enumerated barrier and facilitator themes, so that respondents could provide final agreement on themes. Throughout the data gathering process, a Likert-type scale ranking removed the lowest 50th percentile barriers. Consensus was not required for lower ranked barriers, as greater effort and resources were required for barriers and facilitators identified by the majority of care providers.

All facilitator themes were deemed valid and therefore not ranked or excluded. Facilitators were recorded verbatim, as respondents were requested to offer suggestions that eased the progress of EMR adoption. Prevalent facilitation themes contained key factors for further consideration and eventual concordance among respondents.

Research Design Appropriateness

The Delphi technique applied to the qualitative Delphi study provided an appropriate method of comparison to current literature. Comparisons were made between current EMR adoption and facilitation measures, and the barriers and facilitators suggested by respondents. A comparison was made to other qualitative research designs such as case studies, surveys, grounded theory, phenomenology, and ethnography. Each research design was evaluated to determine why the Delphi design was chosen over other qualitative research designs.

Case studies often involved a study of single phenomena to determine why persons or social groups behaved in certain ways. A case study may have been used to determine low EMR adoption; however, the results would be narrowly construed and relevant only to one person or a few select persons of a group. The essence of studying low adoption among Canadian Forces care providers was to analyze EMR adoption across multiple locations, circumstances,
specialties, and demographics. Case studies were limited in scope to determine behavior within a set population and could not be generalized to a larger population (Creswell, 2008).

The Canadian Medical Association (2009) sponsored a series of 20 case studies on EMR systems across Canada. Key themes that emerged (most to least discussed) were improved efficiency, improved patient care and safety, the need for interoperability, better practice management, importance of technical support, challenges of data entry and conversion, remote access, improved internal and external communications, importance of change management, chronic disease management and standardization of care, improved work environment, importance of a champion, and the need for further research. While the case studies may have offered an in-depth look at pan-Canadian EMR systems, the studies were limited in that respondents had to have an EMR in place for a minimum of 2 years and were using the EMR for charting, prescriptions, and clinical decision support.

Surveys are essentially snapshots taken of responses to an issue. The ability to improve the survey by including new ideas would require a new survey to be completed by respondents. Repeated surveys with changing boundaries may not accurately capture the intent of a qualitative Delphi study, which sought respondent agreement by means of cumulatively refined questionnaires aimed at understanding low EMR adoption. A one-time survey may be sent to poll respondents on EMR adoption issues, but would not assist in reaching concordance regarding key factors affecting EMR adoption.

Grounded theory methodology studies produce theories from emergent data (Mills, Bonner, & Francis, 2006). The essence of the Delphi study was data analysis and eventual concurrence on prevalent themes. Data obtained from iterative response feedback (the Delphi method) produce emergent barriers or facilitators to EMR adoption. Themes were identified
from continuous data analysis. The aim of the study was not to produce a theory, but rather a solution to low EMR adoption rates among physicians.

Phenomenology as philosophical discipline would isolate individual experience from causal influences (Creswell, Hanson, Plano, & Morales, 2007). The rather eclectic approach would be ill-suited to solving concrete problems such as low EMR adoption among physicians. As phenomenology involved making sense of personal experiences in an abstract manner (Creswell et al., 2007), phenomenology would deter the researcher examining realistic and implementable solutions to adoption issues.

Ethnography as a scientific description of a “culture-sharing group” (Creswell & Plano, 2006, p. 32) might investigate broad definitions of care provider cultures; for this reason, ethnography was not sufficiently concise to be used as a research tool for low EMR adoption. Certain commonalities exist between the Delphi method and ethnographical research, yet ethnography typically studied entire populations (Creswell, 2008). The Canadian Forces care provider study did not focus on immersing itself in the culture of one group to determine low adoption rates, and therefore did not employ ethnography as the most suited research method.

The Delphi design was chosen as the most suited research design to determine low adoption rates among Canadian physicians. Inconsistencies in thought and perception regarding causation for low adoption were addressed through common factor analysis. When the scale of measurement was arbitrary – as was the case with most qualitative variables – correlation matrices were more appropriate than covariance matrices (Bentler, 2007). As data were collected and factors were isolated for communalities in barrier and facilitator determination, the fewest number of factors which could account for the common variance (or correlation of sets of variables) were retained.
The findings from a small collective of 467 care providers (467 care providers were initially invited at Round 1, to which 77 care providers responded) may have limited generalizability toward the greater Canadian physician body. Only data obtained from study participants determined final results, avoiding researcher bias and extraneous influences. Generalizability should be limited to those from whom the data were collected.

The Delphi design was appropriate as data were collected quickly and inexpensively, while producing respondent concurrence in only three Rounds of questionnaires. An initial pilot study (available in English only) provided insights and improvements for the eventual full-scale study (available in English and French). The Delphi design was flexible enough to adapt to web-based surveys. The benefits of using the Delphi method included the applicability to EMR adoption. Respondent data were linked to eListen® data before being exported to the Statistical Package for the Social Sciences (SPSS) software suite.

Other studies have used a similar combination of statistical analyses that combined the Delphi technique with an SPSS analysis. Analyses included a building construction estimation report (Hackett & Hicks, 2007), gifted science teachers’ performance evaluations (Gökdere, 2005), and research priorities in hospital care (Snooks et al., 2008). Akins et al. (2005) discussed the value of the Delphi technique in areas of medical education, nursing practice, clinical medicine, and healthcare services by describing the technique below:

Panels of similarly trained experts (who possessed a general understanding in the field of interest) provided effective and reliable utilization of a small sample from a limited number of experts in a field of study to develop reliable criteria that informed judgment and supported effective decision-making (p. 1).
The Delphi design had historic, numeric, and policy phases. The historic Delphi sought to understand the reasons for past decisions, and sought alternatives to past decisions. The numeric Delphi specified the minimum range of numeric estimates using summary statistics, so that decision-making was possible once a certain number of agreed-upon responses were collected. Finally, the policy phase of the Delphi technique referred to “consensus of opinion” regarding arguments for and against key EMR barriers and facilitators (Amos & Pearse, 2008, p. 96).

Statistical inferences drawn from respondent observations were not inferior to observations made from studies with a greater number of respondents. Akins et al. (2005) noted that “there was a lack of agreement around the expert sample size and no criteria against which a sample size choice could be judged” (p. 2). Sample size degradation was countered through repeated email prompts to maximize respondent participation for each questionnaire. The value of care provider participation was stated as an eventual benefit to future researchers.

Population

Respondents from 37 military bases were invited to participate in answering a series of questionnaires regarding EMR adoption barriers and facilitators to Canadian Forces Medical Branch care providers. A representative population sample was inferred by virtue of respondents sourced from the healthcare facility spectrum (clinics, field hospitals, headquarters, field ambulances, and abroad). A spectrum of care providers was chosen to include commissioned as well as non-commissioned care providers, so that results had greater applicability and relevance within the Canadian Forces care provision milieu. Canadian Forces care providers received formative and professional training at civilian institutions, except for medical technicians and physician assistants who received military-offered training at Canadian Forces bases.
Professional training in respective provinces and territories was not uniformly subsidized, as provinces unilaterally applied healthcare financing.

A minimum of 20 responses to Round 3 questions was determined to confer statistical significance on the results. The rigor of the Delphi method should require a 70% Round 3 response rate, according to Hasson, Keeney, and McKenna (2000). Respondent fatigue, non-responsiveness, or absence during the study were countered through repeat email requests for respondents to participate in all three Rounds.

Representation of care providers from a demographically diverse population added to data richness. There was no maximum number of respondents beyond which data were deemed statistically superfluous. The respondent population’s ability to use an EMR was shaped in part by specialization, age, education, and willingness to engage electronic media. The criterion for respondent participation was active engagement in EMR use within a medical facility of the Canadian Forces.

The 2009 Canadian federal budget allocated $500 million toward improving the pan-Canadian Electronic Health Record (Rich, 2009), but the budget did not support related health infrastructure or human resource improvements (“Federal fiscal”, 2009). No monies were set aside to address the national shortage of physicians. The $500 million may eventually provide incentives to physicians for greater adoption of EMRs, in support of the Canadian government’s target of providing 50% of all Canadians with an EHR by 2010 (“Federal fiscal”, 2009). The level of government finance and support provided to each province or territory varied, as each province differed in capacity to generate sufficient funds to provide base-level healthcare to the province’s inhabitants (“Department of Finance Canada”, 2010).
Saskatchewan

A Saskatchewan Medical Association funding arrangement existed with the province of Saskatchewan. Qualifying physicians who selected a system from a certified vendor received monthly payments for using the EMR, with “further increments tied to rates and levels of system component use, early adoption bonuses and continuing support for up to 30 months after deployment” (Fletcher & Hines, 2009, p. 41).

Alberta

Respondents from Alberta were limited by the Physician Office System Program that listed a number of eligible EMR vendors. Albertan care providers were grouped into a single health board, as opposed to nine health boards that existed before amalgamation of regional health authorities (Fletcher & Hines, 2009). The dissolution of regional health authorities affected the future of shared regional EMR initiatives, all of which had significant infrastructure investments. Health authority dissolution affected respondent responses according to newly assigned work conditions.

Ontario

More than 2,700 physicians enrolled in Ontario’s EMR adoption program by 2008 (Fletcher & Hines, 2009), with the EMR program being administered by eHealth Ontario under the Ministry of Health and Long Term Care. The degree and duration of EMR system use were tied to funding, which affected physician responses to EMR adoption within respective practices. Provincial efforts of care provider engagement in EMR usage may have affected Canadian Forces care providers resident in Ontario.
British Columbia

The Physician Information Technology Office of British Columbia received twice as many applications for funding as there were slots for an EMR implementation (Fletcher & Hines, 2009). Reimbursement rates differed from province to province, as British Columbia reimbursed up to 70% of participating physicians’ EMR implementation costs. The province of British Columbia and the British Columbia Medical Association agreed to provide gradual disbursements of $108 million through 2012 (Fletcher & Hines, 2009). Respondents in British Columbia would have the added benefit of polling physicians who piloted EMR adoption projects in five British Columbia cities (Fletcher & Hines, 2009).

Quebec

Approximately 2000 physicians operated within family health groups known as groupe de médecine familiale (GMF). Quebec’s EMR implementation team insisted on getting Quebec’s EMR version (known as the Dossier de santé du Quebec, or DSQ) fully tested before implementation in 2009-2010 (Fletcher & Hines, 2009). Canada Health Infoway provided support for three interoperable EMR projects in Quebec (Canada Health Infoway, 2009). The Auditor General of Quebec expressed reservations regarding the scheduled completion and implementation of the DSQ by end-2010 (Quebec Auditor General, May 2010).

Remaining Provinces and Territories, Except Yukon

Canada Health Infoway allocated funds for EMR interoperability for the Northwestern Territories, Nunavut, Manitoba, Newfoundland, Prince Edward Island, New Brunswick, and Nova Scotia. Since 2007 the Yukon has worked with the Western Health Information Collaborative made up of a number of western Canadian provinces, so that an interoperable EMR would be operational by 2011 (Canada Health Infoway, 2009). Respondents provided care
within provincial or territorial limitations, which may have affected physician access and use of an EMR.

**Sampling**

Selective and purposeful sampling were used to choose only those users providing care in Canadian Forces medical facilities. An earlier mention of sampling criteria for respondent selection noted that sampling might detract from the ability to generalize toward the greater Canadian physician population. More than 400 Canadian Forces care providers drawn from bases across Canada may serve as a sample of pan-Canadian care providers as a whole; however, only 77 care providers responded to the first questionnaire invitation. The sample had limitations and delimitations that might limit any generalization toward the Canadian physician body at large.

Although there were no definitive or ideal numbers of respondents for an effective Delphi study, factors of convenience, purpose, and criteria were often telling in number determination (Hasson et al., 2000). To decrease the likelihood of language limiting responses, the survey was offered in both official Canadian languages, namely English and French. Sampling that excluded either French or English physicians might have affected the results, and could have produced data which were skewed. Sampled respondents were entitled to be addressed in either English or French, as mandated by the Canadian Official Languages Act (1969).

**Informed Consent, Confidentiality, and Geographic Location Information**

Respondents were asked to commit time and effort. An introductory cover letter (see Appendix A) provided situational context prior to questionnaire commencement. An electronically mailed cover letter informed respondents of the value and purpose of the Delphi questionnaire, the reasons and criteria for selecting respondents, methods of ensuring
confidentiality, the author’s name and interest in collecting data, and the proposed timeline for the study.

An informed consent statement was included as the first question of the questionnaire. Failure to provide consent prevented respondents from answering questions, as the survey directed respondents to the end of the questionnaire if the ‘refusal to consent’ option was chosen. The opt-out was activated when respondents did not provide informed consent at the commencement of the survey. Respondents were directed to the end of the survey, without any survey data collected.

An Internet-based survey application called eListen® was used to collect data. eListen® software encrypted responses so that respondent identifiers were hidden. Respondents were informed of confidentiality provisions for collected data. Data obtained by the eListen® survey tool were stored on a server, which could only be accessed by secure military email login and password. Access to the server was restricted to programming personnel, while eListen® transformed respondent names into alphanumeric coding.

Delphi methods were employed to explore ideas among groups of people who did not typically interact in an exchange of ideas (Hasson et al., 2000). Respondent questions of consent and confidentiality were answered before the study started. Geographic location information was required to ensure all provinces and territories were represented. The data culminating from exchanges were coded to ensure anonymity of respondents.

Informed consent, voluntary participation, and confidentiality were important to ensure anonymity of responses, while allocating equal value to all responses. After 3 years, the original material obtained from respondents will be destroyed, while access to original names and data remains restricted.
Data Collection Technique and Rationale

Data collection comprised information on EMR adoption barriers as well as EMR adoption facilitators. A cover letter listed the benefits of respondent participation, resulting in greater understanding of EMR issues as well as material for further military healthcare research. Part of the rationale for the Delphi method included increased research of military healthcare as per the mandate of the Canadian Forces Director General of Health Services. Study results allowed comparisons to current literature findings regarding EMR adoption barriers and facilitators.

A pilot questionnaire on EMR barriers and facilitators was presented to 10 EMR users from the province of Ontario. The 10 EMR users were asked to provide feedback on the validity, clarity, and sense of questions to be asked, in preparation for constructing the first of three questionnaires. Feedback from the pilot questionnaire provided suggestions for changes to question format and content. The pilot questionnaire respondents suggested questions that would address solutions to current adoption issues.

Appendix D illustrates the flow of data collection from the pilot questionnaire as well as the full-scale questionnaire. The eListen® survey tool extracted text and question responses without identifying the source. The same set of respondents answering each Round of questionnaire ensured continuity of data aggregation. Responses from similar groups of specialists, non-commissioned members, and physicians were grouped to determine common themes.

A link to the eListen® survey directed respondents to the server hosting the survey. All completed questionnaires were stored centrally on the eListen® server. Access to stored data was protected by password. A central collection point allowed eListen® to aggregate information
from respondents. The information was subsequently exported to SPSS for further analysis. Data analysis included EMR usage, EMRs as a cost reduction tool, the utility of an EMR as medical decision-making aid, the ability to share information through EMR use, redundancy in tests, patient information aggregation, Canada Health Infoway as EMR adoption agent, improved timeliness of care, consumer demand concerning self-management of care, patient tracking, and the ability of the EMR to lessen wait times. Emergent themes not found in current literature were identified and discussed.

The first of three questionnaires was accessed via the eListen® web-based survey site. Respondents were requested to provide commentary on EMR barriers and facilitators among care providers. Questionnaire instructions required respondents to provide feedback based on care provider knowledge and insights regarding acceptance of EMRs. Examples of barriers and facilitators the respondents recognized as a factor in EMR adoption among Canadian physicians could be cost of EMR implementation (Korn, 2007), the absence of a business case to implement an EMR (Schoen et al., 2006), and time required to install the EMR and train the physician in EMR use (Joos et al., 2006).

The first respondent-completed questionnaire analysis produced frequently mentioned themes of EMR adoption barriers and EMR facilitators. Common barriers and facilitator themes were subsequently ranked. Ranking was assigned by allocating Likert-type scale values ranging from 1 to 5, with a score of 1 indicating least mentioned and 5 denoting most mentioned barriers and facilitators. EMR barrier and facilitator themes were collected and ranked in the first and second questionnaire, in order to achieve eventual third Round consensus on the most prevalent barriers and facilitators. Hsu and Sandford (2007) noted that the stability of respondent response
in successive iterations added credence to the Delphi technique as an acceptable research method.

The second questionnaire contained the most common barriers and facilitators collected from the first questionnaire. Respondents were asked to take heed of barriers and facilitators mentioned by peers in other provinces and territories. Respondents were requested to comment on the list of barriers and facilitators listed in the second questionnaire. Additional barriers and facilitators the respondents wished to include were added, resulting in richer data that were inclusive of every respondent’s input. The first and second questionnaires formed the basis of the third questionnaire’s yes or no response to the most prevalent barriers and facilitators to greater EMR adoption. Respondent concurrence on barriers and facilitators endorsed the researcher’s interpretation and summary (Brown, 2007) for further SPSS interpretation, discussion, recommendations, and conclusions in Chapters 4 and 5.

While there were no defined minimum number of respondents for a Delphi study (Hsu & Sandford, 2007), 20 or more respondents were deemed sufficient. The number of respondents chosen was based on literature research that emphasized group dynamics above statistical power (Delbecq, Van de Ven, & Gustafson, 1975; Okoli & Pawlowski, 2004). A small sample may produce significant results if there were stability of responses, even if the literature did not provide conclusive agreement regarding ideal respondent sample size (Akins et al., 2005; Holey, Feeley, Dixon, & Whittaker, 2007). Delbecq et al. (1975) noted that the Delphi technique remained “a method for the systematic solicitation and collation of judgments of a particular topic through a set of carefully designed sequential questionnaires interspersed with summarized information and feedback of opinions derived from earlier responses” (p. 10).
Stability of response referred to the fact that respondents had knowledge of EMRs. Reminders were sent two weeks after the initial survey was posted. A two week reminder was sent to care providers who may have been absent when the first questionnaire was emailed. Problems of poor response rates arose due to the need of repeated questionnaire resubmissions from respondents, and the intervals between successive Rounds. Respondents were encouraged and kept interested in the study to avoid ‘drop outs’, which could have decreased the volume and quality of information obtained (Ludwick & Doucette, 2008).

The technique of using multiple-choice questions urged respondents to choose all options that applied. One question requested respondents to choose among EMR functionalities such as billing, printing labels, financial management, and appointment scheduling. Respondents were asked to list additional uses of the EMR. Text blocks allowed respondents to enter open-ended commentary, much as an essay would be written in text form. If, for example, cost, time to implement, resistance to change, and wait times were mentioned in 75%, 70%, 67%, and 55% of all responses, the percentages were incorporated in the second questionnaire.

Themes mentioned in less than 50% of responses were not used when determining the most influential barriers and facilitators to EMR adoption. Data were therefore prioritized and focused. An additional reminder was sent to the initial 467 respondents, in order to increase the response rate. The reminder was effective as additional responses were collected, before the first Round data collection ended.

The mean, median, mode and statistical inferences were drawn from the final data to provide an in-depth analysis of barriers and facilitators identified by respondents. eListen® provided data aggregation in the form of pie charts, bar charts, line graphs, and text compilation to graphically display data in picture form. The rationale of using eListen® included the ability
to export data to SPSS, easing data transfer from the military eListen® database to a licenced version of SPSS.

Delphi Instrument Appropriateness

The Delphi process was a means of achieving consensus on conflicting or contradictory evidence. The primary instrument used by the Delphi process was the questionnaire. A series of three questionnaires were sent to the same respondents, so that the data of successive questionnaire could be refined. The iterative nature of questionnaire Rounds allowed participants to revisit past comments as feedback from peers became available.

Feedback from the researcher listed emerging barrier and facilitator topics, presented for respondent perusal and comment during the second questionnaire. Similar Delphi questionnaires were used to poll acute care hospitals of the American Hospital Association (Jha et al., 2009) on the level of electronic health record adoption. Controlled feedback was achieved when participants saw the group’s responses to previous questions. Statistical group responses were presented “using summary measures of the full group response, giving more information than just a consensus statement” (Jones & Hunter, 1995, p. 376).

Questionnaires were sent to Canadian Forces care providers in Canada as well as abroad. The advantage of sending the same questionnaire to dispersed individuals was the ability to detect similarities as well as differences in EMR usage, perceptions, and functionality. Provincial implementation efforts may subsequently be analyzed for respective successes and weaknesses, which can provide a data source for best practices and lessons learnt. The questionnaire returns were therefore more than mere responses to questions posed.

The use of the Delphi questionnaire was appropriate due to the nature of healthcare provision in Canada. Canadian Forces care providers give healthcare to military as well as
Civilian personnel, however the essence of care was the same for both. Provinces and territories in Canada have autonomy regarding healthcare implementation, provided each province and territory abides by the Canada Health Act (1984) regulations of accessibility, comprehensiveness, public administration, universality, and portability (Canada Health Infoway, 2009). The Delphi instrument (the iterative questionnaire) appropriately collected EMR usage within the scope of the Canada Health Act.

Anecdotal questionnaire feedback offered insights on EMR implementation, EMR support to healthcare needs, provincial funding allocations, EMR paucity due to geographical limitations, and jurisdictional impacts on EMRs. The province of Ontario’s population of 13,700,000 (2009) benefitted from greater resource and infrastructure allocation than the territory of Nunavut population of 32,200 (Statistics Canada, 2010). Geographic dispersion, infrastructural impediments such as severe weather, and scarcity of healthcare personnel in remote locations were hindrances to greater EMR adoption. Care providers may share details on coping instruments used in one province that may equally apply in another province or territory.

Narrative formed an important source of information that was captured using the Delphi technique questionnaire (Greenhalgh, Russell, & Swinglehurst, 2008). An insightful overview of adoption issues among users from various provinces with differing provincial support mechanisms was extrapolated to augment region-specific data. The robustness of data permitted concluding recommendations to overcome barriers. Recommendations were based on user-defined issues of adoption.

The transparency of the Delphi methodology may allow comparisons in subsequent studies with similar population characteristics. While the questionnaire content, form, and care provider body may change over time, the essential character of the questionnaire remained a
valid data collection means. A comparison of historical results may indicate the level and speed of progress in jurisdictional EMR adoption. The efficiency of the Delphi technique allowed collating of broad-spectrum responses; collation benefits were countered by the time-consuming process of re-submission, re-evaluation, and laborious data entry into statistical software.

Instrument Reliability and Validity

Pilot questionnaires (the Delphi instrument) provided user feedback on design improvements so that the full-scale survey had less chance of failure or misunderstanding. The full-scale survey was tested for questionnaire functionality, by using an internal eListen® test bed. A test bed address allowed a number of mock questionnaires to be completed, analyzed, and stored in the eListen® database. Reliability referred to the questionnaire behaving as intended when sent to respondents across Canada. Reliability and validity also referred to the translated French version of the original English survey. Canadian Forces medical personnel provided suggestions and corrections to the French version of the survey.

Pilot studies were undertaken to assist in problem focus, questionnaire design and construction, and developing the participant (respondent) sample. Participants in pilot studies were deemed to represent respondents in the full-scale study. Consequently, comments from pilot study participants were used to refine the research instrument. Pilot studies “can also ascertain the relevance the research questions have to industry” from an applied rather than theoretical approach (Skulmoski et al., 2007, p. 3).

Reliability of an instrument was judged by the instrument’s ability to duplicate results using the same method. The reliability of data obtained from iterative questionnaires was strengthened as respondents were drawn from a single organization, namely the Canadian
Reliability of an instrument was enhanced when responses to a questionnaire were answered honestly and accurately.

Canadian Forces care providers had varied backgrounds, formative training, and professional designations. One commonality was care provider use of an EMR. Consensus was achieved after care providers submitted unique comments, which were coded and grouped into common EMR barriers or facilitators. Reliability of results could not be determined from one study alone – if the questionnaire were to be given to Canadian Forces care providers at a later stage, the results would most probably be different. Further study may be necessary to substantiate, negate, or compare the findings.

The content validity of the questionnaire was established by pilot questionnaires followed by iterative questionnaire Rounds that served to strengthen concordant validity among respondents (Hasson et al., 2000). Content validity was reinforced once the instrument covered topics that had previously been determined as important. In essence, the greater the number of respondents agreeing on barriers and facilitators to EMR adoption, the less likely the agreement was due to chance. Iterative EMR user reviews of the questionnaire determined the level of face validity, as the questionnaire measured what the research questions had intended to measure. The “purpose of the review was to improve the questions and format” (Creswell, 2008, p. 150) toward the goal of barrier and facilitator identification.

The tendency toward concurrence on essential barriers and facilitators (main issues) may infer collective agreement, as the number of comments debating an issue’s significance and importance decreased (Holey et al., 2007). Even though successive Delphi questionnaires on EMR adoption were unlikely to produce duplicate results given the unique character and circumstance of each study, the method of seeking results was based on a “statistical group
response” (Ospina et al., 2007, p. 340) which was an expression of the degree of consensus among respondents.

Internal validity was strengthened once the questionnaire feedback obtained from respondents accurately reflected EMR barrier and facilitation factors. Threats to validity were chance, bias, and confounding variables, which were factors that confounded the quest to determine causal relationships of an intervention (Onwuegbuzie & Collins, 2007). To determine causality, questions such as ‘What causes low EMR adoption?’ and ‘What were the resulting effects on EMR adoption?’ were asked. Questions posed to respondents were direct and unambiguous, while providing flexibility to solicit evidence that clarified or added to an understanding of low EMR adoption.

Alternative explanations may exist for causal relationships between EMR adoption and barriers or facilitation to adoption. The questionnaire offered respondents the chance to incorporate personal experiences that shaped an individual’s EMR adoption. Careful consideration was given to question construction, so that internal validity remained free of bias, chance, and confounding variables that might skew the results.

External validity involved the relationship between the instrument’s results and an application to the general population. Threats to external validity may have been “incorrect inferences (drawn) from the questionnaire data to other persons, settings, and past and future situations” (Creswell, 2008, p. 162). Inferences drawn or extrapolated from the population were assessed for capacity to provide external validity. The number of respondents, the respondents’ unique work environment, and the variety of experiences care providers had with EMRs, limited the ability to generalize results nationally.
Subject matter limitations influenced the level of generalization to the greater body of care providers outside the parameters of the Delphi study. Limitations affected the outcome, and could not be controlled. Reliable and valid inferences may be drawn once follow-on EMR research investigates care providers in similar circumstances to those found here. Hence, care providers employed within the Canadian Forces at a certain time and place provided feedback unique to individual circumstances.

The questionnaire’s qualitative validity and reliability were placed in context of the respondent population. Consistency was maintained as the results obtained from the questionnaire were credible, transferrable, dependable, and confirmable. Qualitative validity included checking on the accuracy of results, whereas qualitative reliability inferred consistency of research method as recognized by other researchers (Creswell, 2008). Care provider connectivity to EMR systems that linked more than just internal office networks showed considerable variation depending on provincial IT strategies and supporting infrastructure in place (CMA, 2008). The questionnaire aggregated information to allow cross-referencing of data, so that respondent feedback provided more than just EMR adoption barriers and facilitators.

Data Analysis

The Delphi method was used when incomplete knowledge existed about a problem or phenomena (Delbecq et al., 1975; Hasson, 2000). Delphi was used to investigate what did not yet exist (Skulmoski et al., 2007). The method was applied to problems that did not lend themselves to precise analytical techniques; problems could benefit from subjective judgments of individuals on a collective basis (Hasson, 2000). Data analyses were enhanced when experts focussed a
collective human intelligence on the problem at hand. A statistical aggregation of data provided reasons for low EMR adoption among Canadian Forces care providers.

A pilot Delphi study provided valuable preparatory guidelines for a full-scale qualitative questionnaire. Pilot study participants offered methodological testing grounds (Samoutis et al., 2007) for the full-scale study that followed. Broad and open-ended questions produced greater volumes of data analysis than restrictive yes or no questions. Data analysis required an orderly arrangement of recurring EMR adoption and facilitation themes.

Recurring barrier and facilitator themes were modified to reflect each new Round’s addition of data. Respondents were encouraged to evaluate peer commentary, which possibly resulted in the re-evaluation of previous responses. First Round responses were assessed for relevance, and recurring responses were coded and assigned values based on frequency. All responses were analyzed and included in the next Round to generate new ideas regarding EMR adoption and facilitation.

Data analysis provided adoption and facilitation ‘themes’ to be re-evaluated in subsequent questionnaires. The second questionnaire assumed more of a dialogue format than strict questions and answers. Growing convergence of agreed-upon barriers and facilitators was inferred when a high mean score and low standard deviation of recurrent barriers and facilitators became evident.

An analysis of data from the first two Rounds required extracting salient themes for further discussion. The third Round required a simple yes or no agreement with key barrier and facilitator themes ascertained from the first two questionnaires. Inferences were not drawn from selective data gathering methods, sample size, probability of error, or researcher bias. While quantitative or mixed method research may have provided viable data analysis options, the
nature of subjective data analysis required the adoption of qualitative research methodology (Creswell & Plano, 2006). Even though quantitative correlations were sought to rank common factors among barriers and facilitators, the recommendations and conclusions were subjectively based on qualitative themes.

Data analysis was performed by SPSS software. Prevalent barriers and facilitators attained the largest values, as significant barriers scored 4 or 5 as opposed to minimal barriers scoring 1 or 2 on the Likert-type rating scale. A process of partial correlation was applied to remove significantly influential barriers from the overall list of barriers. An explanation of partial correlation follows to clarify the reason for ‘partialling out’ barriers.

Partial correlation may be explained by relating gender to intellect and age. To demonstrate partial correlation by means of an example, an assumption was made that female intellect increased with age. Removing gender (gender is therefore partialled out) showed that overall human intellect increased with age, despite a person’s gender. By applying this example to the Delphi study, when prevalent barriers were partialled out, numerous pairs of strongly correlated barrier pairs were identified. After data analysis, correlations exceeding 0.7 were chosen by referencing Pearson’s Rho correlation coefficient (Osborn, 2008). Correlations exceeding 0.7 were deemed to be strong positive correlations.

SPSS data analysis correlated all 28 respondent-identified barriers to produce negative as well as positive correlations. Figure 5 shows graphic examples of positive, negative, maximum, minimum, and outlier effects on correlations. Pairs of barriers were deemed to be correlated when respondents identified both barriers as simultaneously significant. Importantly, simultaneously identified barriers did not infer causality as one barrier did not cause another barrier.
A quantitative research method was not suitable for studying concepts such as indifference, abstention, or rejection within the realm of EMR adoption (Creswell, 2008). New findings were correlated to known EMR adoption issues, while respondent suggestions produced novel ideas aimed at increased EMR adoption. Data analysis added to a common understanding of concepts involved in EMR adoption and facilitation among Canadian Forces care providers. Statistically significant data analysis presupposed data from at least 20 respondents replying to all three questionnaires.

Open-ended questions were analyzed by an initial read-through of all responses. Responses were categorized and coded according to common themes. Common themes were listed alongside known topics of cost, time to educate, interoperability, helpdesk issues, lack of government support, incentives, disincentives, and ease of use (Webster, 2010).

Summary

The purpose of the qualitative study employing the Delphi technique was to assess barriers and facilitators to Canadian Forces care provider EMR adoption. The Delphi technique was the most suitable method for collecting qualified opinions and feedback from respondents across Canada. The geographical dispersion (Syed, Hjarnoe, & Aro, 2009) of respondents provided a pan-Canadian overview of EMR implementation in provinces and territories at varying stages of EMR realization. Canada’s 13 provincial and territorial medical bases employed Canadian Forces care providers providing responses to three Delphi Rounds. An initial respondent population of 467 care providers was expected to produce more than 20 respondents replying to all three questionnaires.

Obtaining consensus on barriers and facilitators of EMR adoption among care providers allowed for thematic data ordering. The Delphi technique was appropriate and has been used for
similar studies (Barnsley, Berta, Cockerill, MacPhail, & Vayda, 2005; Essex et al., 2007; Hasson et al., 2000). Data were collected by a reliable instrument capable of achieving consensus after minimal Rounds of questionnaires answered by qualified respondents. Content validity referred to respondent feedback providing material that addressed the two research questions (see Chapter 1).

Data analysis of questionnaire content allowed for ranking of EMR barriers and facilitators according to the level of importance. Respondents noticed similarities among individual assessments and reached eventual concurrence of EMR adoption factors. Recurring EMR barriers and facilitators were grouped and submitted to respondents for consensus. SPSS was used to analyze questionnaire data. Chapter 4 discusses the results obtained.
CHAPTER 4: RESULTS

The purpose of the questionnaires was to elicit survey feedback from care providers regarding barriers to and facilitators of electronic medical record adoption, in order to determine ways to increase EMR adoption among care providers. The survey was sent to 467 care providers working at Canadian Forces bases across Canada, so that a core group of interested respondents could be established for Round 2 and Round 3 surveys. Chapter 3 included the research method description, survey population and sampling, informed consent details, data collection particulars, and instrument appropriateness. The purpose of Chapter 4 is to study prevalent barrier and facilitator themes as units of qualitative measurement. A discussion of the findings and conclusions is based on respondent feedback from both the pilot as well as the Delphi study.

Chapter 4 includes a restatement of the central research questions, the pilot study, a description of the respondent sample, data collection and analysis procedures, qualitative data findings, feedback from three Rounds of questionnaires, respondent concurrence on the most significant EMR barriers and adoption facilitators, outlier responses, a summary and conclusion. Demographic data included respondent age, gender, occupation, level of education, primary language, place of employment, and familiarity with electronic medical records. Charts and tables were used to graphically illustrate data.

Results were grouped under themes describing respondent barriers and facilitators to greater EMR adoption. Open-ended text formed the basis for emergent themes, while themes already known from literature searches were correlated to respondent feedback. The eListen® survey tool provided cumulative statistics for successive data compilations.
Central Research Questions

Question One: “What barriers exist to increasing Electronic Medical Record (EMR) adoption among Canadian Forces care providers?”

Question Two: “What solutions might increase Canadian Forces care provider adoption of the EMR?”

While the central research questions were not posed in the survey, a positive degree of content validity emerged as survey question responses allowed for barriers and facilitator ranking.

The Pilot Study

The purpose of the pilot study was to collect care provider critique and constructive feedback on an initial version of a full-scale survey. To prevent duplicate questions being asked in a simultaneously deployed Canadian Forces Health Information System (CFHIS) survey, senior CFHIS management viewed the proposed Delphi pilot questions. The pilot study introduction stated that the survey would not be concerned with CFHIS, but rather adoption of the EMR. Pilot study questions were compiled from internet research, personal interviews, previous surveys closely related to healthcare research, and peer-reviewed research.

A total of 10 care providers and CFHIS leadership personnel were sourced from two Canadian military medical facilities as well as the National Defence Medical Centre in Ottawa, Canada. All care providers were physicians actively engaged at medical facilities, while National Defence personnel were senior leadership members involved with CFHIS implementation and management. Criteria for respondent inclusion for the pilot study included mandatory access to the Defence Wide Area Network (DWAN). A letter of intent was sent requesting respondent feedback prior to commencement of the pilot study.
Table 2

**Pilot Study Respondent Questions and Responses**

<table>
<thead>
<tr>
<th>Respondents and Questions</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Care Provider 1</td>
<td></td>
</tr>
<tr>
<td>Questionnaire too long</td>
<td>Questionnaire shortened from 20 questions to 13 questions</td>
</tr>
<tr>
<td>Does researcher have CFHIS knowledge?</td>
<td>Three years CFHIS implementation experience</td>
</tr>
<tr>
<td>Care Provider 2</td>
<td></td>
</tr>
<tr>
<td>Informed consent should be at survey beginning</td>
<td>Before respondent participation in the survey, an acknowledgement had to show informed consent</td>
</tr>
<tr>
<td>Care Provider 3</td>
<td></td>
</tr>
<tr>
<td>Doubts about interface capabilities of EMR</td>
<td>An emailed response explained current pan-Canadian efforts to incorporate provincial EMRs into an interoperable EHR</td>
</tr>
<tr>
<td>Care Provider 4</td>
<td></td>
</tr>
<tr>
<td>CFHIS does not port into civilian practice</td>
<td>Interface limitations were required due to military health record access and security requirements</td>
</tr>
<tr>
<td>CFHIS Implementation Team (Chief Information Officer, Project Director, Epidemiologist, Survey implementation members consisting of four programming staff).</td>
<td>Delphi survey and CFHIS survey were compared to avoid any question or issue overlap</td>
</tr>
</tbody>
</table>
The Delphi Study

Upon completion of the pilot study, alterations were made to the survey based on care provider and the CFHIS implementation team suggestions. A letter of intent was mailed to respondents to state the purpose and goal of the survey. An informed consent option to agree or not was inserted at the start of the survey. Respondents selecting the ‘I do NOT provide my informed consent’ option were taken to the end of the survey, without any data being captured. The goal was to capture data from participants who responded to all three Rounds. Concurrence was required from respondents who participated in all three Rounds. Round 1 included sending the survey to 467 care providers at Canadian Forces healthcare facilities. After two weeks (August 6, 2010 to August 20, 2010), data returns were analyzed and grouped into preliminary thematic headings. The first Round ran between August 6, 2010 and August 25, 2010.

Description of the Sample

Civilian physician organizations with large membership databases were not forthcoming in sharing member information. Repeated refusals to provide access to physician membership lists resulted in seeking study approval from the Canadian Forces health sector. The sample drawn from the Canadian Forces included healthcare providers with a Defence Wide Area Network (DWAN) account. The purposeful sampling of select care providers satisfied the requirements of data security, as the eListen® server only received data from within the military intranet. Sampled respondent feedback could not be traced to any one individual, as individual respondent data were assigned an alphanumeric code devoid of personal identifiers.

The sample was chosen from a spectrum of care providers, including junior, senior, experienced, and inexperienced military members. Survey respondents were drawn from the
healthcare sectors in the Canadian Army, Navy, and Air Force. Names were ordered alphabetically as opposed to military rank, directorate, or medical specialization. Full time military medical personnel, contractors, civilians, and reservist medical care providers were included. Most reservist care providers did not have a military email address and therefore could not access the survey. The respondent sample comprised English as well as Francophone care provider personnel. The survey was translated from English into French as mandated by Canada’s Official Languages Act requirement (Official Languages Act, 1969).

Availability of the sample was affected by out-of-office messages, as some care providers employed in the Canadian Forces have alternate and complementary employment. The Canadian Forces vacation period occurred during July and August, when personnel were posted from one unit to the next. The first survey was extended to the end of August to cover posting period as well as vacationing care providers. Care providers generally scheduled only select days of the week at military health care facilities, as care providers have concurrent private practices. Due to sporadic absences, care providers were sent reminders two weeks after the initial email, urging survey completion to increase the response rate.

Of the 467 survey invitations sent to Canadian Forces care providers, 77 responses were received by the close of Round 1. The Canadian Forces had 16 Clinics with 21 detached clinics. Depending on the size of the clinic, care was provided by base surgeons, medical technicians, nurse practitioners, nurses, general duty medical officers, family medicine doctors, and other ancillary specialist care providers. Care providers without access to the Defence Wide Area Network could not access the survey, as a military email address was required for secure questionnaire login. Determining response rates was beset by variables such as absence at the time of the survey, access to military email, size of clinics and detachments, deployment
overseas, maternal or paternal leave, or general apathy by care providers constantly polled for survey completion.

Respondents invited to participate included care providers employed in anesthesia, internal medicine, psychiatry, general surgery, community medicine, radiology, orthopedics, psychology, ophthalmology, occupational obstetrics and gynecology, neurology, rheumatology, emergency medicine, flight surgeons, sport medicine, nephrology, cardiology, plastic surgery, geriatrics, epidemiology, the medical technician trade, physician assistant, and nurses. Responses were received from all provinces with healthcare facilities. Responses from Canada’s territories were limited, as the territories of Nunavut, Northwestern Territories, and Yukon had small care facilities often staffed by one or two personnel. The greatest number of responses were recorded from the age group 41 – 50 years old (54%), indicating greater survey interest among a more mature care provider demographic. The number of respondents younger than 30 years old to respondents older than 60 years old exhibited a bell curve (see Figure 1).

![Figure 1. Respondent age groups.](image)

Further demographic particulars showed respondents to be 64% male and 36% female. Respondent employment indicated 51% Army, 34% Air Force, and 15% Navy, while 93% were
regular force and 5% were contractors. 2% respondents did not answer the question. Medical occupations were (in descending order) 32% Physician Assistants, followed by 29% Nurses and others as illustrated in Figure 2.

**Figure 2.** Respondent occupation.

In order to assign meaning to military healthcare occupations, educational levels required of each profession are mentioned. Physician Assistants (PAs) require a high school, diploma or two-year associate qualification. Nurses have Bachelor’s degrees, Nurse Practitioners hold Master’s degrees, Family Medicine practitioners hold a Medical Doctor (MD) designation, while specialists have attained advanced Medical Doctor schooling. Specialists require continued specialty training during residency. The optional added designations of Master’s or PhD designations were included in the questionnaire. Specialist technician care providers would have college diplomas or more.

Respondents’ employment locations were illustrated in Figure 3. While care was provided to Canadian Forces members serving in theatre, a conscious decision was made not to include care providers in theatre at the time of the survey dissemination. Personnel responding to
the survey while deployed abroad might be able to answer the same survey upon returning to Canada, which would affect the validity of data.

**Figure 3.** Respondent employment location.

**Data Collection and Analysis Procedures**

Data were collected by providing respondents with a hyperlink address that was included in an introductory email. Survey results were downloaded once a day to provide cumulative data that were analyzed for emergent barrier and facilitation themes. The survey collection tool eListen® provided frequency distribution pie and bar charts, cross-tabulation of one to many variables, response summaries, ranking summaries, and descriptive statistics of text questions. The eListen® application could export data to SPSS for analysis and syntax editing.

Validity and reliability of data depended on the level of detail and response veracity of respondents. Respondents were asked to include open-ended text that would enrich the survey beyond merely answering the questions posed. Qualitative data validity were not measured.
against set criteria, as respondent feedback was deemed eminently valid to each respondent. Making sense of respondent comments depended on the researcher’s capability to intelligently read and categorize text responses. Validity and reliability were influenced by sample size, resources used to manipulate data (eListen® and SPSS), and data limitations (limited text entries provided limited predictive capabilities). Data returns were assumed valid and reliable in the absence of reasons not to trust the data.

Survey response rates were affected when survey invitations were sent to mailboxes that were full. System administrator alerts were received when survey invitations did not arrive at the intended destination. Reasons for messages not arriving included full mailboxes, email accounts that did not exist (recipient addresses had changed), out of office alerts (physicians only present on select days of the week), recipient deployed, recipient posted, or recipient on leave.

Qualitative data were coded according to themes that became evident as responses were received. Qualitative analysis relied on data synthesis that limited the number of themes, rather than listing a multitude of themes covering every idea, thought, and observation. Themes concurring with current literature were identified, as were new themes not readily apparent in current or historical literature. Outlier themes and feedback were included to provide complete data representation.

Analysis of overall responses took respondent occupations into account. Certain care provider occupations might be less likely to physically enter data into an EMR, but were however very dependent on the accuracy and speed of data entry. Within the military occupation spectrum, EMR data were mainly entered by data entry clerks (military as well as civilian), pharmacists, immunization clerks, preventive medical technicians, medical records clerks, and
nurses. Physicians tended to enter personal clinical notes, while reviewing EMR data entered by clerical and ancillary staff.

*Responses to Multiple-Choice Questions*

After collecting data returned from Round 1, responses to multiple choice questions were compiled by eListen® software. In response to a question on user experience with an EMR, respondents would choose from levels of limited, broad, extensive, or no experience. Greater detail was however asked of “how the EMR affected physician practices” in terms of: (a) quality of clinical decision; (b) communications with other providers; (c) communications with patients; and so forth (see Table 3). Subheadings (a) through (g) were rated as positive impact, negative impact, no impact, not applicable, or don’t know (see Table 3). The table shows that 52% of respondents rated the EMR as having a positive impact on the quality of clinical decisions within physician practices.

Table 3

*Extent of EMR Affecting Physician Practices: Overview*

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Positive Impact (%)</th>
<th>No Impact (%)</th>
<th>Negative Impact (%)</th>
<th>Don’t Know (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of clinical decision</td>
<td>52</td>
<td>22</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td>Communication with providers</td>
<td>65</td>
<td>11</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>Communication with patients</td>
<td>41</td>
<td>31</td>
<td>7</td>
<td>21</td>
</tr>
<tr>
<td>Physician Order Entry</td>
<td>44</td>
<td>24</td>
<td>4</td>
<td>28</td>
</tr>
<tr>
<td>Timely access to med records</td>
<td>68</td>
<td>2</td>
<td>11</td>
<td>19</td>
</tr>
<tr>
<td>Avoiding medication errors</td>
<td>31</td>
<td>26</td>
<td>2</td>
<td>41</td>
</tr>
<tr>
<td>Preventive care meets guidelines</td>
<td>41</td>
<td>29</td>
<td>2</td>
<td>28</td>
</tr>
</tbody>
</table>
In response to the question of “Which of the following were barriers to greater EMR adoption? ”, respondents were presented with a limited list of barriers drawn from previous literature research. The purpose of directed types of question was to elicit responses to known barriers, so that comparisons could be made between respondent feedback and the literature. The question served to prompt Canadian Forces care providers to think about barriers experienced during daily care provision. Barriers were described in text boxes provided for open-ended commentary. Table 4 below recorded barrier levels to questions regarding EMR adoption.

Table 4

*Barriers to Greater EMR Adoption: Overview*

<table>
<thead>
<tr>
<th>Factor</th>
<th>Minimal Barrier (%)</th>
<th>Barrier (%)</th>
<th>Significant Barrier (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Danger of EMR becoming dated</td>
<td>40</td>
<td>44</td>
<td>16</td>
</tr>
<tr>
<td>EMR-EMR interoperability</td>
<td>26</td>
<td>24</td>
<td>50</td>
</tr>
<tr>
<td>Rural location of practice</td>
<td>59</td>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td>Physician resistance to change</td>
<td>33</td>
<td>39</td>
<td>28</td>
</tr>
<tr>
<td>Physician comfort level with IT</td>
<td>31</td>
<td>48</td>
<td>21</td>
</tr>
<tr>
<td>Conversion of paper to electronic</td>
<td>13</td>
<td>41</td>
<td>44</td>
</tr>
<tr>
<td>EMR set-up time</td>
<td>18</td>
<td>54</td>
<td>18</td>
</tr>
<tr>
<td>Security and privacy issues</td>
<td>46</td>
<td>37</td>
<td>17</td>
</tr>
<tr>
<td>Scanning reports into EMR</td>
<td>33</td>
<td>35</td>
<td>32</td>
</tr>
</tbody>
</table>

In response to suggested barriers such as cost, time to train care providers, rural location, resistance to change, software becoming dated, interoperability, comfort levels with information
technology, paper to electronic conversion, EMR set up time, confidentiality, and scanning practices, respondents were provided the options of: (a) minimal barrier; (b) barrier; or (c) significant barrier. In a further question, 41% of respondents agreed with the statement “The EMR eliminates redundant tests and effort”, while the rest disagreed. The statement “The EMR facilitates the aggregation of patient information across episodes of care” showed 70% agreement, while 30% of respondents disagreed. “The EMR has created unexpected problems” met with 42% disagreement and 58% agreement. Further analysis of percentages and respondent reasons for agreement or disagreement follows later in the chapter.

A set choice of options for EMR usage in physician offices was presented (see Figure 4). The list of EMR functionality was not definitive, but provided respondents with a list of commonly known applications (Canada Health Infoway, 2010). Open-ended respondent feedback provided additional uses of an EMR that included pharmacy or multi-physician prescribing and tracking, hospital to hospital interfaces, access to patient pharmaceutical histories, and imaging in local facilities besides hospitals.
Figure 4. Common uses of the EMR in care provider practices.

Responses to Open-ended Text Questions

The first questionnaire provided respondents with open-ended textboxes designed for additional comments. Questions soliciting open-ended responses are listed in Table 5. Open-ended text responses (see Table 5) were examined for common threads that could be grouped as themes. As daily questionnaire returns were downloaded from the eListen® database, new text was assessed for inclusion under existing themes or assigned a new theme. Responses from French care providers were translated and similarly assigned.
### Table 5

**Open-ended Text Questions Round 1**

<table>
<thead>
<tr>
<th>Question Number</th>
<th>Question Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 (b)</td>
<td>If occupation OTHER, please specify.</td>
</tr>
<tr>
<td>6 (b)</td>
<td>If location OTHER, please specify.</td>
</tr>
<tr>
<td>10 (h)</td>
<td>Please add comments regarding how the EMR HAS AFFECTED PHYSICIAN PRACTICES, if so desired.</td>
</tr>
<tr>
<td>11 (l)</td>
<td>Please add comments regarding what other elements WOULD BE BARRIERS TO GREATER EMR ADOPTION, if so desired.</td>
</tr>
<tr>
<td>12 (c)</td>
<td>Please add any comments regarding EMR IMPACTS, if desired.</td>
</tr>
<tr>
<td>13 (b)</td>
<td>Please elaborate on issues you may have with the interface between CFHIS and the civilian Electronic Medical Record.</td>
</tr>
<tr>
<td>14 (b)</td>
<td>Additional EMR uses.</td>
</tr>
<tr>
<td>15 (a)</td>
<td>Please include any anecdotal or additional material you feel may add to an understanding of barriers and facilitators of physician EMR adoption within your province, territory or elsewhere.</td>
</tr>
<tr>
<td>15 (b)</td>
<td>Do you have any other comments or suggestions regarding the EMR.</td>
</tr>
</tbody>
</table>
Themes

In Round 1, a composite database was created that contained text and paragraph responses to each question. As an example, single concepts such as ‘problems with access’, ‘ease of access’ or ‘database accessibility’ were grouped under the theme ACCESS. Five key themes were identified based on the number of repeated references made by at least five respondents (see Table 6). Themes that emerged provided content material for the second Round Likert-type ranking of EMR barriers and facilitators.

Table 6

*Round 1 Thematic Headings*

<table>
<thead>
<tr>
<th>Theme</th>
<th>As Barrier</th>
<th>As Facilitator</th>
<th>Code Assigned</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMR application and implementation</td>
<td>57</td>
<td>4</td>
<td>APP</td>
</tr>
<tr>
<td>Data accessibility</td>
<td>24</td>
<td>12</td>
<td>ACC</td>
</tr>
<tr>
<td>Managerial</td>
<td>17</td>
<td>7</td>
<td>MGR</td>
</tr>
<tr>
<td>Patient Care</td>
<td>21</td>
<td>4</td>
<td>PTC</td>
</tr>
<tr>
<td>Documentation</td>
<td>7</td>
<td>5</td>
<td>DOC</td>
</tr>
</tbody>
</table>

Ten pages of raw data were collected during Round 1 (see Appendix E). Open-ended text was analyzed line by line to extract meaning and sense within the context of the question asked. Data were exported to spreadsheets and then imported into SPSS (qualitative software) for further analysis. Outlier themes were not discounted or removed from further analysis. In Round 2, respondents were asked to rank barriers and facilitators on a Likert-type scale of 1 to 5. Five barrier headings were assigned (see Table 6), each of which contained barriers or facilitators
closely related to respective headings. Distinct facilitators were listed so that respondents could rank them by impact or benefit to greater EMR adoption (1 = least impact on increased EMR adoption to 5 = greatest impact on EMR adoption). Facilitators were however not discounted based on low or high Likert-type scores.

As an example of the coding methodology, texts from five respondents (R1 to R5) were assigned to the ‘Application’ theme (texts were inserted verbatim, and may contain spelling errors):

R1. “The fact the ships still do not have CFHIS access makes using CFHIS a very time consuming event. I have to go to Base clinic to review my inbox then print out results I wish to review with my pt's.”

R2. “Civilian practitioners are still being utilized and do not have access to implement electronic records or to access electronic records. As an example, I work in an OR that was not recognized in the new medical model and therefore does not benefit from being provided computer access to electronic charting. While in the OR, the surgeon or anaesthesiologist may request specific information that was not readily available to the OR staff and means a delay in the procedure (possibly) as information was tracked down.”

R3. “No interoperability at present – this need will arise eventually.”

R4. “See 12. Also, to my knowledge, CFHIS isn't able to interface with local health authority databases in a manner that allows timely updates from specialist referrals, admissions, OR reports, imaging, etc.

R5. “Where I work the two systems do not interface which was a problem. Implementation problems were mostly related to the snail like pace of
implentation. If we are going to use the system please let me use the entire system not just pieces of it.”

Theme 1: EMR Application and Implementation

The theme application covered references made to the EMR providing a uniform search method (deemed to be a facilitator). Errors could easily be identified and corrected (facilitator). The EMR was time consuming and didn’t provide a central information repository (deemed to be a barrier). Non-uniformity of EMR applications used in Canada and abroad (barrier), time to train personnel, time to implement the system, and time to scan historical and civilian care provider documentation into the EMR (barriers) were reported.

The EMR was slow and not comprehensive (barrier), while many EMR updates created a continuous learning curve and increased confusion (barrier). Server failure (barrier) was mentioned, while comments were made on how the EMR application forced users to structure thought processes (facilitator). Time to enter data was discussed (barrier), as was reduced redundancy (facilitator). The inability of shipborne EMR applications to be connected at all times (barrier) was tied to naval care providers not being able to scan reports (barrier).

EMR comparisons were made to cheaper versions in use in civilian hospitals (barrier); Canadian Forces care providers using one application to the exclusion of others prevented alternative application awareness (barrier). An absence of automatic file conversion into all sub sections of the EMR application was seen as a hindrance (barrier). Inefficient searches for poorly identified documents (barrier) added time to care providers looking to build a cumulative patient profile. Stakeholders other than care providers presented hurdles due to conflicting needs (barrier); delayed clinical notes entry functionality slowed comprehensive patient data capture (barrier).
EMR safety and security considerations required time-consuming data entry processes (barrier), while care providers as well as patients expressed concerns about data access control (barrier). Electronic forwarding of referrals to specialists reduced duplication of tests (facilitator). The absence of voice recognition software slowed data entry that could be dictated and automatically entered (barrier). The absence of a province-wide EMR format (barrier) was countered by suggestions of adopting currently functional provincial systems (facilitator). Differences between test dates and scan dates created uncertainty as the EMR would not require greater granularity (barrier). EMRs using dropdown menus were considered user-friendly (facilitator).

Theme 2: Data Accessibility

The data accessibility theme covered text responses on the EMR facilitating rapid access to data, assistance in making a diagnosis, and medication delivery (facilitator). Easy access to the entire record as well as communications with other care providers were also pointed out (facilitator). Patient file review without having to remove the file from the clinic were noted (facilitator), however timely processing of records and the ease of access were assumed. Access restrictions due to hardware malfunctions influenced care delivery (barrier); clinical notes when entered were clear and readable (facilitator).

Deployed operations abroad were negatively impacted as care providers had “difficulty accessing national databases when deployed with limited connectivity – still require hard copy backup that’s readily accessible for example on ships or submarines” (Respondent 35). Data accessibility was compared to EMR systems used by German and U.S. Forces, while suggestions were made to seek comparisons to EMR systems currently in use in Quebec and other parts of Canada. If accessible, the EMR was deemed excellent at organizing clinical information
Patient information that was properly filed in respective electronic repositories was easily found and updated (facilitator). Access issues resulted from server crashes and insufficient technical support (barrier), as well as poorly filed patient information (barrier). Physical access to computers, logging in and out of an EMR, and access permissions affected the interface between the Canadian Forces Health Information System and civilian EMRs (barrier).

Accessibility due to operational safety and security concerns (barrier) in addition to concerns of losing access to data were mentioned (barrier). Quick access to patient data at the point of care was beneficial (facilitator), provided access was speeded by using “a key system like a waitress or a finger print identification, or a swipe card (to) get rid of the passwords” (Respondent 22). Access included access to implementation experts who could assist care providers pressed for time to familiarize themselves with an EMR (facilitator). Access to greater patient numbers would be increased once care providers learnt to type rapidly (barrier). An absence of province-wide EMR standards prevented improved access to patient data stored in a variety of care facilities (barrier). Access that was contingent on sophisticated technology was prone to impact the EMR if the technology failed (barrier).

Theme 3: Managerial

Comments were made regarding the lack of remuneration for care providers having to work harder and longer to align respective practices with the new EMR model (barrier). Comments were made that EMR vendors were placing fiscal gain ahead of EMR functionality (barrier). Financial compensation was requested to cover two weeks of dedicated information technology and EMR training, currently not available to care providers (barrier). Startup costs associated with EMR implementation were considered a barrier to greater EMR adoption (barrier). Provincial medical services plans had in the past attempted to induce care provider
acceptance of the EMR (facilitator). Care providers commented on user resistance to the EMR as a substantial barrier (barrier). The greatest impediment was getting care providers to accept change (barrier).

Theme 4: Patient Care

Pharmacy software that was not part of the EMR software suite created gaps in care provision (barrier). Software issues diminished patient contact time (barrier) as care providers paid more attention to the computer than to the patient (barrier). Time taken to write a script by EMR took much longer than a handwritten script (barrier). Care provision during critical times such as daily morning sick parade affected the level of care if the EMR was slow or non-responsive (barrier). Patients suspicious of data integrity of the EMR affected patient willingness to confide in care providers (barrier). Care provision would not be comprehensive if data were missing, incomplete, or not yet entered (barrier).

Respondent 37 mentioned a workaround to data not yet scanned in by adding that “time has been saved by asking other MDs to repeat tests for example, and scan them in, avoiding having to defer decisions resulting from missing information” (see Appendix E). Care provision was affected as care providers would duplicate tests to compensate for EMR inefficiencies or tardy scanning practices. Care providers would spend less time with patients and more time assisting others due to EMR ineffectiveness (barrier).

An EMR dropdown menu that provided pre-determined laboratory and diagnostic routines to engage based upon presenting ailments was beneficial (facilitator). Care provided in facilities not yet connected to electronic data management, could not be entered into databanks solely reliant on electronic data input (barrier). Care providers refused to authorize treatments “unless it was in the electronic record” (barrier - see Appendix E). Care provision was slowed
when paper copies were no longer printed, affecting follow-up of patient care as records needed to be tracked down (barrier).

Excessive scanning of civilian healthcare documents occupied much scanning time, made worse when patients arrived with civilian documentation requiring complicated scanning (barrier). When one patient was seen by multiple providers who had to enter discrete information into the EMR, the layered care would take time to be entered into the EMR database (barrier) and decreased the number of patients the care provider could see (barrier). One care provider was surprised at the low level of EMR adoption in view of the “sorry state of the CF 2034 (Canadian Forces paper-based patient medical file), the issue of mobility of our patient population, and the need for patients’ charts to be reviewed by various organizations scattered across the Canadian Forces, I can’t understand why anyone would be reluctant to use the EMR” (barrier- Respondent 40).

Theme 5: Documentation

An absence of connectivity between land bases and data on board ship created delays as care providers entered dispersed information into unconnected EMR databases (barrier). Civilian practitioners used by the Canadian Forces did not have access to the military EMR, impacting EMR implementation efforts (barrier). Civilian specialist referrals, admissions, orderly room reports, and imaging results could not interface with the military EMR, necessitating scanning in of select documents (barrier). Military rules governing data transfer and sharing created barriers to data exchange (barrier).

Most civilian care providers work part time with the Canadian Forces, and would be reticent in committing time and effort toward greater EMR adoption (barrier). A system not available outside the confines of the Canadian Forces intranet would not be readily adopted
Patients on short stays in hospital may not have had all episodes of care entered, interrupting the spectrum of care and complicating database interoperability (barrier). One respondent suggested that compatible EMR systems might speed interoperability among coalition forces abroad. Civilian facilities did not comprehend the Canadian Forces EMR system (barrier); suggestions were made to introduce information sessions designed to educate civilian care providers on the capabilities of the Canadian Forces EMR (facilitator).

Theme Discussion

Round 2 determined theme importance by using a Likert-type ranking (1 = least important barrier or facilitator, and 5 = most important barrier or facilitator). Judging by the number of comments made under each theme, care providers had the greatest concerns with the ‘EMR Application and Implementation’ theme (see Table 6).

Data returned from respondents showed 54% respondents in the 41-50 age group, which pertained to the managerial theme. While the data may not mean much in isolation, the age group saw value in responding to the survey notwithstanding differences in education, professional designation, military element, or type of healthcare facility. The Nursing and Physician Assistant occupations provided 59% of all survey responses. A reasonable assumption was made that two occupations (29% Physician Assistants and 30% Nurses) were most interested in barriers and facilitators to greater EMR adoption. Decreasing numbers of responses were recorded from family medicine physicians (14%), while the remaining responses were evenly spread among aeromedicine physicians, emergency medicine, epidemiology, general medical practitioners, psychiatrists, nurse practitioners, and others.

Regarding patient care as theme, care was predominantly provided at Canadian Forces clinics and headquarters; 43% responses originated from clinics, and 17% came from healthcare
headquarters. Descending responses rates were obtained from health services training centre (11%), field ambulances (9%), field hospitals and ships. Identified barriers and facilitators would likely affect care providers within the care facilities mentioned above, even though 60% of respondents indicated limited to no experience with an EMR other than the Canadian Forces Health Information System (CFHIS). Respondents who reported broad or extensive EMR experience (other than with the CFHIS) provided valuable suggestions to overcoming EMR adoption barriers.

The effect of an EMR on physician practices (ways of doing business) was assessed by asking respondents to rate the EMRs impact as positive, none, negative, or don’t know. The EMR application and implementation theme was addressed, when respondents answered the question “To what extent has the EMR affected physician practices?” Table 3 showed, for example, that 52% of respondents considered the EMR to have a positive impact on the quality of clinical decision.

Selective questions were asked regarding barriers to greater EMR adoption. Respondents could determine whether aspects such as the ‘cost to implement an EMR’ was a minimal barrier, a barrier, or a significant barrier. The purpose of providing choices was to encourage personal feedback on barriers experienced while dealing with an EMR. Known barriers such as cost, time to train, location of practice, resistance to change, and the EMR becoming dated were listed.

Data accessibility as theme referred to care provider concerns with EMR interoperability, comfort levels with and access to information technology, conversion of paper records to electronic access, a lack of access to data during an EMR set-up time, limiting access due to imposed security and confidentiality requirements, and comprehensive data accessibility resulting from increased scanning of patient files into an EMR.
In reference to the documentation theme, care providers were encouraged to add barriers not included in the survey, so that further insight was gained regarding barriers to EMR adoption. Care providers were also encouraged to agree or disagree with statements such as ‘The EMR eliminates redundant tests and effort’, ‘The EMR facilitates the aggregation of patient information across episodes of care’, and ‘EMR implementation has created unexpected problems’. While the choices of answer were a simple agree or disagree, respondents were encouraged to provide detailed comment in open-ended format (see Appendix E).

**Correlation and Statistical Significance**

Barrier M4 (Canadian Forces focus on only one EMR leading to conflicting EMR stakeholder requirements) and barrier App8 (The EMR vendor not aligned with provider needs and start up costs) were selected to describe the concept ‘strong positive correlation’ (see Figure 5). Particular attention should be paid to the graphs that describe maximum positive, strong positive, and zero correlation. The strong positive correlation graph ($r = 0.80$ in Figure 5) illustrates App8 on the x-axis, and M4 on the y-axis. All respondents selected barrier App8 as well as barrier M4 by a factor of 0.8. Had all respondents consistently selected both barriers App8 and M4, a maximum positive correlation factor of 1.0 would result. Correlation did not infer causality, as one barrier did not cause another barrier.
An interesting discovery was made when barrier pairs showed up numerous times (see Table 7). Barriers App8 (The EMR vendor not aligned with provider needs and start up costs) and M5 (conflicting EMR stakeholder requirements) correlated strongly in partialled out barriers D4, M6, Acc3, Acc1, M7, and P2 (see Figure 5). Even though App8 and M5 showed varying correlations, the repetitive occurrence of the App8 and M5 pair warranted closer investigation. Similarly, the paired barriers App2 and App7 as well as Acc3 and App6 occurred more than once. Reoccurring barrier pairs might indicate pervasive problems within the spectrum of EMR.
implementation, documentation, management, application, and patient care. An explanation of barrier codes App8, M5, App2, App7, Acc3, and App6 is provided in Appendix F.

EMR vendors not aligned with the provider’s needs (App8) may have influenced but not necessarily caused conflict among EMR implementation stakeholders (M5). The non-uniformity of EMR variants found in Canada and abroad (App2) may have increased the need for EMR upgrades, software patches, and changes to standard operating procedures (App7). Repeated logins to the EMR as a result of safety and security concerns (Acc3) may be deemed costly to care providers in terms of time taken, fewer patients seen, and the additional effort of tending to an EMR (App6). App8 did not cause M5, App2 similarly did not cause App7, and Acc3 did not cause App6; however, each of the strongly correlated barrier pairs showed one barrier greatly influencing the other.

Correlations were deemed valid based on less than a 5% probability of results occurring by chance (p < .05). Highly correlated barrier pairs examined above (App8 and M5, App2 and App7, and Acc3 and App6) were deemed valid and reliable based on multiple respondent concurrence. The research questions posed in Chapter 1 sought to address barriers as well as solutions to overcoming barriers to EMR adoption. The highest scoring barriers (see Figure 6) such as D4, M6, App5, D1 and so on were addressed by collectively looking at all correlated barrier pairs resulting from each partialling out (see Table 7). An inference was made that the remaining pairs of highly correlated barriers (see Table 7) would contain distinct interdependencies similar to previously discussed barrier pairs.
A total of 13 facilitation themes were identified (see Appendix H). Each of the 13 facilitators were partialled out to discover significant correlations among remaining facilitators. Significant correlations were deemed to have a value greater than 0.7, similar to the correlation
parameters set for barriers. Certain facilitator pairs were present more than once when correlated against partialled out facilitators. Facilitators F7 and F6 (‘communication with other providers’ and ‘diagnosis and medication delivery’) were observed in 10 of the 13 facilitator control variables (partialled out facilitators).

Persistent barriers might be overcome by applying facilitator pairs. F7 (communication with other care providers) and F6 (diagnosis and medication delivery facilitation by using an EMR) may be used in tandem, and could address barriers such as D3 (searching for poorly identified documents), App6 (cost to care provider in terms of time, patients seen, and effort), and M7 (steep learning curve for EMR users).

Patterns and Relationships

Demographic data (respondent age) was linked with respondent occupation, healthcare facility, level of education, and the highest number of respondents of a particular occupational group. The central tendency age group comprised 41-50 year old Nurses and Physician Assistants with bachelors or doctor’s designations, working in clinics, headquarters, health services training centres, field ambulances, and naval care facilities. The grouping was deemed the mode or most frequent set of values. EMR experience (other than the Canadian Forces Health Information System) showed one-third to have broad or extensive experience. Two-thirds respondents had limited to no experience with a civilian EMR. Respondents most affected by EMR barriers and facilitators were most likely to respond.

Thematic headings (see Table 6) from the first Round were sent back to respondents in the form of a two-question survey. Data reduction was necessary to determine which variables to rank. Theoretical saturation was achieved after 77 respondents replied, as no new themes arose to augment validated and established barrier and facilitator themes.
Data quality was corroborated by comparing multiple choice answers to open-ended text questions. Trustworthiness and triangulation of respondent results showed barrier and facilitator correlation between multiple choice answers and text responses. As multiple choice questions had a limited ability to address the entire scope of barriers and facilitators, additional open-ended text boxes were provided to broaden the scope. The theoretical framework of resistance to change formed the basis of an enquiry into low EMR adoption among Canada’s care providers.

New findings from Round 2 did not concur with the original theoretical framework, namely resistance to change being the basis of low EMR adoption. Rather, user resistance to the EMR scored second highest in barrier rankings. Consequently, the original theoretical framework was changed from ‘resistance to change as the basis of low EMR adoption’ to ‘user resistance to the EMR as the basis of low EMR adoption’.

Respondents ranked 28 barriers (see Figure 6), with the most significant barrier scoring 78 and least scoring 49. If all respondents had consistently ranked one barrier with only 5s, the score would be $28 \times 5 = 140$. Lesser barriers were assigned values of 4, 3, 2, and 1 (‘least barrier to EMR adoption’). When the influence of one prevalent barrier (for example D4 in Figure 6) was removed, remaining barriers were assessed for correlations. Correlation coefficients exceeding a value of 0.7 were deemed as significant. To determine the ‘pure’ relationship between paired barriers, prevalent barriers were ‘partialled out’. Partialling out removed the influence of the prevalent barrier, so that strong positive correlations could be identified among remaining barriers. Caution was necessary not to infer causality from correlation coefficients, as one barrier would not cause another barrier.
Outliers

Outliers were identified if the values were atypical of the general slope of values (see Figure 6). Facilitators were not analyzed for outlier values, as facilitators were not assessed by linear regression. Subjective opinion would not easily fit into neat linear patterns. Barriers were ranked and placed in a histogram for ease of overview (see Figure 6). The lowest barrier value P1 (patient suspicions regarding EMR privacy) followed the general left-to-right downward trend. The lowest value facilitator and barriers were consistent with the general themes identified. Consequently, barrier and facilitator outliers were not isolated for further analysis.
Summary

Major barrier and facilitator themes were evident after Round 1 and 2 analysis. Barrier themes were grouped under headings of EMR application and implementation, data accessibility, managerial, patient care, and documentation. The majority of barriers (57 of 126) were found under the EMR application and implementation theme, while ease of use and communication were seen as key facilitators of greater EMR adoption. Both research questions were addressed by respondent feedback that included major barriers and facilitators to greater EMR adoption. Likert-type scoring of barriers provided an indication of the most influential barriers. Facilitation responses provided feedback on increased adoption measures that respondents deemed suitable.

The quantitative data analysis provided strongly correlated pairs of barriers and facilitators. Strongly correlated barrier pairs were interconnected, as one barrier influenced the other. The value of strongly correlated barrier pairs became evident when greater clarity emerged as a result of paired barriers indicating an interconnected relationship. Barriers were therefore linked to provide further guidelines to overcoming EMR adoption issues concerning the speed of data processing, the time required to scan, incomplete paper to electronic file conversion, searching for files, delays in data entry, data transfer between databases, and time taken to enter scripts into the EMR. Facilitators were matched to barriers to see whether solutions were evident.

The research questions were addressed as barrier pairs provided correlated connectivity between individual barriers. Causality was not inferred, as barriers did not cause other barriers. Facilitation data were grouped under 13 headings. Suggested solutions to identified barriers were offered by matching facilitators with identified barriers. An interpretation and recommendation on implementing the data follows in Chapter 5.
CHAPTER 5: INTERPRETATION AND RECOMMENDATIONS

The first section provides a brief overview of the study and research questions. The second section offers an interpretation of findings. The third section presents recommendations for greater EMR adoption among care providers. The summary incorporates current literature with new data obtained from respondent feedback.

Overview of the Study

The intent of the Delphi study was to reach consensus among Canadian Forces care providers regarding influential barriers and facilitators to greater EMR adoption. Further research was required based on the low adoption of EMRs despite the known benefits of employing an EMR in healthcare provision (Alvarez, 2004; Baxley & Campbell, 2008; Gagnon et al., 2009). The theoretical framework of resistance to change initially formed the basis of a three Round Delphi study of low EMR adoption among care providers. The Delphi study was limited to feedback provided by Canadian Forces care providers in military healthcare facilities. Limitations on data collection included obstacles peculiar to the Canadian Forces healthcare provision milieu. Data collection obstacles included care provider absences, vacations, survey completion apathy, and postings overseas.

Research questions addressed barriers and facilitators to greater EMR adoption. Results showed user frustration with EMR capabilities, and time to enter data as central barriers to greater EMR adoption. User resistance to the EMR as a whole scored second highest among 28 identified barriers. Care providers were drawn from Canadian Forces healthcare facilities, where a variety of regular force, reserve force, civilian, and contracted care providers worked.
Interpretation of Findings

Two research questions formed the basis of EMR adoption questionnaires. Question One asked: “What barriers exist to increasing Electronic Medical Record (EMR) adoption among care providers?”. Question Two asked: “What solutions might increase care provider adoption of the EMR?”.

The initial conceptual framework, namely resistance to change as the basis for low EMR adoption, was not supported, based on respondent feedback collected during three Rounds. Results from three survey Rounds suggested a modification to the conceptual framework; ‘resistance to change’ was changed to ‘user resistance to the EMR’. A preponderance of references were made to issues encountered with the actual EMR as application. Respondent concurrence determined ‘delayed clinical note entry’ as the most influential barrier to greater EMR adoption.

Data were classified under five headings (see Table 6). Of the 72 third Round replies, 65 respondents agreed with the list of facilitators (the rest disagreed) and 69 respondents agreed with the list of barriers (the rest disagreed). Theme headings comprised barriers as well as facilitators, although most headings contained more barriers than facilitators.

Highly correlated barrier pairs were extracted based on correlation coefficients exceeding a value of 0.7. Each of the paired barriers influenced the other. An example of this interpretation might be the barrier pair App2 and App7, where App2 (non-uniform EMRs between Canada and abroad) was closely linked to App7 (the need for EMR upgrades, patches, and changes to standard operating procedures). Closer inspection found all highly correlated barrier pairs to be closely linked. Highly correlated pairs of facilitators such as F7 (EMR facilitating communication among care providers) and F6 (EMR facilitating diagnosis and medication
delivery) showed a similar linkage, as care providers discussed the EMR facility of better
diagnosis and safer, improved medication delivery.

Negative as well as insignificant correlations were noted but not used, as correlations
other than strong positive correlations were not analyzed. Strong correlations were identified (see
Appendix G) and grouped under partialled barriers (see Table 7). Once the highly correlated
barrier pairs were tabulated, further interpretation indicated multiple instances of correlated pairs
among a number of individually partialled out barriers. For example, the barrier pair Acc3 and
App6 were found in the partialled out barriers D2, D4, P2, App5, App8, M6, M7, and App1.
Multiple occurrences of one pair among many partialled out barriers may be interpreted as a
common issue among many barriers.

Theme Comparison to Literature

Prevalent barrier themes included documentation issues with an EMR, patient-related
care affected by an EMR, issues found with the EMR as application, EMR managerial impacts
on EMR adoption, and access problems with the EMR. Existing literature themes addressed
physician resistance to change (Coch & French, 1948), cost as a factor in physician adoption
(Keshavjee, 2007), the impact of health information technology on EMR adoption (Brender et
al., 2006), EMRs adding to workflow disruptions and improvements (Lapointe & Rivard, 2006),
the absence of clear business benefits in EMR implementation (Neville, Gates, et al., 2004), low
EMR adoption rates among physicians (Keshavjee et al, 2006), and innovation diffusion as
model when considering the pace of EMR adoption (Rogers, 1995).

Documentation

Similarities occurred between existing literature and new data drawn from questionnaire
responses. The most significant theme not found in existing literature was the theme ‘delayed
clinical note entry into the EMR’, which was the respondent’s greatest barrier to increased EMR adoption. Delayed clinical note entries resulted from care provider lack of time, auxiliary personnel not expeditiously entering clinical notes, and software and hardware failures preventing system access. The effects of delayed patient information entry may result in ill-informed diagnosis, duplicate medication delivery, and sub-optimal care provision. A literature gap was acknowledged, as the literature did not provide material on the importance, meaning, and significance of accurate and timely clinical note entry into patient files.

Addressing the gap in literature might require a root cause analysis of delayed clinical note entry. Proposals to overcome a gap in literature may include polling physicians for suggestions on improving clinical note entry. Barriers mentioned may exacerbate expeditious note entry. Time to scan documents, absence of automatic file conversion, searching for poorly identified documents, patient data transfer from source to source, and entering scripts into the EMR were specifically mentioned under the documentation theme.

Zandieh (2008) discussed issues surrounding documentation transfer from legacy systems to electronic medical records. Documentation delays, duplication of results, and workflow disruptions showed distinct priority differences between paper-based and EMR-based care providers (Zandieh, 2008). Similarities occurred when the Delphi study results were compared to existing literature, however documentation concerns remained an issue based on the Delphi study feedback.

Patient care

Patients were suspicious of the EMRs capability to ensure data privacy. Respondents mentioned an increase in the complexity of data entry caused by short-stay patients requiring multiple episodes of care. Ludwick, Manca, and Doucette (2010) mentioned that patient care was
affected by the size and location of the hospital, financial resources available, and care provider networking. A literature search did not find material regarding patients who were suspicious of the EMRs privacy.

*The EMR as application*

Delphi study feedback included respondent issues surrounding the non-uniformity among EMRs, problems caused by server failure, a lack of EMR interoperability, the cost in time and fewer patients seen, EMR vendors seeking profit above functionality, and the need for repeated EMR upgrades. The literature (Brookstone, 2010) mentioned Canadian provincial EMR systems exhibiting most of the barriers reported by the Delphi study respondents. Brookstone (2010) reported that the EMR should be implemented before an EHR was feasible, in part due to the lack of EMR interoperability. Vendor relationships with users (Webster, 2010) indicated vendor emphasis on profit rather than satisfying user needs. Neville (2004) proposed that vendors should align the product to user expectations.

*Managerial*

From an EMR managerial aspect, poor access to helpdesk personnel and user resistance to EMR adoption were directly traced to delayed clinical note entry. Managerial interaction with the EMR included users as managers of information, managers influencing EMR application, vendors managing EMR implementations, care provider resistance to EMR use, and management not assisting users dealing with steep learning curves. The Canadian Medical Association (2008) noted the benefits of EMR user training prior to and during an EMR implementation.
Accessibility

Respondent access to an EMR was both positively and negatively reported. Positive aspects of improved access to data were cited, while negative access issues included the lack of access to EMRs on ships or abroad, access interruptions during server failures, fragmented access due to disparate data repositories, limited access to data on other EMRs, and multiple access logins. Access to EMRs was affected by unequal levels of implementation across Canada’s provinces and territories (Keshavjee, 2007), further delaying full-scale patient history availability at distinct points of care.

General adoption

Adoption themes in current literature showed gaps in understanding EMR adoption among care providers. Prevalent adoption issues found in the literature search included resistance to change, development of the EMR, cost, information technology impacts, workflow disruptions, business benefits, models of adoption, and domestic and international implementation efforts. New themes such as delays in clinical notes entry were not adequately covered in current literature, and may require additional research.

Further studies may involve a re-focus to include user resistance to the EMR as opposed to resistance to change being responsible for low EMR adoption. Development of the EMR should include development of rapport between users and vendors. Development costs should incorporate latent costs such as goodwill, time, effort, and human resource training. Comparative studies of information technology adoption in other spheres such as banking, tourism, entertainment, utilities, and the airline sector showed benefits not yet realized by the healthcare sector.
Workflow disruptions were overcome by applying user suggestions on improved interoperability of EMRs. The current business model of large-scale, all-inclusive keystone installations should refocus on smaller EMR adoptions in localized care provision cells as opposed to large-scale implementations with seemingly extensive savings. The model of adoption should therefore be smaller, targeted, and piecemeal, so that a manageable progression of EMR functionality may occur in controlled phases.

National Canadian implementations could benefit from comparative studies and lessons learnt from other nations, as problems encountered in Canada were probably not unique to Canada alone. Smaller implementations of manageable and controlled EMR functionalities (such as pharmacy prescription codification consistently standardized across Canada) may offer a phased approach to EMR implementation progress. Recommendations will follow that may provide a set of parameters to guide subsequent EMR implementation efforts.

Recommendations

Recommendations should be based on actual findings, and should be viable from a realist point of view. Flexible and adaptable recommendations were preferable to set guidelines, as results were not definitive and the sampled population was relatively small (467 care providers were invited, of which 77 responded in Round 1; Round 2 respondents numbered 24, while 72 respondents answered Round 3). Recommendations were supported by current literature if a confluence of ideas existed between literature and new findings. Healthcare leadership should heed recommendations based on ‘lived-experience’ feedback that concurred with current literature.

Based on respondent feedback on barriers to and facilitators of greater EMR adoption, three topics were assigned to cover responses from all surveys:
**EMR Application Specific Concerns**

Improved quality and efficiency of EMR systems should be provided from proven, credible software manufacturers (Canadian Medical Association, 2008). Improved interoperability standards should be supported and structured according to Health Level 7, an international standardization effort. Streamlined documentation of patient information entry could prevent data backlogs, while employing standardized information technology architecture, disease naming conventions, and EMR licencing law formalization.

**Vendor-Purchaser Relationship**

Service guarantees from vendors, assistance with care provider decision-making, recognition of time and effort required to adopt an EMR, more administrative staff training, and more champions to lead EMR integration influence vendor-buyer relationships may improve vendor-purchaser relationships (Canadian Medical Association submission to House Committee, 2008). Constant feedback mechanisms ensuring synergy between EMR vendors, EMR users, and management interested in rapid EMR adoption may minimize conflict.

**Implementation**

Structured financial incentives, standards, and technical support at the national level were material factors to increasing EMR adoption (Canadian Medical Association Journal, 2009). Comprehensive tallies of costs involved in EMR implementation (Keshavjee, 2006) may show the benefits of smaller, granular EMR implementations. Large, all-inclusive EHRs that proposed one-stop convenience and all-encompassing solutions (Menachemi et al., 2006) created unforeseen problems better addressed at provincial and regional levels. A review of current EMR funding and implementation methods showed how banking (automated access cards), aerospace
(simulation and modelling exercises), automotive (six sigma error reduction), and retail sectors (customer retention) applied information technology to advantage.

Care providers ought to be able to rapidly assess and improve the efficacy of software programs designed to speed data entry. Care provider input might help determine the sequence and logic of EMR implementations, partially addressing care provider resistance to EMR adoption. Incorporating patient preferences into care giving practices could provide patient empowerment and a sense of engagement (Ahmed et al., 2008). Increased information technology budgets and champions tasked to spur EMR adoption may well overcome issues arising from patient data being used by care providers, as well as the admissibility of joint control over patient health information. Medical students should also have an electronic media and health information technology component as part of medical school curricula.

Delphi Study Limitations

Limitations impacted the study by restricting respondent selection by virtue of military access considerations. A Defence Wide Area Network account was stipulated for respondents taking part in the study. Most reservists did not have military email accounts due to limited contractual engagement. Reservist input was therefore minimal. Insufficient literature showing agreement on the minimum number of responses required to produce statistically significant results (Akins et al., 2005), necessitated selecting 20 responses as sufficient for the study.

The military survey tool eListen® could not track individual respondents for reasons of privacy and personal information removal. While the privacy requirement was met, the study could not track which respondents actually participated in all three Rounds. While an assumption was made that initial respondent interest in the survey would spur participation in all three Rounds, no actual verification mechanism was available to confirm respondent follow-through.
An initial theoretical framework assumption of resistance to change had to be reviewed in light of respondent feedback. While theoretical framework assumptions were changed to match the emergent data, the initial literature research on resistance to change had to be modified to concentrate on user resistance to the EMR.

Respondents drawn from the Canadian military most likely provided feedback based on experiences with the Canadian Forces Health Information Systems, or CFHIS project. While an express comment was inserted in the introductory letter sent before the survey commenced, many subsequent respondent comments referenced the CFHIS. Responses referencing both CFHIS and an EMR in the same sentence would require careful assessment for validity.

Care provider absences, military intra-base postings, care provision on select days of the week, reticence to participate in surveys, and an absence of financial incentive impacted the number of respondent participation. The study had to rely on the goodwill of care providers willing to take the time to respond. Care providers in theatre (Afghanistan) were not requested to participate, due to the possibility of multiple responses to the same questionnaires.

Suggestions for Future Research

Final analysis of respondent results was surprising for two reasons. First, the initial conceptual framework based on resistance to change as instrumental in explaining low EMR adoption, had to be aligned to reflect user resistance to the EMR. In essence, care providers were not averse to change, but rather resistant to the EMR as concept. Second, cost was not deemed to have the largest influence on EMR adoption, as opposed to current literature findings (Canadian Medical Association Journal, 2010; Keshavjee, 2007; Ludwick & Doucette, 2009; Terry et al., 2008).
The Delphi study indicated significant barriers to low EMR adoption resulting from delayed clinical note entry into the EMR, while costs in terms of time, effort, training, and patient volume decrease, were ranked 16th of 28 identified barriers. Considerations listed above may be of interest to future researchers investigating low EMR adoption among care providers. Researchers may look at current EMR adoption measures, adoption efficacy, cost to implement, and progress in terms of interoperability among care providers locally, nationally, and internationally. Cost-benefit analyses may show whether resources were wisely employed, or whether more money was spent addressing the same problems. Successful small-scale implementations could be studied to determine synergies of interoperability, scale of EMR implementation, and costs.

Research methodology might employ the Delphi method as employed here. Future researchers could use historical results as a baseline of EMR adoption. Researchers could provide questionnaires urging EMR users to reflect on progress made in overcoming barriers and implementing facilitators. Open-ended text could prompt EMR users to suggest solutions to new issues, and to comment on solutions that effectively addressed issues of the past.

The purpose of future research would be to inform leadership of progress in EMR adoption, while highlighting persistent issues of EMR adoption. A compilation of Delphi methodology data obtained from an EMR-user population segment could address remaining EMR adoption issues, by recommending solutions based on real-time feedback.

Conclusion

Researcher reflections should guard against inadvertent use of bias, assumptions, and experiences with an EMR that may have influenced researcher impartiality. The initial theoretical framework was changed from ‘resistance to change’ to ‘resistance to an EMR’ based
on respondent feedback. Respondents provided open-ended text that augmented multiple choice questions. Select barrier and facilitator themes in current literature were validated by respondent feedback, however respondent issues with delayed clinical note entry were a surprise barrier. In retrospect, delays in clinical note entry affected patient care to a great extent, and the topic should be researched as a matter of urgency. EMR adoption improvements and facilitators were drawn from a limited pool of care providers, however limited numbers did not diminish the value of respondent observations. Overcoming EMR adoption issues required a concerted effort of all stakeholders interested in the Electronic Medical Record’s success.

Research question findings indicated highly correlated barrier pairs that were closely linked in content. Respondents reported barriers as well as facilitators to greater EMR adoption. Five headings captured barrier and facilitator themes concerning documentation, patient care, the EMR as application, managerial, and accessibility. Potential benefits to leadership may be realized by implementing recommendations produced from this study.

Benefits to leadership include greater insight regarding low EMR adoption. Leadership may consequently be able to predict future human and financial resource allocation for EMR implementation. Improved organizational performance should result when personnel, resources, planning, and control are strategically aligned. The results of this study will allow leadership to address EMR adoption barriers by looking at barrier pairs and facilitators reported by study respondents.

Universal EMR adoption should be possible once EMR implementors, users, and support staff concur on priorities; leadership should strive to align the four components mentioned above. EMR performance based on modular implementation should expedite overall EMR adoption through incremental EMR building blocks. Planned implementation could allow for immediate
barrier resolution, while implementing facilitator pairs identified in this study. Controlling barriers and expediting facilitators by means of phased modular implementation of EMR functionality is key to addressing low EMR adoption.
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APPENDIX A: PILOT STUDY COVER LETTER

May 10, 2010

Subject: Request to participate in a pilot Delphi study for Doctoral thesis

Dear Sir or Madam,

I am a doctoral candidate at the University of Phoenix, currently studying toward a Doctor of Health Administration degree. I am conducting research for my dissertation project entitled “Canadian Forces Care Provider Acceptance of the Electronic Medical Record: A Qualitative Delphi Study.”

The purpose of a qualitative Delphi study were to identify barriers to Electronic Medical Record (EMR) adoption. Participation in the study were voluntary. The purpose of the pilot survey were to further assess the sequence, validity, format, flow, and content of questions to be included in a Pan-Canadian survey. Your participation will provide user insight toward research on greater EMR adoption. Pilot survey respondents were drawn from Canadian Forces hospitals only. Suggestions provided will assist the researcher in fine-tuning the survey before the survey were sent out to Canadian Forces care providers. There were no foreseeable risks to you while providing feedback on survey structure, question content, and suggestions for further questions.

The probable benefit of your participation may contribute to the body of knowledge of electronic medical record implementation and acceptance, specifically among Canadian Forces care providers. Your participation will assist policymaking and further the goal of Electronic Medical Record implementation in the Canadian Forces as well as Canada.

Confidentiality and privacy were of great importance. eListen® was a civilian software suite designed to facilitate survey dissemination and data collection. The researcher has signed a confidentiality agreement to ensure restricted safekeeping of data.

The results of the pilot survey feedback will be returned to you as a matter of courtesy. Results do not show any personal identifying information.

Sincerely
Capt Anton Graser
G3 Ops International Desk Officer
1. Default Section

1. Informed Consent Release
   - [ ] I understand the above statements and give consent for my information to be used in this study. I will be contacted by email or mail until the survey is complete. Upon completion, my identifying information will be destroyed.
   - [ ] I understand the above statements and do NOT give consent for my information to be used in the study.

2. What is your professional position at work?

3. What is your age
   - Please select one button
   - 30 or younger
   - 31-40
   - 41-50
   - 51-60
   - 61 and older

4. Please select the type of health care facility you work at
   - Please select one
   - Health Services
   - Air Division
   - Ops
   - Field Hospital Ambulance
   - HQ
   - Clinic
   - Operations Force
   - On Board Ship
   - Naval Healthcare Facility

5. Do you have any experience with an electronic medical record, other than CFHIS?
   - Please select one
   - Extensive
   - Broad
   - Limited
   - No experience

6. To what extent has the EMR affected physician practices?
   - Please select one
   - Quality of clinical decision
   - Communications with other providers
   - Communications with patients
   - Physician order entry
   - Timely access to medical records
   - Avoiding medication errors
   - Delivery of preventive care that meets guidelines
   - Please add comments if so desired
APPENDIX C: DELPHI STUDY COVER LETTER

June 9, 2010

Subject: Request to participate in a Delphi study for Doctoral thesis

Dear Sir or Madam,

I am a healthcare administrator at the Health Care Centre, Ottawa, currently analyzing EMR usage within the Canadian Forces Health Services. The study has been supported by Healthcare leadership, in part to add to the body of healthcare related research. The study were titled: “Canadian Forces Care Provider Acceptance of the Electronic Medical Record: A Qualitative Delphi Study.”

Participation in the study were voluntary. The purpose of the qualitative Delphi study were to identify Canadian Forces care provider barriers or facilitators to Electronic Medical Record (EMR) adoption. The study will not address the Canadian Forces Health Information System (CFHIS). The principal researcher has three years CFHIS implementation experience. Survey respondents were drawn from healthcare providers within the Canadian Forces. There were no foreseeable risks to you while providing feedback. A confirmation email will summarize collective responses from an initial mail-out of 467 care providers. A final email will seek agreement on what respondents found to be the greatest barriers and facilitators to EMR adoption. The first survey should take 10 minutes to complete, and will be sent out shortly.

The probable benefit of your participation may contribute to the body of knowledge of electronic medical record implementation and acceptance, specifically among Canadian Forces care providers. Your participation will assist policymaking and further the goal of Electronic Medical Record implementation in the Canadian Forces as well as Canada. Anecdotal and insightful comments provide an excellent addition to the 13 questions posed in the survey. By not providing informed consent at the commencement of the survey, you will be directed to the end of the survey without any data collected. Final results of the study will be posted on the Canadian Forces Science and Technology website. The research thesis defence were scheduled no later than end-2010.

Confidentiality and privacy were of great importance. eListen®, a survey dissemination tool, will be used for data collection. The researcher has signed a confidentiality agreement to ensure restricted safekeeping of data. Results do not show any personal identifying information.

Sincerely
Capt Anton Graser
G3 Operations Desk Officer
Ottawa
1. Produce pilot questionnaire

2. EMR Users evaluate pilot questionnaire and return comments to Researcher

3. Analyze pilot questionnaire for suggestions on improving first Barrier and Facilitator

4. Prepare first Barrier and Facilitator Questionnaire

5. Send cover letter to respondents across Canada, explaining reason and goals of the Delphi study

6. Respondents answer researcher with intent to participate in study

7. 1st Barrier and Facilitator Questionnaire sent to respondents across Canada.

8. Individual respondents return questionnaire to researcher.

9. SPSS qualitative analysis performed. Prevalent barrier and facilitator themes sent for Likert-style ranking in 2nd Questionnaire

10. Individual respondents review complete list of barriers and facilitators returned by peers, and rank least and most important barriers and facilitators

11. 3rd Questionnaire: Researcher compiles updated list of barriers and facilitators and resends for concurrence

12. Individual respondents make final choice of least important/most important barriers/facilitators to EMR adoption among Canadian Forces care providers

13. Researcher processes 3rd Questionnaire.


Respondents pre-qualified by questionnaire as EMR users: Criteria used include actually providing care, and working in Canadian Forces healthcare

Respondents

Researcher
Text and Paragraph Responses by Question CFHS_EMR_Datadump

Coding themes: ACC (accessibility), DOC (documentation), MGR (managerial), APP (the EMR application), PTC (patient care). Code (F) = facilitator

Question: 5b. If occupation OTHER, please specify:
* Pharm O
* 00195
* Occupational Medicine
* Public Health

Question: 6b. If Location OTHER, please specify:
* Europe
* borden
* Europe

Question: 10h. Please add comments regarding how EMR HAS AFFECTED PHYSICIAN PRACTICES, if so desired:

* En donnant un accès plus rapide à certaines données relatives à l'établissement de diagnostic ou à la délivrance de médicaments.  
  ACC (F)

* The fact the ships still do not have CFHIS access makes using CFHIS a very time consuming event. I have to go to Base clinic to review my inbaox then print out results i wish to review with my pt's.  
  ACC

* Accès plus facile à l'ensemble du dossier et facilite échange d'information avec d'autres professionnels.  
  ACC (F)

* At HQ level, review of files easier and more accurate, without removing file from the patient's clinic  
  ACC (F)

* All positive impacts assigned above were directly related to ease of accessing records and their timely processing into EMR.  
  ACC (F)

* At his time pharmacy software were separate and physicians have to call to obtain a patient's pharmacy history.  
  APP

* Slowed patient contact time. More time looking for items on the computer and would have completed pt entry in half the time if written.  
  PTC

* Toujours la même méthode de recherche pour trouver l'information. Pas besoin de signaler les différents intervenants pour saisir l'information. Les erreurs sont facilement identifiables et rectifiables.  
  DOC (F)

* When physicians pay more attention to their computers than their patients this does not lead to better patient care. The EMR were a tool just like a paper chart and
can have both a positive and negative effect on patient care.

* Time-consuming and no central depot of all information. I.e. Some records still on paper. Some electronic results not in paper file!

* My civilian experience with EMR's demonstrate that they significantly increase total patient encounter time (in my experience by approx 30%) due to data entry time vs writing on a chart. They were not efficient and designed by non-doctors with too many drop down menues, buttons, etc all of which take time. It takes me 6 seconds to write an rx by hand and about 30 or more to do a script by EMR. Of course, MSP does NOT remunerate docs for the increased workload due to EMR's so docs either have to see fewer patients or work harder and longer. I don't know of any other professions that were mandated to work harder or take pay cuts for 'technology' reasons.

* Timely access to medical records can be severely hindered when system were down.

* Lenteur et inaccessibilité périodique, en particulier en phase critique lors des Sans Rendez-vous matinaux.
Suspicion des patients sur la confidentialité.

* Accès rapide à l'information qui toute regroupée. Notes cliniques plus claires, mieux lisibles. Communication et échanges plus rapides entre les professionnels

* Information must be present in the EMR for decisions to be made on it. I am sometimes left to make decisions without such, and then have someone complain "it were there all along" when in fact, it were available in paper, but not yet scanned into the EMR. However, time has been saved by asking other MDs to repeat tests for example, and scan them in, avoiding having to defer decisions resulting from missing information.

* Quick access to organized clinical information were a tremendously positive impact of EMR. I have not had the opportunity to use EMR for order entry of patient information, but I expect that these abilities would also have a very positive impact.

* Greater accessibility to patient documentation and results.

* Timelier access to information. Better situation awareness. Helps for faster and better decision-making.

* Only where EMR gives you the ability to track item(s)graphically has it had a significant impact on clinical decisions involving individual patients and clinical/occupational decisions involving populations.

* EMR must not replace good doctor-patient interaction.

* Timely / advanced access to medical records allows for quicker response times and decreased waiting times. The ability to communicate with other physicians across the country also allows for quicker, smoother transition of care. Full capability has n

* It has allowed others in the care to be aware of what were done and what were
needed, in saying so it has stopped any duplication and any drug errors that could occur if not charted or unreadable.  

* Clinical decisions have been negatively impacted in many cases. Although it has positively affected cases as well, the fact that there were any such negative situations has led me to overall an overall negative. The implementation has been piece-meal, fragmenting patient information between old written notes and EMR notes. Obviously this were a growing pain with any implementation of this magnitude and one would expect that the transition would eventually resolve...however, by beginning the process before electronic patient record entries were done perpetuates the cycle of discordant chart records.

Communication with other providers has been greatly enhanced although f/u with patients has been hampered (in my opinion). In the past I would have a physical copy of the result I were contacting a patient about and when they presented it would be present to discuss. Now, I mark the record with "Book Appt" and when the patient comes in there can be confusion as to why they were called in (especially if you were covering for someone else). Although there were bookmarks, if you have not been granted privileges to your colleague's bookmarks you spend a considerable amount of time searching through properties of every recent record to make sure you haven't missed anything. I feel a simple solution to this would be to allow flags to be set on the records themselves for recalls and other attributes. The fragmentation of records again results in possible communication errors as well.

* Older physicians that have no or little computer experience have voiced concerns about computer friendliness... Slight fear of technological change or comfort.  

* I do not have access to CFHIS or EMR on board ship.

**Question:** 11l. Please add comments regarding what other elements WOULD BE BARRIERS TO GREATER EMR ADOPTION, if so desired:

* Difficulty accessing national databases when deployed with limited connectivity - still require hard copy backup that's readily accessible (ie on ships or submarines).

* Le DSE doit être uniformisé a la grandeur du Canada et en théatre. Le principale obstacle est, à mon avis, le temps pour implanter le systême, la durée des formations pour le personnel et le temps qu'il faut pour convertir les dossiers antérieurs et les intégrer au systême.

* The greatest barrier were having a device that were easy to use and available at the point of patient care. Multiple passwords, and slow computers were the biggest problems.

* Our CFHIS were not user-friendly. It were clunky, slow and not comprehensive.

* Compensate the physicians for the large amount of time expended for adopt and use EMR's. I do CME on my own time, I pay for my own CME, I do lots of charting/labs on my own time. Physician time were not less valuable than any other professions. If nurses were expected to chart EMR would the union stand for increased amount of time and work without appropriate compensation? Same said of training. Would the nurse wage decrease because they were incapable of seeing as many patients? The answer were no, but the docs were expected to be negatively affected. Not acceptable.

* Nombreuses mises à jour, signifiant apprentissages continues et confusion. Firmes informatiques ont avantages à compliquer et modifier afin d'y trouver
profit. Piratage toujours possible avec perte de fonctionnement. Pannes de serveurs...

* L'informatique nous oblige à avoir une approche plus structurée, et aussi un mode de pensée plus structurée. Certaines personnes sont moins à l'aise dans un tel environnement de travail.

* in order to avoid having to look at the paper chart in addition to the EMR, the entire historical chart needs to be present in the EMR. With large charts, often only a portion of the historical data were scanned due to the size and nature of the information. For my purposes however, this historical data were often quite relevant for decision-making

* One of the biggest barriers were the need to personally type clinical notes.

* Interoperability were a great barrier. Every province / region / facility can end up using differing programs which cannot communicate and make a paper copy necessary (electronic redundant). Conversion of charts were time consuming, costly and Human Resource intensive. Setup time for our program has been 10 years due to the experimental nature. Another barrier were infrastructure (computers, wiring, location)

* Continued from previous:
There has been a negative impact on timely access to patient files, again because of the fragmentation. Access to lab results has improved though. Also, although completely understandable that the records need to be securely accessed, the time it takes to log in through the multiple levels of security were ponderous. There has been talk of accessing the patient's record and recording chart notes at the bedside. In our hospital this would essentially halt activity! Signing in to the computer in a patient's room as you move through urgent care would take an inordinate amount of time.

* La complexité d'ouverture du système et des dossiers. nous devons entrer 2 à 3 mots de passe pour avoir acces au système alors que nous avons déjà fait ces entrer pour ouvrir l'ordinateur. chaque fois que nous nous enregistrions ça prends de 1 à 3 min si on multiplie par 30 patients de PDM nous avons perdu 30 à 90 min à attendre l'ordinateur.

* EMR does not interact with civilian hospital EMR. Unsure about security and privacy limitations... unsure to who has access... Does sponser company reps have? EMR continue to limits access when system were down. Some clinics require additional staff for report scanning.

** Question:** 12c. Please add any comments regarding the EMR IMPACTS, if desired.

* Frequently what the EMR were trying to do (have all medical records inputted electronically) does not work, as there were several areas still, in which electronic recording were not available. This means that some tests/procedures were not recorded and unavailable at the time, necessitating a repeat of any testing/procedure needed within that moment

* Outil idéal pour regrouper au même endroit tout les éléments d'un dossier patient.
* It doesn't eliminate redundancy, but it does seem to reduce it

* The above would be true dependent on who has access

* In units such as this, due to connectivity reasons, it's difficult for clinicians on floating units to access information in a timely manner, especially if they aren't able to scan in reports, etc.

* Les systèmes utilisé par les américains en Allemagne fonctionne bien. Voir aussi certains systèmes implanté dans les différents hôpitaux québécois et canadiens (non uniforme)

* EMR were neither good or bad it does not eliminate the need to clinical decision making. It were far better at organizing clinical information if it were accessible.

* Si toutes les informations sont bien classés (dans les bons dossiers), il devient beaucoup plus facile de les retrouvées. Leur mise à jour est aussi plus rapide (si on exclut le facteur humain)

* also allows pre-determined labs/diagnostics based upon presenting ailments (ie. cardiac complaint, trauma panel, psych panel, etc ... have used this often in emergency dept)

* Better/faster clinical decision-making

* 12c. Is disagree until all EMR's can communicate, and every file were converted into electronic format vice a dual system of paper and paperless.

* Positive impact overall.

Question: 13b. Please elaborate on issues you may have with the interface between CFHIS and the civilian Electronics Medical Records.

* Civilian practitioners were still being utilized and do not have access to implement electronic records or to access electronic records. As an example, I work in an OR that were not recognized in the new medical model and therefore does not benefit from being provided computer access to electronic charting. While in the OR, the surgeon or anaesthesiologist may request specific information that were not readily available to the OR staff and means a delay in the procedure (possibly) as informatino were tracked down.

* the access from the ships and band space.

* People were unwilling to authorize or initiate treatments unless it were in the electronic Record

* Aucune interface. On devra éventuellement se pencher sur cette interface...

* See 12. Also, to my knowledge, CFHIS isn't abel to interface with local health authority databases in a manner that allows timely updates from specialist referrals, admissions, OR reports, imaging, etc.

* Never used EMR in the CF only at McGill HospitalMontreal. Contact Dr.Dawe, McGill Family Practice University. He has the best program that anyone could come up with. It's also probably less expensive.

* Les gens travaille sur un seul système et ne regarde pas les différents systèmes.
La paresse collective nous incite à trouver comment convetir ces dossiers pour qu’il soit automatiquement intégrer dans tous les différents systèmes.

* Where I work the two systmes do not interface which were a problem. Implementation problems were mostly related to the snail like pace of implemtation. If we were going to use the system please let me use the entire system not just pieces of it.

* With server issues (crashing) and technical support issues (delivery, timliness) it can create accessibility issues to patient information as opposed to a paper chart.

* CFHIS were a database, not an EMR. CFHIS were exceptionally inefficient as it takes time to bring up poorly identified documents only to find it were not the one I were looking for... then the process were repeated. Annual medicals should be electronically entered and modified there after, not hand done each time only to be scanned with the same or minor changes in the information. CFHIS were so inefficient it would not survive in the civilian world.

* having access to computers, logging in & out, proper permission for access

* Sécurité et confidentialité, en particulier en matière opérationnelle.

* L’adaptation à tous les différents intervenants a probablement ralenti l’implémentation du système. La prise de notes cliniques n’est pas encore en fonction dans notre milieu malgré qu’elle devait avoir lieu il y déjà plusieurs mois selon le modèle original.

* It were brought in before it were ready to use in all places of clinical pratice and paper copies where no longer printed and this made follow up of some patient care very difficult and require longer wait time because of time spent attempting to trac down various records

* too much scanning of civilian healthcare documents into CFHIS ... massive amount of storage space required! Information transfer into CFHIS from EMR takes time to be processed and thus unavail to CFHS healthprofessionals when patient presents at local clinic upon discharge from civilian facilities.

* training, electronic signatures, non-compatibility between the 2, interface difficult, DND rules on electronic protected docs were not very flexible which creates many Barriers

* incomplete entries, delayed entries, lack of trg, slowness of system, can't communicate with civ databases, no cumulative profile etc.

* I would think that at the beginning you would have duplication.

* The interface of CFHIS and civilian EMR's were practically non-existent. Results from outsourced referrals were: printed, faxed, scanned (which constitutes 2 sheets of paper rendered useless by their electronic counterpart)- this system can be optimized

* The time between beginning EMR to going "live" results in seeing every test in paper form and a hugely full CFHIS inbox. CFHIS were painfully slow, to the point of angering the user. The inability to be able to input clinical notes makes it a useless endeavor. I've worked in rural clinics in the middle of nowhere in alberta who run the FOX EMR system, and it were like doing medicine on the Starship Enterprise compared to CFHIS's Atari like program. It would not cut the mustard
in the civilian world.

**Question:** 14b. Additional EMR uses (facilitators):

* Pharmacy / multi physician prescribing and tracking  
  
* Interfacing with other hospitals to access charts/reports; in ER’s, ability to access patient pharmaceutical histories, any imaging in local facilities besides the hospitals.  
  
* Transfert de dossier electroniquement (sauf du temps)  
  
* Most likely for government audit.  
  
* Decision-making regarding fitness to work in various trades requiring medical sign-off prior to commencing trade-specific training.  
  
* Presentement, je travailles avec le systeme americain AHLTA. Le programme aide vraiment pour le tenue des dosiers et les notes clinique. Je me demande si il aurait pas ete plus simple de prendre leurs systemes et l integrer au notres??  
  
* Communication between health professionals at different locations. Monitoring chart/patient movements within the system. Typed reports - clarity of information compared to handwriting.  

**Question:** 15a. Please include any anecdotal or additional material you feel may add to an understanding of barriers and facilitators of physician EMR adoption within your province, territory or elsewhere.

* As I work almost exclusively with surgeons who were not employed fulltime with the CF, as either a military member or civilian member, there were reluctance on their part to working with an EMR in our setting. The surgeons and anaesthetists may only be employed once a month, and were not interested in learning a system that may not be externally available to them in their normal practice and usually leave the "important stuff" to the permanent staff.  
  
* On doit convaincre les utilisateurs que celà leur sauvera éventuellement du temps, même si initialement ceci nécessite un apprentissage ardu pour certains.  
  
* Minimum of two weeks of dedicated IT training with financial compensation for healthcare professional would be helpful.  
  
* There were concern with the upcoming release of software for electronic clinical notes entry - one concern were the amount of time required for typing in notes vs writing or dictating, as well as the potential for losing said information once it's entered. As well, this adds layers of time in other manners if several persons were involved in treating a patient on a given day and have to chart - as an example, a patient appearing on sick parade, screened by a triage NCO/RN, then a Med Tech +/- a PA or MO or MH worker and MO. The note entry on paper usually works well with the Hx already taken, notes of physical exam, etc that were either added to by the higher clinician or simply concurred. However, this could lead to a lack of fluidity in the entry of the clinical notes if there were layered care. Also, if the patient were there for short stay reasons and has consecutive entries on the chart (IV or medication maintenance), this could lead to issues when the patient comes to discharge if entries aren't made in a very timely manner by all
concerned - there were a flow on paper that may not occur with the electronic version.

* I do not think that confidentiality were adequately addressed by CFHIS. Based on past history, I believe that few resources will be provided to both check usage and follow-up on incidents. Even being inside the system, I feel my medical information were much less secure than in the days of paper files and that CFHS would access it for reasons that I would not consent if asked. If I had a personal or sensitive issue I would seek care outside of the CF; fortunately this hasn't been the case.

* Nous utilisons différents systèmes informatiques ici, en Allemagne LRMC, et le suivi des patients canadiens en est facilité. Le transfert via CFHIS est satisfaisant mais non parfait. Des systèmes compatibles entre les forces de coalition sera un grand avantage.

* When a system were implemented quickly with turn key software and access to a computer at the point of patient care it goes well. You need quick access at point of patient care (no long complicated passwords, no carrying laptops, no logging in for every patient or every time you change rooms, fast computers) I suggest you use a key system like a waitress or a finger print identification, or a swipe card and get rid of the passwords.

* Resistance to change and the time to convert current files to electronic format have been the largest barriers that I have seen to date. Also, with a variety of options to choose from, not all of which bring the same level of interoperability with external stakeholders, such as labs, local hospitals, etc.) the decision becomes bogged down in a scorecard that were never ideal.

* EMR were an outstanding tool but major concerns with it were that there were significant cost associated with start up and that the province may endorse a system besides the one you choose.

* I have work in some clinics where all medical charting were done via EMR and it were fantastic. But I am finding now where you still have the use of paper and EMR it were not a very good system at all.

* Provincial Medical Services Plan has attempted over the past several years to provide $ incentive for physician offices to transition towards electronic medical records. Makes doing referrals to specialists easier as copies of labs/diagnostics etc can be electronically forwarded thus reducing duplication of tests and/or delays

* Lack of implementation resources for individual physicians who do not have time to become computing experts. Wouldn't it be nice to be able to call a "service" to come and "hook it up"?

* There needs to be appropriate time and resources set aside to adequately train providers on all aspects and capabilities of the EMR so it can be used to its full potential.

* I feel that the biggest barrier to EMR were firstly getting clinicians/medical support staff to accept change. The second would be the increased timing for documentation between patients. A clinician can often see several patients in a clinic in the time it takes for them to document electronically on one. In the long run access to and review of medical info will be much faster and the time delays between patients will be addressed with familiarity with learning to type rapidly.

* Civilian facilities will create a barrier between themselves and DND because they
do not comprehend the DND medical system

* Pour moi le fait d'utiliser un autre système que celui qu'on utilise présentement, c'est que je dois imprimer et scanner toutes les notes que je fait pour pouvoir garder à jour les dossiers de nos membre...donc plus de temps en administration et moins de temps pour les soins au patients....

* It's made my life easier in rendering decisions with respect to entitlement to care, quality of medical care, and analyzing complaints and grievances of all types.

* Setup costs - especially staff time to enter data and scan in data - were a major barrier. Surprisingly equipment costs have been less of a concern, mainly because government has subsidized this in many cases. Exposure to the system often overcomes phys

* Physicians at this period of time were of two generations: pre and post-computer. As time goes on, all physicians and medical professionals will have more exposure and comfort with computer operations making implementation easier. Specialists in Information technology can facilitate adoption of this technology (Clinics with embedded IT persons have a resource to help teach, train, and troubleshoot). Technology often advances faster than development and things that were developed were outdated by these advances (over a 10 year implementation, the advances in computer speeds, memory, portability were problematic requiring constant changes in the system to maintain its usefulness). Ten years ago, a handheld device were very limited in application, and now they were just as powerful as the computers 10 years ago but were not part of the overall design. The size and portability of these devices have amazing potential and yet may take another 10 years to incorporate into the EMR process (at which time they may also have been replaced by the engineering of the future).

* Provincial (Manitoba) inter-clinic access and clinician comfort/confidence were the largest issues.

* getting the old guys to learn how to use it. spending the money to make it go. getting one that works and will work for a long time. The provinces and country should all get on the same or compatible system.

* I am not sure if I am a good candidate for the survey, as I have no dealings with any EMR on board ship

Question: 15b. Do you have any other comments or suggestions regarding the EMR.

* EMR adoption on HMCS platforms were pivotal. Current databases utilized were out of date, difficult to maintain and provide little aid in the management of patient charts. As a clinician not having easy access to diagnostics currently available on CFHIS were a hindrance in patient management.

* Given the sorry state of the CF 2034, the issue of the mobility of our patient population, and the need for patients' charts to be reviewed by various organizations scattered across the CF, I can't understand why anyone would be reluctant to use the EMR.

* If notes were to be by data entry, might it be easier and faster to have voice recognition software installed into CFHIS to allow for dictation of notes and medicals OR instead of user data directly with keyboard, have all clinical notes dictated and then transcribed within 24 hours - one clinic I trained at used a system where we dictated all patient contacts immediately after into digital voice recorders and the information were downloaded and transcribed the next day onto the EMR.
Count and Percent
Test_CFHS_EMR_Round2

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<td>Total Responses</td>
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1. EMRs provide a uniform search method
2. Errors are easily identified and corrected
3. The EMR structures thought processes
4. There is a reduced duplication of tests
5. Adopting currently functional provincial systems
6. ...
   Agree | 55 | 90.28 % |
   Disagree | 7 | 9.72 % |
| Total Responses | 72 | 100 % |

1. Delayed clinical note entry into EMR
2. User resistance to EMR adoption
3. Lacks interoperability with other EMRs
4. Time to scan documents into EMR
5. Server failure / downtime for...
   Agree | 69 | 96.83 % |
   Disagree | 3 | 4.17 % |
| Total Responses | 72 | 100 % |

September 28, 2010
# APPENDIX F: BARRIER DESCRIPTIONS

## Documentation (D)
1. Time to scan documents into EMR
2. Absence of automatic file conversion
3. Searching for poorly identified docs
4. Delayed clinical note entry into EMR
5. EMR - patient sick parade data transfer
6. Time to enter script into EMR

## Patient Care Related (P)
1. Patient suspicion re: EMR privacy
2. Short stay patients with multiple episodes of care means complex data entry

## Application (App)
1. No central information repository
2. Non-uniform EMR between Canada and abroad:
3. EMR not comprehensive:
4. Server failure/downtime for EMR
5. Lacks interoperability with other EMRs
6. Cost to care provider in terms of time, patients seen, and effort
7. EMR upgrades, patches, and standard operating procedures
8. EMR vendor not aligned with provider needs, and EMR start up costs too high

## Access (Acc)
1. No EMR on ships
2. EMR safety, security considerations
3. Repeated login into EMR
4. Reduced patient contact time
5. Lack of civilian physician access to military EMR

## Managerial (M)
1. Poor access to EMR implementation experts
2. Lack of remuneration for provider alignment with EMR
3. Absence of dedicated IT/EMR trg
4. CF focus on one EMR
5. Conflicting EMR stakeholder requirements
6. User resistance to EMR adoption
7. Steep learning curve for EMR
## APPENDIX G: CORRELATION MATRIX SHOWING D1 PARTIALLED OUT

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</table>

**Note:** The table shows the correlation matrix where D1 has been partialled out. The values indicate the degree of linear dependence between variables. Significant values are highlighted with a different color.
### APPENDIX H: FACILITATOR CONTROL VARIABLES AND CORRELATIONS

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<th>Control</th>
<th>Variable</th>
<th>Correlation</th>
<th>Legend</th>
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<td>F7 &amp; F5</td>
<td>0.729</td>
<td>1) uniform search method</td>
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<td>F7 &amp; F6</td>
<td>0.82</td>
<td>2) errors easily identified and corrected</td>
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<td>3) structures thought processes</td>
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<td>4) reduced duplication of tests</td>
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<td>5) adopting current functional provincial systems</td>
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<td>6) diagnosis and medication delivery</td>
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<td>7) communication with other care providers</td>
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<td>8) patient file review</td>
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<td>9) clinical notes clear and readable</td>
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<td>10) organizing clinical information</td>
</tr>
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<td>F7 &amp; F6</td>
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<td>11) predetermined lab and diagnostic routines</td>
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<td>12) information sessions to educate</td>
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<td>13) provincial medical services plans</td>
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<td>assisting Clinician care providers on CPRIS</td>
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APPENDIX I : ROUND 3 CONCURRENCE ON BARRIERS AND FACILITATORS

Count and Percent
Test_CFHS_EMR Round2

<table>
<thead>
<tr>
<th>Please select a language / S'il vous plait choisir une langue:</th>
<th>Count</th>
<th>Percent</th>
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</thead>
<tbody>
<tr>
<td>English</td>
<td>63</td>
<td>87.50%</td>
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<tr>
<td>Français</td>
<td>9</td>
<td>12.50%</td>
</tr>
<tr>
<td>Total Responses</td>
<td>72</td>
<td>100%</td>
</tr>
</tbody>
</table>

(1) EMRs provide a uniform search method

(2) Errors are easily identified and corrected

(3) The EMR structures thought processes

(4) There is a reduced duplication of tests

(5) Adopting currently functional provincial systems

(6) ...

<table>
<thead>
<tr>
<th>Agree</th>
<th>65</th>
<th>90.28%</th>
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<tr>
<td>Disagree</td>
<td>7</td>
<td>9.72%</td>
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<tr>
<td>Total Responses</td>
<td>72</td>
<td>100%</td>
</tr>
</tbody>
</table>

(1) Delayed clinical note entry into EMR

(2) User resistance to EMR adoption

(3) Lacks interoperability with other EMRs

(4) Time to scan documents into EMR

(5) Server failure / downtime for...

<table>
<thead>
<tr>
<th>Agree</th>
<th>69</th>
<th>95.83%</th>
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<tr>
<td>Disagree</td>
<td>3</td>
<td>4.17%</td>
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<td>Total Responses</td>
<td>72</td>
<td>100%</td>
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